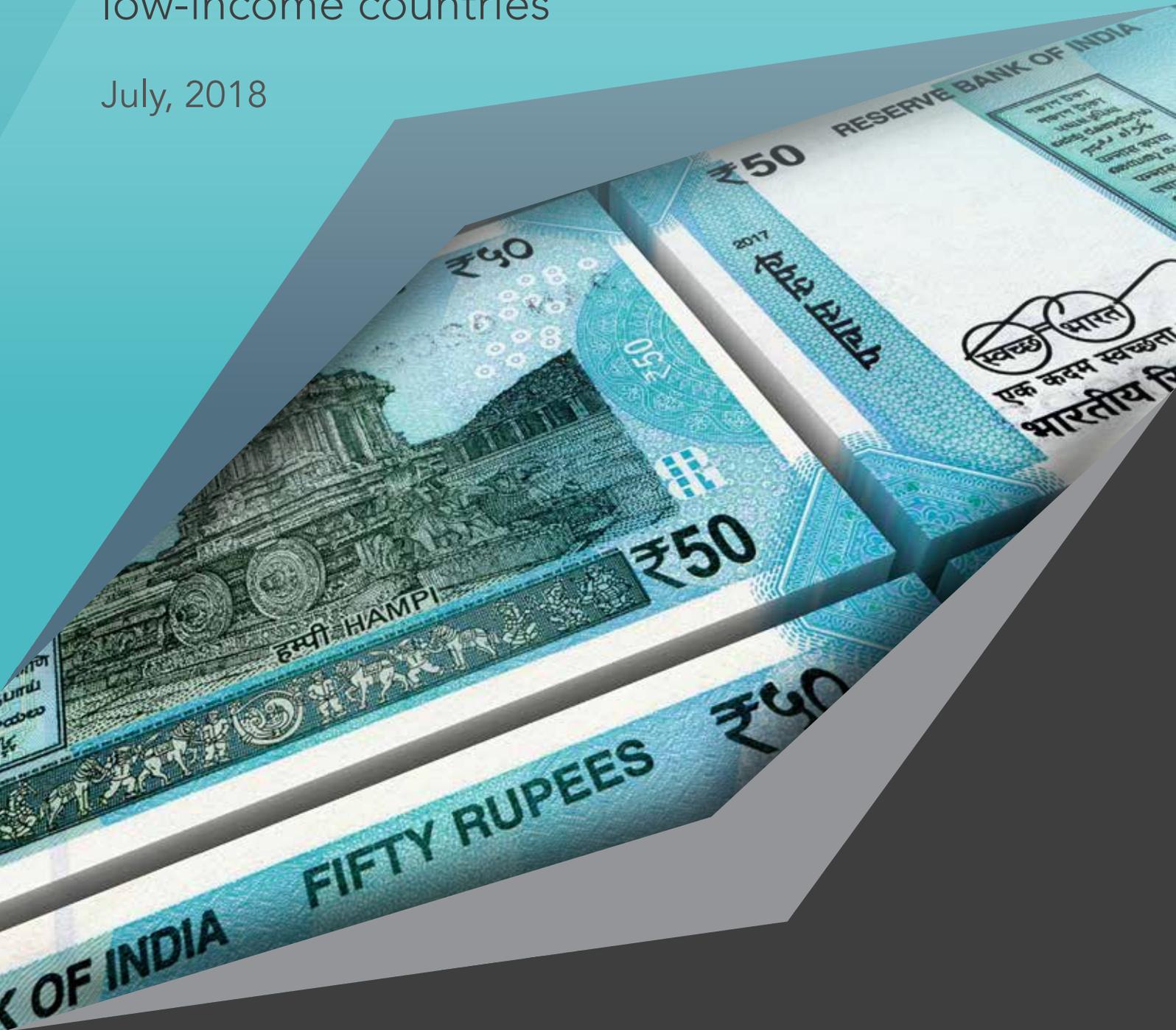


Digital Innovation in Public Financial Management (PFM):

Opportunities and implications for low-income countries

July, 2018



BILL & MELINDA
GATES foundation

αlphaβeta
strategy x economics

Contents

Foreword	3
Executive Summary	7
1 The challenges of low-income countries in public financial management	22
2 Technologies with the potential to transform PFM	34
3 Making it happen: lessons learnt on capturing PFM opportunities	45
3.1 Geographic Information System (GIS)	48
3.2 E-procurement systems	61
3.3 Big data to detect tax fraud and evasion	74
3.4 Digitization of existing & potential G2P payments	90
3.5 Blockchain technologies	107
4 Concluding thoughts	122
Appendix	128

Foreword

There has been a global push in recent years to help low-income countries improve the way they raise, manage and spend taxpayer money. In multilateral agreements such as the Paris Declaration (2005), the Accra Agenda for Action (2008) and the Busan Partnership for Effective Development Co-operation (2011), governments from around the world have reaffirmed their commitment to collaboratively strengthen the public resources management in developing countries. Such management of public resources – both revenue and expenditure – and its impact on an economy or society is known as ‘Public Financial Management’ (PFM).¹

Well-functioning PFM systems are essential for governments to provide services and improve the lives of citizens effectively. Strong PFM institutions can also make development financing in low-income countries more impactful.

Latest efforts to strengthen PFM systems in low-income countries come at a time where information and communications technology (ICT) are becoming more accessible. More and more people in low-income countries are using digital devices, which in turn opens up new opportunities for the local public sector to digitize its services offering. Greater storage capacity and computing power now enable tax authorities to collect growing amounts of taxpayer data, supporting their efforts to counter tax fraud and evasion. Geographical Information Systems (GIS), computerized databases designed to work with data referenced by spatial coordinates, have substantially increased the property tax collection in several developing countries. New digital payment systems have helped to lower administration costs and fraud, made welfare programs more targeted, and allowed beneficiaries to receive aid faster. Other emerging technologies, including blockchain, assist government efforts to minimize fraud and make services more effective by creating permanent, immutable identity records of citizens and businesses.

While many of these digital technologies are not new, their application to PFM has received less focus compared to other areas of public sector concern. While some of these technologies, including electronic procurement systems and budget preparation software have often been analyzed as part of an integrated system of information technologies, there has been less focus on their individual impacts and implementation processes. However, interest is clearly growing in this area. The International Monetary Fund (IMF) recently became one of the first to provide a systematic survey of the potential impacts of digitization on PFM.²

¹ Matt Andrews, Marco Cangiano, Neil Cole, Paolo de Renzio, Philipp Krause, and Renaud Seligmann (July 2014). This is PFM, CID Working Paper No. 285.

² Gupta S, Keen M, Shah A, Verdier G (2017). Digital Revolutions in Public Finance. International Monetary Fund, Washington DC.

Foreword

This report seeks to contribute to the existing research. Based on an extensive literature review, and interviews with over 50 government officials, industry experts, and specialists in development aid and PFM-related technical assistance programs in low-income countries, this report provides:

1. A broad-based and comprehensive overview of potential technologies applicable to PFM in low-income countries;
2. A 'deep-dive' on technologies that have so far received less attention, particularly in the PFM area (such as blockchain and geospatial information systems); and
3. An analysis of the specific factors that make some technologies more suitable for use in some countries, and an overview of resulting policy priorities (drawing on lessons in other low-income countries).

The goal of this report is to help finance ministries in low-income countries understand how various digital technologies could strengthen their public financial management. At the same time, this report is cognizant of a common pitfall of technology adoption: the risk that a government adopts solutions that may have worked elsewhere in the world but are less suitable for its own purpose. The result would be a loss in time and money.³

Against this backdrop, the approach of this research report is to first identify the most acute challenges of managing public revenues and expenses in low-income countries, namely aligning budgets with policy priorities, improving tax compliance, allocating public spending more efficiently and deliver services more effectively, reducing corruption in public procurement, and ensuring institutional accountability. After identifying potential technological solutions in a series of case studies, this report uses a 'readiness framework' to assess country-specific requirements for different levels of technology adoption.

We are grateful for the advice and input of many experts in academia, government, not-for-profit organisations, and industry, who have provided invaluable guidance, suggestions, and advice. Our particular thanks goes to Marco Cangiano and Richard Allen.

³ A recent World Bank report remarked, "many investments in e-government fail to have any impact other than wasting scarce fiscal resources". World Bank (2016), World Development Report 2016: Digital Dividends.



Key Terminology

Allocative efficiency

Scenario where the distribution of goods and services matches consumer preferences.

Big data

Big data comprises extremely large, often heterogenous and unrelated streams of information from multiple sources.

Biometrics

The measurement and statistical analysis of person's unique physical and behavioral characteristics for identification and access control.

Blockchain

Blockchain is a digital ledger – a continuously growing list of records (called blocks) linked and secured using cryptography. Blockchains embed contracts and transactions in digital code that is resistant to modification, so information can be shared safely in a peer-to-peer network of computers.

Cadastre registry

Official register of the ownership and value of property in a given area, used as a basis for taxation.

Digitization

Process of converting analogue streams of information into digital format.

Geocoding

Geocoding is the process of converting an address or place name into geographic coordinates.

Geographical Information Systems

A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on the earth's surface. By relating seemingly unrelated data, GIS can help individuals and organizations better understand spatial patterns and relationships.

Integrated Financial Management Information Systems

IFMIS refers to the computerization of PFM processes, from budget preparation and execution to accounting and reporting, with the help of an integrated system for financial management of public entities.

Interoperability

The ability of data in different databases to be easily and securely exchanged.

Open source software

Software with source code that anyone can inspect, modify, and enhance.

Participatory budgeting

A democratic process in which community members directly decide how a public budget is spent.

Smart contracts

Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code.

Technology opportunities in Public Financial Management

THE OPPORTUNITIES



Aligning budgets with policy priorities



Allocating public spending more efficiently and deliver services more effectively



Improving tax compliance



Reducing corruption in public procurement



Enhancing institutional accountability

THE REQUIREMENTS

Pre-readiness



Traditional approach with no or only limited use of technology

Basic readiness



Some basic use of technologies in PFM, but limited in scope

Advanced readiness



Advanced and widespread adoption of relevant technology across relevant PFM functions

THE LESSONS

1

Know your starting point

2

Be clear on the objectives

3

Adopt a phased rollout

4

Champion digitization in the public sector

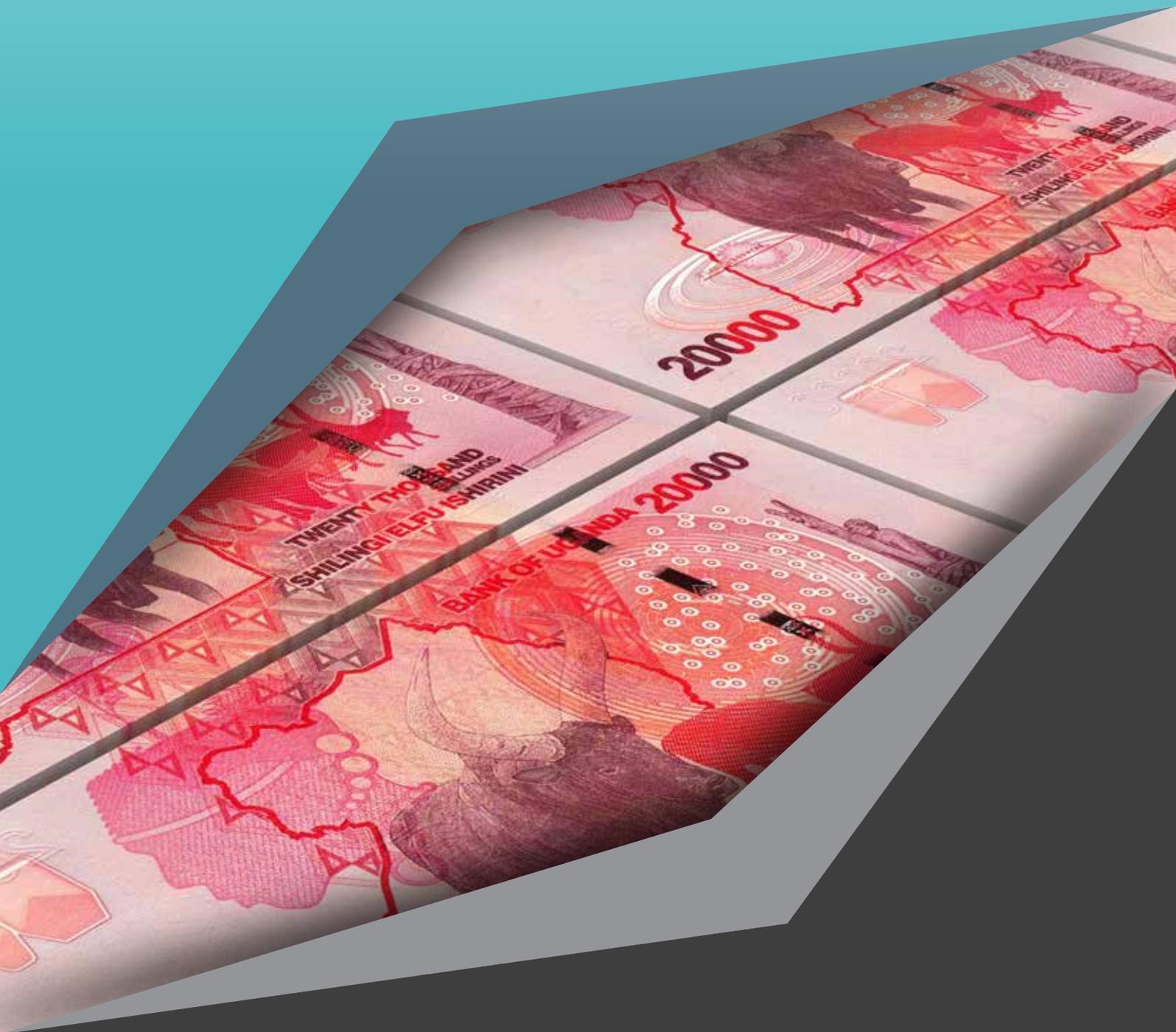
5

Focus on shifting mindsets (and not just on skills)

6

Communicate, communicate, communicate!

Executive Summary



Findings at a glance

- **The issue:** Governments in low-income countries typically have **five key concerns when managing public finances**. They are: 1) aligning budgets with policy priorities; 2) improving tax compliance; 3) allocating public spending more efficiently and deliver services more effectively; 4) reducing corruption in public procurement; and 5) Ensuring institutional accountability.
- **The potential solution:** This report identifies **60 technology applications** with the potential to transform PFM systems and help authorities in low-income countries overcome key challenges of managing expenses and revenues. These technological applications can be broadly categorized into five groups: 1) digitization of payments; 2) integrated IT hardware and software; 3) citizen and business engagement solutions; 4) identification and recording technologies; and 5) data analytical applications.
- **The country context:** PFM technology can only be implemented successfully if the individual conditions in a country are conducive. Three broad levels of country-specific readiness can be distinguished:
 1. **Pre-readiness:** Countries at the pre-readiness stage lack many of the key enabling conditions to efficiently use PFM technologies. They may need to introduce PFM technology in small 'pilot programs' first or undertake reforms to increase their technological readiness, such as developing basic legislative frameworks and assigning institutional mandates for use of PFM technologies.
 2. **Basic readiness:** Countries at the basic readiness stage have the necessary enabling conditions in place to use PFM technologies in a limited way. For example, they could confine the use of PFM technology to a few priority programs.
 3. **Advanced readiness:** Countries at the advanced readiness stage have the opportunity for widespread adoption of the technology across relevant PFM functions.
- **The lessons:** Global examples offer several lessons on how low-income countries can best harness available technologies to improve their PFM, regardless of their individual readiness level. These lessons are:
 1. Know your starting point;
 2. Be clear on the objectives;
 3. Adopt a phased rollout;
 4. Champion digitization in the public sector;
 5. Focus on shifting mindsets (and not just on skills); and
 6. Communicate, communicate, communicate!

The challenges of low-income countries when managing public finances

Public Financial Management in low-income countries has become an important focus of global reform initiatives. Many low-income countries are lacking the structures and institutions to efficiently manage taxpayer money, deliver targeted services, and shield their public resources from fraud, corruption and waste. The inefficiency of PFM systems in many low-income countries is of concern – not only for local citizens, but also for international donor countries whose development aid may be rendered less impactful than intended.

Low-income countries are commonly concerned with **five key tasks** in relation to PFM:

- **Aligning budgets with policy priorities.** The role of governments is to produce credible budgets that achieve their policy objectives, given the expected conditions of the economy. However, a lack of robust and timely analysis of current and future economic conditions, and their potential impact on fiscal policy, can complicate government efforts to achieve their policy objectives; fiscal rules or debt levels can also act as constraints.
- **Improving tax compliance.** Many low-income countries are struggling to deliver public services because poor tax compliance is eroding their tax base and available revenue. Recent OECD data show overall tax-to-GDP ratios in Cameroon (16.1 percent), Rwanda (16.1 percent), Senegal, (20.1 percent), Côte d'Ivoire (17.8 percent), and South Africa (27.8 percent) are significantly below the OECD average of 34.4 percent.⁴
- **Allocating public spending more efficiently and deliver services more effectively.** Delivering services to citizens is at the heart of what governments do, and the public trust in government depends on the quality of these services.
- **Reducing corruption in public procurement.** Public procurement is one of the government activities most vulnerable to corruption; inefficient procurement processes can lead to reduced market competition.
- **Ensuring institutional accountability.** Financial government reports are the core of internal and external audits, as these audits are compromised if the quality of financial reporting is poor. Broad access to financial reports is also necessary to energize public discussions on fiscal policy – an increasingly popular prescription to hold governments accountable for their spending decisions.

⁴ OECD, ATAF and AUC (2016), Revenue Statistics in Africa, OECD Publishing, Paris. Available at: <http://dx.doi.org/10.1787/9789264253308-en-fr>

Digital technologies have the potential to transform PFM and overcome key challenges

An extensive analysis of existing tools to improve the public financial management in developing countries reveals a substantial opportunity: digital technologies offer tremendous potential to enhance PFM systems but have yet to be used more widely in the developing world. This report has assessed **60 technological applications** of relevance for PFM (Exhibit E1). Box 1 provides an overview of the methodology used to identify these technologies.

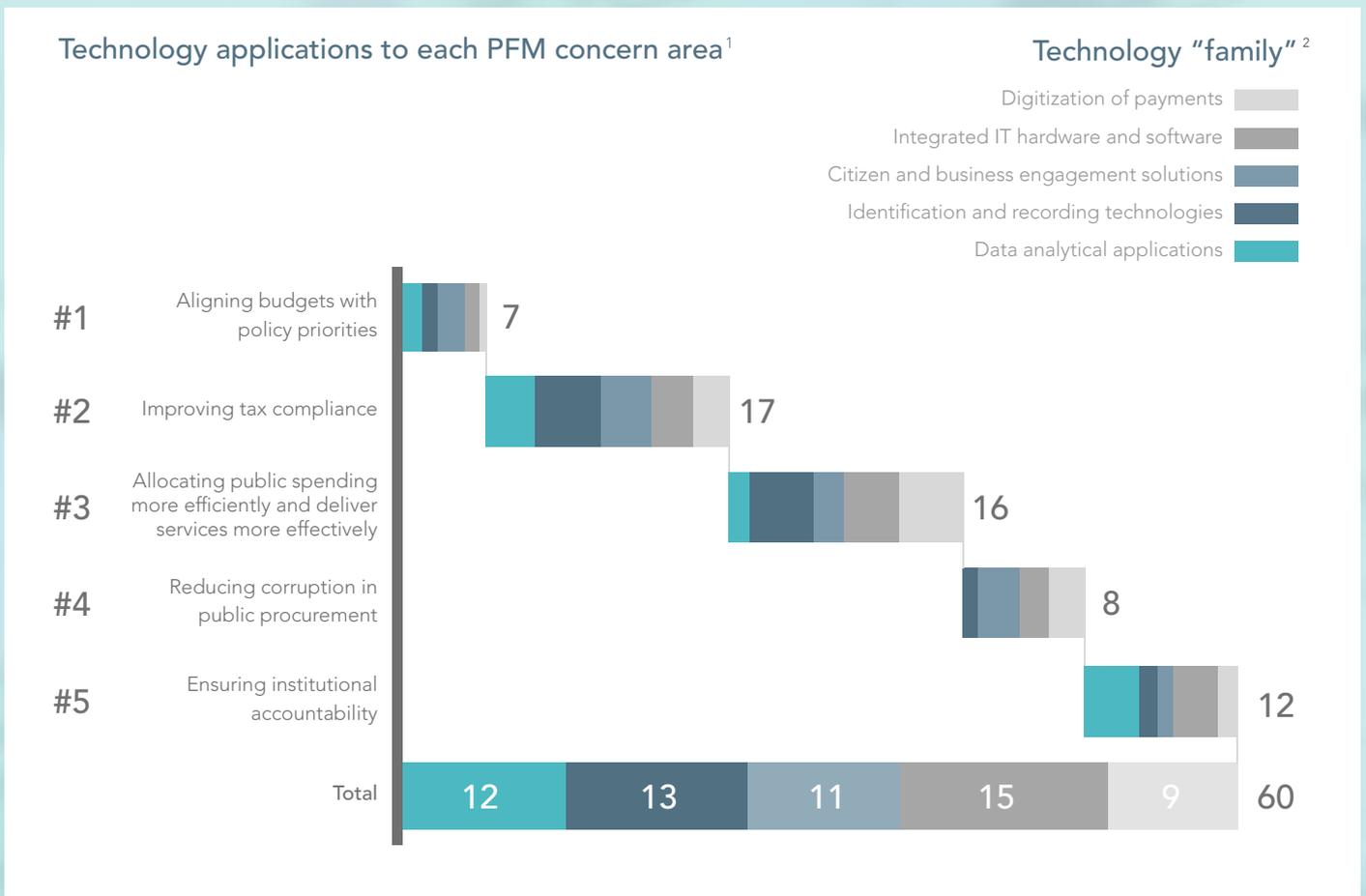
To narrow the focus of the analysis, this report illustrates the opportunities and country-specific requirements related to PFM technology by discussing five applications in detail: 1) geographic Information Systems (GIS) to increase property tax revenues; 2) e-procurement; 3) big data analytics to identify tax fraud and evasion; 4) digital government-to-person payments; and 5) blockchain to enhance auditing.⁵

⁵ These technological applications were selected after broad consultations for meeting the three criteria of i) relevance to PFM concerns, ii) potential for significant impact and iii) limited exploration to date.



Exhibit E1

60 technological applications across the 5 concern areas of PFM have been identified



¹ This exhibit measures the number of technology applications (i.e. the linkage of a technology to a specific area of PFM), rather than the number of technologies. One technology can have multiple applications to different PFM concern areas (e.g., big data could be applicable to multiple PFM concerns). The full list of technology applications can be found in the Appendix.

² A Technology "Family" refers to technologies that share similar characteristics in terms of their application.

SOURCE: AlphaBeta analysis

Executive Summary

- **Aligning budgets with policy priorities.** Technological applications can help verify alignment between policy objectives and funding of such policies by making more transparent the debate around the budget in all its critical phases - between line ministries and the Ministry of Finance (e.g. Finland), within the parliamentary debate, and by providing citizens the opportunity to participate and influence that debate. For example, East Timor uses budget preparation software to run live data simulations of different spending scenarios to better inform parliamentary budget debates. Technologies can also help to produce more robust analysis of macroeconomic conditions and how they will impact fiscal policy, The International Monetary Fund (IMF) shows that access and analysis of daily VAT revenue data allows authorities to achieve 3.5 months “advanced warning” of potential fiscal stresses compared to when traditional quarterly data is used.⁶
- **Improving tax compliance.** Technology can help authorities to better detect tax fraud and evasion. It can also increase the efficiency of the tax collection. For example, mapping technology used by Geographic Information Systems allowed authorities in the Indian city of Kanpur to more than triple the annual revenue from house taxes.⁷ In Cartago, Costa Rica, the use of GIS to update fiscal cadastres helped authorities identify fraudulent tax declarations. As a result, local collection revenues increased by more than 300 percent over 10 years, more than offsetting the cost of implementing the new technology.⁸ Big data techniques can also assist in identifying potential tax fraud or evasion. For example, Brazil’s use of big data analysis to audit corporate tax declarations has helped unveil fraudulent business networks and led to a 12.5 percent increase in the country’s federal tax collection since 2010.⁹ Mandatory e-invoicing for businesses helped authorities in Mexico combat false invoicing and unrecorded transactions, leading to significant increases in tax revenue.¹⁰
- **Allocating public spending more efficiently and deliver services more effectively.** Technologies can help transform the efficiency of government delivery of services and spending. Biometric technology can help to reduce absenteeism in the public sector, while digital payments technology can improve the accuracy of payments or social transfers, and make it more convenient for recipients to access funds. In Kenya, the World Food Program found that the use of electronic transfers, rather than in-kind payments, to support food insecure households lowered delivery costs by 15 percent.¹¹ Digitizing payroll and human resources systems can also reduce costs. For example, Nigeria has saved US\$1 billion over the last decade after switching to an Integrated Personnel & Payroll Information System.¹²

6 Misch F, Olden B, Poplawski-Ribeiro M and Kejji L (2017). Nowcashing. Using daily fiscal data for real-time macroeconomic analysis. Digital Revolutions in Public Finance. IMF.

7 Kumar R (2012). “GIS Simplifying Property Tax Collection in India.” Available at: <https://www.geospatialworld.net/article/gis-simplifying-property-tax-collection-in-india/>

8 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

9 Ernst and Young (2016), Tax administration is going digital: Understanding the challenges and opportunities. Available at: [http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/\\$FILE/EY-tax-administration-is-going-digital.pdf](http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/$FILE/EY-tax-administration-is-going-digital.pdf)

10 OECD (2017), Technology tools to tackle tax evasion and tax fraud. Available at: <https://www.oecd.org/tax/crime/technology-tools-to-tackle-tax-evasion-and-tax-fraud.pdf>

11 CGAP (2013). World Food Programme’s exploration of the in-kind to e-payments shift for food assistance in Kenya.

12 Effective Institutions Platform (2015). A study of peer learning in public sector reforms. Available at: https://www.effectiveinstitutions.org/media/Peer_learning_study_final_p5v0700.pdf

- **Reducing corruption in public procurement.** Relevant technologies to lower the corruption risk in public procurement include e-procurement systems, fiscal transparency portals, and smart contracts on blockchain networks. E-procurement systems have proved to increase transparency and attract more bidders, thus increasing competition, and allowing government agencies to make higher-quality purchases at lower costs. Fiscal transparency portals promote transparency and accountability in public procurement by publishing government revenue and expenditure data. An emerging, but potentially highly impactful technology is the use of smart contracts on blockchain networks to ensure public transactions and agreements are properly authenticated, traceable, transparent, and irreversible.
- **Enhancing institutional accountability.** Technology can help to increase the financial accountability of governments by improving reporting and auditing standards. Such technologies include audit software known as Computer Assisted Audit Tools and Techniques (CAATTs), and accounting software to standardize formats and rules. Mobile apps for citizens to give feedback or act as ‘whistleblowers’ can increase the scrutiny over public spending. Emerging technologies such as blockchain are expected to revolutionize the transparency and accountability of PFM functions, including data recording, accounting and auditing. Blockchain technology is estimated to potentially halve the cost of recording transactions by moving from paper-based systems to an online system of distributed ledgers.

A country’s state of readiness will dictate the degree to which they are able to capture the technology opportunities

Low-income countries need to be mindful of their existing IT infrastructure and institutional structures when trying to improve their public financial management with the help of technology. The specific situation in each country limits the speed at which governments can transform their PFM systems and deliver better public services.

This report applies a “readiness framework” to help low-income countries understand which PFM technologies may be most appropriate for their specific context. It also outlines policy priorities depending on a country’s level of technological readiness: pre-readiness, basic readiness, and advanced readiness. A country should fulfil all the priorities in its state of readiness before transitioning to the next state. Generally, the higher the technological readiness of a country, the larger its scope to implement sophisticated PFM technology across the public sector and achieve maximum impact.

Countries at the pre-readiness state lack many of the key enabling conditions to use available PFM technologies effectively. These countries may need to focus on small “pilot programs” or stick with more traditional approaches first, while putting in place a set of basic reforms to enable the more widespread use

Executive Summary

of PFM technology. For example, before setting up electronic procurement systems, some countries could immediately benefit from very basic actions such as allowing more time between the tender issuance and the award of the contract. In the meantime, they could post tender requests and results in traditional media to improve transparency. **Countries with basic readiness state** have conditions in place that enable them to use PFM technology, albeit still in a limited way. These countries can introduce PFM technology for specific government functions, where conditions allow a smooth implementation. **Countries at the advanced readiness state** are well positioned to widely adopt PFM technology, potentially across the entire public sector.

While a country's readiness level and roadmap to fully harness the potential of implementing PFM technologies will differ depending on the specific technology in question, some broad guidelines exist to facilitate the overall technological adoption, as summarized in Exhibit E2.

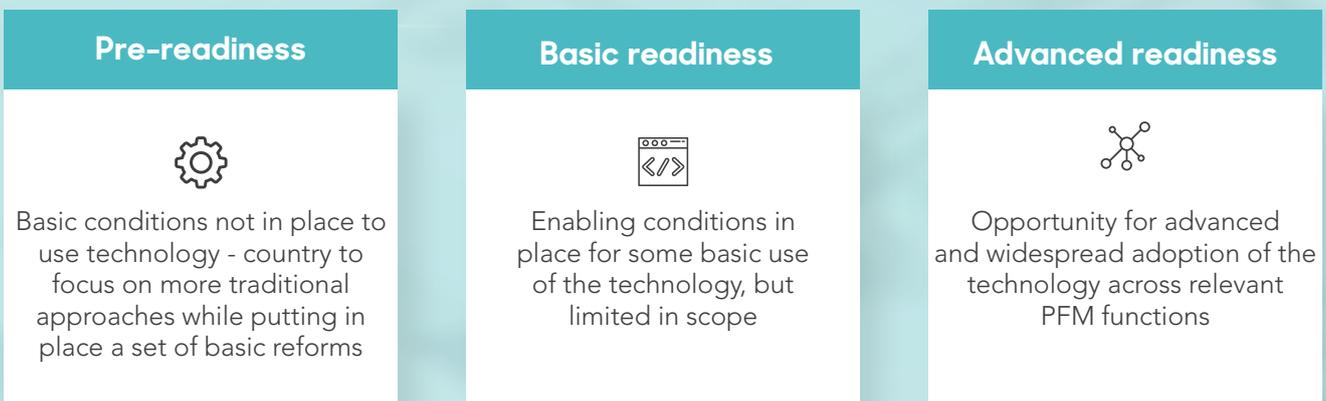
A key question is whether it is possible for countries to jump straight from a pre-readiness to an advanced readiness level. A case study analysis of five standout technologies (Geographic Information Systems to increase property tax revenues; e-procurement; big data analytics to identify tax fraud and evasion; digital government-to-person payments; and blockchain to enhance auditing) show that in the majority of instances it is necessary for low-income countries to move through each state of readiness consecutively.

However, since low-income countries typically don't have to deal with legacy infrastructure in the same way as higher income countries do, they are expected to progress much quicker on the readiness scale, once basic requirements are met. For instance, the digitization of paper-based records can be done faster in many low-income countries once the required infrastructure is installed because of the much smaller and less complex base of records. Kenya and other low-income countries have leveraged powerful network effects to rapidly implement digital payments systems.



Exhibit E2

There are three states of readiness for countries to utilize PFM-related technologies



Typical requirements

- Clear and comprehensive legislation (e.g. processes, responsibilities, penalties)
- Appropriate mandate for relevant government department
- Basic accounting and financial reporting skills
- Basic ICT infrastructure
- Sufficient funding to achieve pre-defined objectives
- Technical skills in Ministry of Finance and budget office
- Data-driven culture
- Political support at highest level
- Interoperability between government data systems
- High degree of digital devices
- Comprehensive measures to support data security

SOURCE: AlphaBeta analysis

Executive Summary

Requirements for technological impact at the pre-readiness state:

- **Clear and comprehensive legislation.** Clear and comprehensive legislation is the foundation for low-income countries seeking to enhance the efficiency of their PFM systems. For example, tax evasion is often enabled by three legislative shortcomings: complex and ambiguous tax codes, inefficient filing and payment processes, and insufficient or improperly imposed penalties.
- **Clear mandates for implementing agencies.** The efficiency of the tax collection in many low-income countries is hampered by divisions and blurred responsibilities across government departments. The most efficient tax systems typically operate with a so-called hub-and-spoke system, where a central revenue body is responsible for setting standards and processes, and regional tax offices are then tasked to ensure a smooth execution.
- **Basic financial reporting and accounting skills:** Technologies cannot compensate for the lack of basic financial reporting and accounting skills in many low-income countries, which has contributed significantly to many of the negative PFM outcomes such as delayed or inaccurate budgets and spending reports. Efforts must be taken to strengthen these capabilities so that the potential of technology can be fully realized.

Requirements for technological impact at the basic readiness state:

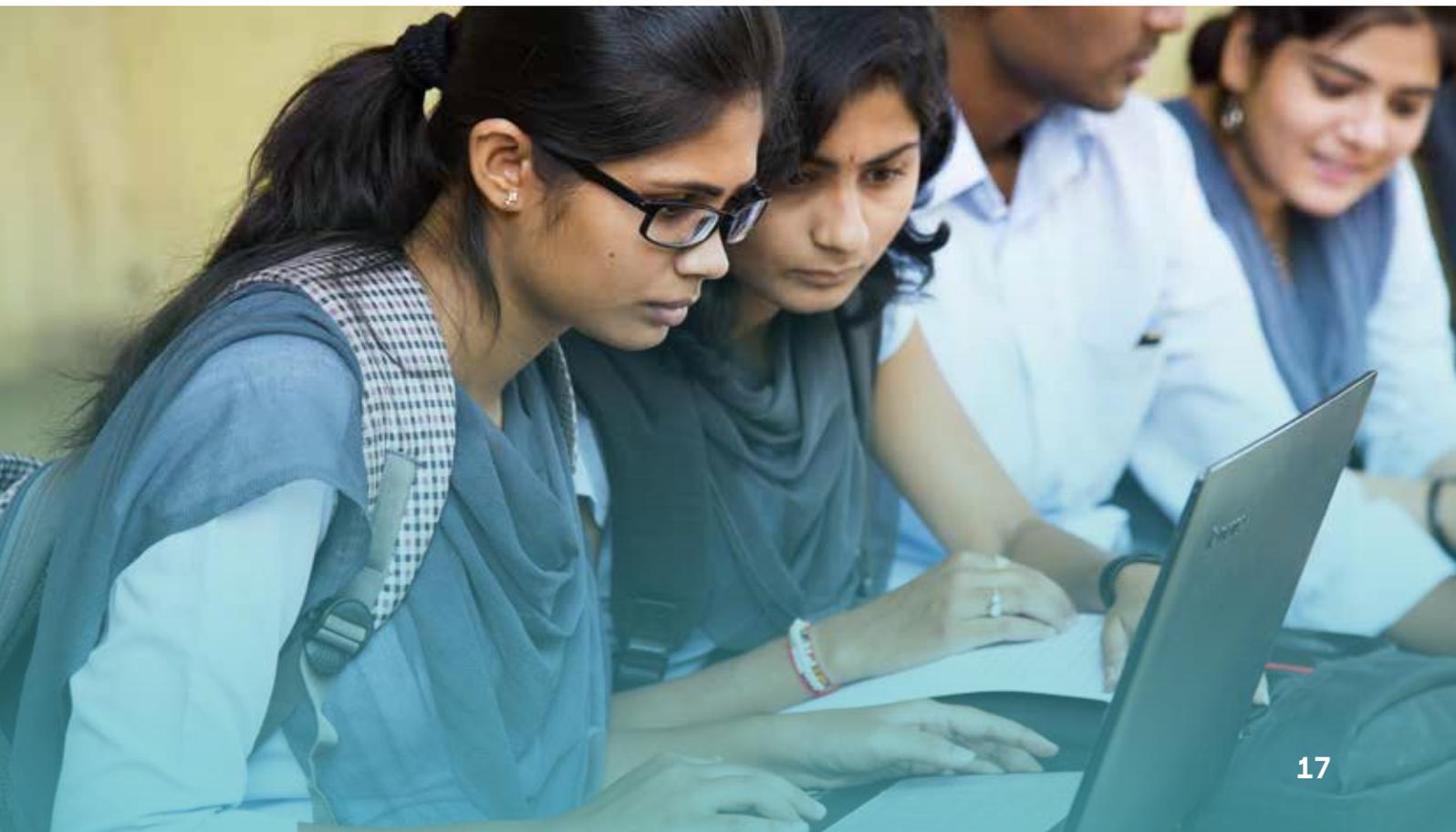
- **Basic ICT infrastructure.** Without basic and functioning ICT infrastructure, such as computers and internet access, it is impossible for countries to capture the benefits of PFM-related digital technology.
- **Sufficient funding.** Insufficient funding is a major barrier to technological progress in low-income countries. Governments need to invest in hardware, software and training. They also need funds to improve basic ICT infrastructure, including power supply, data centers, and network connectivity to successfully implement PFM technology. Often, the cost of setting up such infrastructure and of outweighs the immediate benefit from using the new technology. Data collection and maintenance can also be costly in developing cities where spatial data is typically scarce. On a positive note, the relentless pace of technological advances and digitization has also made available attractive options. For example, the abundance of open-source software and peer-to-peer learning platforms is likely to reduce implementation costs considerably for many low-income countries.
- **Access to computing and technical skills.** Governments frequently face a shortage of skilled personnel to implement and manage the latest digital technologies. Stiff competition from the private sector for the limited talent pool adds to the challenge. While international development agencies fund education in low-income countries, training programs could come to a standstill once funding arrangements end.

Executive Summary

- **Data-driven culture.** A mindset shift may be required to pave the ground for technological change. Such a shift could mean that government officials need to focus more strongly on data-driven decision-making.

Requirements for impact at the advanced readiness state:

- **Political support at the highest level.** Senior government sponsorship and coordination is crucial for the widespread adoption of many of these technologies. Large-scale technological reforms typically encounter strong resistance and high-level political support can help to appease stakeholders.
- **Interoperability of data systems.** To facilitate the widespread adoption and effectiveness of technologies, governments need to have interoperable data systems. This means using the same file format and other standards between government agencies to ensure a smooth data transfer.
- **High penetration of digital devices.** To improve the data collection and output of PFM technologies, governments need to foster the growth of the digital economy. This includes a high penetration rate of digital devices such as smartphones, laptops, tablets, among others, which are required to generate the sheer data volume for meaningful big data analytics.
- **Comprehensive measures to support data security.** Governments must create mechanisms to address privacy concerns and ensure sensitive data can be transmitted securely. Government records must also be protected from unauthorized access.



Global lessons on how to harness the opportunity of using technology to improve PFM

Regardless of current readiness levels, a look at global efforts to improve PFM systems with available technology holds valuable lessons for low-income countries:

- 1. Know your starting point.** Technology adoption must always take into account a country's specific context, its needs and readiness to implement different types of PFM technology. This means not all countries will be able to adopt every available PFM technology. There are scenarios, including for technologies not covered in these case studies, where countries will not meet the minimum conditions required to adopt a more advanced technology. They should instead choose more practical options, including pushing for basic reforms first. Before implementing a technology, public sector officials should develop a good understanding of the benefits and costs of technologies with varying degrees of sophistication, and the overall enabling conditions required to reach different levels of technological adoption. Subsequently, countries need to have an honest assessment of their own capabilities and have realistic expectations of what technology can achieve.
- 2. Be clear on the objectives.** Having a clear and realistic understanding of what the implementation of a specific technology should achieve, can significantly lower costs and produce the greatest impact in the shortest period of time. For example, it is important to distinguish essential from non-essential data when adopting GIS for tax purposes, particularly because data creation and collection costs can be prohibitive in low-income countries where geospatial data is not as developed and readily available. Another example is in India and Indonesia, where tax authorities used data analytics to target the "big fish" – the largest taxpayers and institutions expected to yield the highest tax penalties.
- 3. Adopt a phased rollout.** Research shows it is generally unfeasible for countries to skip stages of technological development, meaning any implementation needs to occur gradually. Starting to roll out a novel technology in areas where stakeholders are open-minded and enabling conditions are most favorable, can help governments reduce costs, allow time for feedback, and troubleshoot kinks in the system early. It can also help to reduce expectations and, by setting a positive example of change, lower resistance on a broader level. Low-income countries should resist the temptation and political pressure to quickly expand the scope and reach of successful pilot projects, as the service quality may suddenly drop if the right conditions are not in place yet. For example, in an effort to smooth the shift to e-procurement, Turkish authorities created a transition period of almost seven months before launching a pilot tender. In this period, contracting agencies and suppliers could register on the electronic platform and learn how to use it.

While leapfrogging within a technology is typically unfeasible, current low-income countries may be in the position to benefit from many of these technologies much quicker than developed countries - both in terms of the implementation process and the opportunity to leapfrog outdated technology or operation models, because they are not constrained by legacy systems (and assuming that enabling conditions are met). For instance, the digitization of paper-based records can be done faster in many low-income countries once the required infrastructure is installed because of the much smaller and less complex base of records. Another example is the adoption of mobile payments outside financial institutions. The famous example is M-Pesa in Kenya which leveraged powerful network effects to dramatically grow the adoption rate of its mobile wallet offerings at much quicker rate than traditional financial services accounts which grow at roughly the pace of national income.¹³ This kind of “shortcutting” was something developed countries did not have the luxury of having in the past.

4. **Champion digitization in the public sector.** Technological reforms in PFM often encounter strong opposition from influential groups who are deeply vested in the status quo. They can also be slow to implement due to inertia among government officials. Case studies presented in this report show that large parts of an economy need to be digitized before many technologies can be used in an advanced way. This suggests that PFM technology and reform programs will often have to be part of a national drive towards digital inclusion. Global best practice shows that high-level political support can be crucial to achieve results. A success story is Mexico, which was able to harness the synergies between digitization and PFM after announcing a sweeping National Digital Strategy. The strategy provided the necessary foundation for complex coordination across government agencies.
5. **Focus on shifting mindsets (and not just on skills).** While building skills to support implementation is important, it is also important to focus on creating a digital mindset among government employees. Transforming into a data-driven culture requires a fundamental change in mindset for managers and staff. Government leaders can help by rewarding the development of statistical and computing skills. One expert revealed that South Africa is a leader in incentivizing a data-driven approach, linking performance rewards to the use of data in decision-making.
6. **Communicate, communicate, communicate!** Constant communication with users is an important element of change management, particularly when a large behavioral change is required. Offering opportunities for stakeholders to provide feedback can play a key role to increase trust and lower resistance towards technological change. For example, in Kenya, a hotline was established for recipients that were part of the program for digitizing food assistance payments, where they could ask questions, express concerns, and report grievances without fear of reprisal.

13 The New Dawn (2016). “The Promise of Digital Finance”. Available at: <http://www.thenewdawnliberia.com/commentary/6095-the-promise-of-digital-finance>

Structure of this report

Chapter 1 discusses the components of the PFM system and outlines key concerns of low-income countries when managing public resources. Chapter 2 provides an overview of the potential benefits of different technological applications. Chapter 3 analyzes how five select technological applications can improve PFM and offers common lessons from these case studies. Chapter 4 concludes with suggestions on areas requiring further research.

Box 1: Summary of research methodology

A three-step process was used in this research to identify relevant technologies to PFM and understand their applicability for low-income countries:

Step 1: Identifying key PFM concerns in low-income countries

An extensive literature review, including newspaper articles, statements from government officials and reports from development agencies such as the IMF and World Bank, was complemented by around 50 expert interviews with PFM-related specialists working on technical assistance programs in low-income countries, as well as local officials in the public finance domain. Given the scope of the topic, it is clearly unfeasible for this report to address every issue and concern. Subsequently, this report highlights five specific examples that are largely common and urgent in low-income countries, and also cover the major PFM components.

Step 2: Gathering a long-list of technological applications that address the concerns

Sources from academia, international think tanks, international development agencies, as well as government entities were consulted to understand the range of applicable technologies. There are two major groups of technological applications included: i) those already adopted in the PFM landscape and have demonstrated positive impacts, and ii) those that have been implemented in other areas of the public or private sectors and have the potential to address key PFM concern areas. The technological applications identified can be summarized into five “families”:

- Digitization of payments. These are technologies that relate to transforming cash-based or in-kind payments into digital transfers.
- Integrated IT hardware and software. These are technologies that help to integrate different PFM functions, such as budgeting, cash management, and reporting.

- Citizen and business engagement solutions. These are technologies that support better engagement with citizens and businesses.
- Identification and recording technologies. These are technologies that enhance recording of transactions and identification of key beneficiaries or actors.
- Data analytical applications. These are technologies that support enhanced analytics of data related to PFM functions.

Step 3: Prioritizing technological applications for “deep dives”

In order to understand how to capture the potential benefits in each of the PFM concern areas, a number of technology applications were explored in further detail through case studies, examining typical challenges faced in implementation and how countries have overcome those challenges. The case studies were selected based on several criteria:

- Relevance to PFM concerns. The PFM technologies should have a good coverage of the five areas of PFM concern.
- Potential for significant impact. The technology applications have proven impact in previous reforms or high potential to achieve impact (for applications that are still uncommon in PFM reforms) in a low-income country context.
- Limited exploration to date. The technology applications have not been thoroughly explored in the past literature.

Based on these criteria, five PFM technology applications were selected for case studies:

1. Geographic Information System (GIS) adoption for increasing property tax revenues;
2. E-procurement adoption;
3. Big data analytics capability for identifying tax fraud and evasion;
4. Digital government-to-person payments; and
5. Blockchain for enhancing auditing.

The challenges of low-income countries in public financial management



The challenges of low-income countries in public financial management

PFM consists of three broad phases: budget formulation and authorization; budget execution; and budget evaluation. Based on interviews with PFM experts, academics, and Ministry of Finance officials in low-income countries, five main concerns were highlighted across these three phases where technology could play a role.

Public Financial Management consists of three broad phases

Public Financial Management (PFM) relates to the way governments manage public resources, both revenue and expenditure, and the impact of these financial flows on the economy or society.¹⁴ Every country has its own laws, rules, systems and processes to manage its public finances effectively and transparently.¹⁵ However, as seen in Exhibit 1, Public Financial Management typically involves three broad phases:¹⁶

1. **Budget formulation and authorization.** Government officials use this phase to develop a budget strategy and set financial targets in line with broader policy goals, before passing the budget on to legislators for debate and approval. Strategic budgeting involves the allocation of funds to government programs and entities to meet specific policy objectives. There are financial constraints, as governments need to take into account projections of future economic growth, commodity prices, exchange rates, and the availability of external funding mechanisms including debt and foreign aid. During budget preparation, officials create a budget proposal with detailed revenue and expenditure figures. Expenditure proposals usually need multiple iterations and require a coordinating entity, typically the Ministry of Finance, to assess and negotiate spending requests submitted by various government bodies. Once finalized, the budget proposal is submitted to a legislative body for debate. To achieve consensus, legislators may decide to amend the proposal before enacting it into law.
2. **Budget execution.** This phase involves revenue and expenditure management, internal controlling and auditing, and accounting and reporting. As part of its revenue management, the government collects the financial resources it needs to meet the objectives laid out in the budget. This includes collecting various taxes, underwriting debt, managing foreign aid, and transferring resources to local governments or spending entities. Expenditure management describes the disbursement of resources. Key areas of public expenditure include recurrent expenses (civil service wages, benefits, pensions, utilities), transfer payments (subsidies, unemployment benefits, tax rebates) and capital spending (to repair, upgrade or build new infrastructure). Internal control and audit mechanisms ensure that a government complies with existing regulations when executing its budget. Timely and accurate financial reports must be produced and circulated to allow audits to be effective.

¹⁴ Matt Andrews, Marco Cangiano, Neil Cole, Paolo de Renzio, Philipp Krause, and Renaud Seligmann (July 2014). This is PFM, CID Working Paper No. 285.

¹⁵ The budget process can be divided into upstream and downstream budget formulation. Upstream processes include strategic planning, setting up a medium-term expenditure framework, and annual budgeting. Downstream processes include revenue management,

¹⁶ Matt Andrews, Marco Cangiano, Neil Cole, Paolo de Renzio, Philipp Krause, and Renaud Seligmann (July 2014). This is PFM, CID Working Paper No. 285.

The challenges of low-income countries in public financial management

3. **Budget evaluation.** External auditors assess the accountability of the government’s budget execution. These independent bodies (called Supreme Audit Institution or Accountant-General Office, depending on countries) have the legislative power to investigate, demand clarification, and pursue sanctions against suspected misspending by government entities and personnel.

Exhibit 1

PFM comprises of three phases: budget formulation & authorization, budget execution and budget evaluation

PFM Phases	Components	Key processes by component	
Budget formulation and authorization	Strategic budgeting	<ul style="list-style-type: none"> Discussions to define high-level policy targets Macroeconomic forecasts 	<ul style="list-style-type: none"> Policy analysis and scenario modelling Initial revenue and spending estimates
	Budget preparation	<ul style="list-style-type: none"> Release of budget circulars Engagement with line ministries and agencies 	<ul style="list-style-type: none"> Formal budget proposal with detailed revenue and spending classifications
	Legislative debate and enactment	<ul style="list-style-type: none"> Examination and discussion of budget details 	<ul style="list-style-type: none"> Proposed amendments Adoption and enactment into law
Budget execution	Revenue management	<ul style="list-style-type: none"> Collection of revenue Management of borrowing 	<ul style="list-style-type: none"> Transfer of revenues to government central accounts and spending entities
	Expenditure management	<ul style="list-style-type: none"> Payment of civil service salaries, pensions, benefits, and other government disbursements Procurement of goods and services 	<ul style="list-style-type: none"> Costing and appraisal of capital projects Investment management (non-recurrent spend)
	Internal control and audit	<ul style="list-style-type: none"> Compliance with established rules and procedures 	<ul style="list-style-type: none"> Identification of risky and non-compliant areas for audit Debt and aid management
	Accounting and reporting	<ul style="list-style-type: none"> Clear records of financial accounts 	<ul style="list-style-type: none"> Structuring of records to facilitate scrutiny Harmonization of classification regimes
Budget evaluation	External audit and accountability	<ul style="list-style-type: none"> Timely delivery of reports to independent bodies Examination of spending as outlined by budget Conducting of enquiry sessions in light of irregularities 	<ul style="list-style-type: none"> Pursuing sanctions specific to mismanagement Enabling role of civil society in checks and balances

The challenges of low-income countries in public financial management

Given the inefficiencies of PFM systems in many low-income countries amid a continued rise in global development aid, PFM reform is a major focus of both governments and international donor programs.¹⁷ For example, the number of World Bank-financed projects with a substantive PFM component quadrupled between the early 1990s and 2005.¹⁸ The funds committed to PFM aid projects increased more than 10-fold to over US\$930 million between 1995 and 2007. Internally, low-income governments have enacted or reviewed laws to improve PFM function. These include the PFM Act 2012 in Kenya, which sets out clear responsibilities for how money can be raised and spent at the national and county levels, as well as installing new guidelines to enhance the participation of ordinary citizens in the budgetary process. However, despite the growing push for PFM reform, its success in low-income countries has so far been mixed (Box 2).

Box 2: Why have many PFM reforms not led to the desired outcomes?

Governments in low-income countries often struggle to efficiently run their public finances. This can be seen in the confluence of poor PFM outcomes characterized by years of budget deficits, unsustainable debt accumulation, unproductive spending, and limited tax bases.¹⁹ The implications of weak PFM systems extend far beyond public finance and budgeting processes. Ultimately, the failure to use public resources fairly and efficiently has a direct negative impact on service delivery that is not only detrimental to the immediate well-being of citizens but could potentially hurt the long-term economic development and income growth of a country.²⁰

Typical PFM reforms²¹ include establishing medium-term expenditure frameworks (MTEFs) and performance-based budgeting, standardizing classification systems, introducing accrual accounting methods, using a Treasury Single Account to centralize financial stocks and flows, and automating various budget functions via Integrated Financial Management Systems (IFMIS).

These reforms have often not achieved the desired results in low-income countries, as observed by the persistence of suboptimal PFM outcomes described above. This box briefly mentions some of the reasons that are highlighted in the academic literature as to why positive outcomes are not achieved.

17 OECD (2017). Development aid rises again in 2016 but flows to poorest countries dip. Available at: <http://www.oecd.org/dac/development-aid-rises-again-in-2016-but-flows-to-poorest-countries-dip.htm>

18 Overseas Development Institute (2011). Does donor support to public financial management reforms in developing countries work? Available at: <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7098.pdf>

19 AlphaBeta analysis based on extensive reviews of country-specific official assessments including IMF Article IV Consultations, and data from sources including the Bank of International Settlements.

20 For a wider discussion on the connection between PFM quality and economic, social and political variables, see: Friz V, Verhoeven M and Avenia A (2017). Political Economy of Public Financial Management Reforms. Experiences and Implications for Dialogue and Operational Engagement. World Bank Group.

21 Matt Andrews, Marco Cangiano, Neil Cole, Paolo de Renzio, Philipp Krause, and Renaud Seligmann (July 2014). This is PFM, CID Working Paper No. 285.

The challenges of low-income countries in public financial management

First, proposed solutions have not been context-specific and too-often copy-pasted from developed country experiences,²² leading to so-called “isomorphic mimicry” where weak states pretend to look like functional states by copying features of the latter.²³ In some cases, overambitious goals are established for reform which are not matched with the capacity to deliver. Second, the misuse of measurement systems like the Public Expenditure and Financial Accountability (PEFA) as an assessment framework for PFM performance has been pinpointed as a factor for the lack of context-specific understanding of a country’s PFM system.²⁴ Third, it is argued that incentives of the various stakeholders engaged in PFM reforms are ill-defined and misaligned. For example, donors are more concerned about fund disbursement rather than impact and outcome of technical assistance projects, while finance ministries are more concerned with eye-catching projects that capture international attention rather than prioritizing basic reforms in accounting and control of the budget.²⁵ Fourth, which is somewhat linked to the previous point, is that the complete revamp of a PFM system involves a myriad of interconnected processes and requires the strong will of all stakeholders involved. However, it is not uncommon for relevant stakeholders, from high-level politicians to low-level public officials, to resist reforms due to potential conflicts with their personal interests. Yet, there appears to be a continued lack of attention to the political economy factors and the potential to use behavioral economics to explain why many PFM reforms in low-income countries appear to have hit an “institutional wall”.²⁶

22 Hepworth N (2014). “Why PFM Reforms Often Fail in Developing Countries.” IMF PFM blog. Available at: <http://blog-pfm.imf.org/pfmblog/2014/06/why-pfm-reforms-often-fails-in-developing-countries.html>

23 Andrews M (2009). Isomorphism and the limits African public financial management reforms, HKS Working Paper No. RWP09-012, Cambridge MA

24 The PEFA methodology has been criticized for measuring “form” and not “function” by focusing on indicators that measure how systems look but not how they work in practice, hence does not pinpoint the underlying causes of the strengths and weaknesses of PFM systems. See: Lawson A and Bucknall I (2016). “The 2016 PEFA Framework: Let’s not throw the baby out with the bath water.” Available at: <http://fiscus.org.uk/2016-pefa-framework/>

25 Allen R (2015). “Angels and Demons – the political economy of PFM Reform”. IMF Public Financial Management blog. Available at: <http://blog-pfm.imf.org/pfmblog/2015/01/angels-and-demons-the-political-economy-of-pfm-reform.html>

26 Allen R (2015). “Angels and Demons – the political economy of PFM Reform”. IMF Public Financial Management blog. Available at: <http://blog-pfm.imf.org/pfmblog/2015/01/angels-and-demons-the-political-economy-of-pfm-reform.html>

The challenges of low-income countries in public financial management

Identifying key PFM concerns in low-income countries

As highlighted in Box 2, a major stumbling block for many reform programs is the failure to properly diagnose the issues at hand and offer context-specific solutions. In other words, countries need to identify the key concerns they are trying to solve for and match them with solutions that they are best placed to implement. Although each country has its own specific set of issues across the PFM spectrum, this section aims to pinpoint the core concerns on top of policymakers' minds. Doing so requires a clear understanding of what PFM entails and the key concerns that many low-income countries face. To identify these concerns, a multi-prong approach was used. An extensive literature review, including newspaper articles, statements from government officials and reports from development agencies such as the IMF and World Bank, was complemented by around 50 expert interviews with PFM-related specialists and industry leaders. These interviewees included senior country budget officials; economists from think tanks providing advice to developing country governments; senior technical advisors from international financial institutions and other multilateral organizations that have worked extensively across low-income countries in Africa and Asia; officials from donor institutions; executives of private firms that provide IT solutions to governments; and academics specializing in public finance.

Given the breadth of PFM, it is clearly unfeasible for this report to address every issue and concern. However, five key concerns emerged from the interviews and desk research, which are closely linked to the different components of PFM discussed earlier (Exhibit 2).



The challenges of low-income countries in public financial management

Exhibit 2

There are five main concerns across the PFM components in low-income countries

■ Concern relevant to a PFM component

Components of PFM	PFM concerns				
	Aligning budgets with policy priorities	Improving tax compliance	Allocating public spending more efficiently and deliver services more effectively	Reducing corruption in public procurement	Enhancing institutional accountability
Phase 1: Budget formulation and authorization					
Strategic budgeting	■				
Budget preparation	■				
Legislative debate and enactment					
Phase 2: Budget execution					
Revenue management		■			
Expenditure management			■		
Internal control and audit				■	
Accounting and reporting					■
Phase 3: Budget evaluation					
External audit and accountability					■

SOURCE: Andrews, Cangiano, Cole, de Renzio, Krause and Seligmann (2014); AlphaBeta analysis

1. **Aligning budgets with policy priorities.** This concern refers to the ability of governments to produce credible budgets that achieve their policy objectives, given the expected conditions of the economy. Concerns in this area include a lack of robust and timely analysis of macroeconomic conditions and how they could impact fiscal policy; as well as the management of fiscal constraints such as fiscal rules or debt levels.

Failure to align the budget to economic, ministry and citizens priorities can lead to a series of negative outcomes, including business uncertainty, the shutdown of public services, and social instability. For example, Nigeria has experienced frequent delays in its budget process since returning to democratic rule in 1999 due to disagreements between the executive and legislature.²⁷ The 2017 budget was delayed by more than six months after the Presidency refused to sign the document as the version passed by the National Assembly turned out to be vastly different, with many “grey areas” from the one

27 Olukoya S (2017). “Budget Delay Not Good for Economic Recovery – Expert.” Available at: <http://investorsking.com/budget-delay-not-good-economic-recovery-expert/>

The challenges of low-income countries in public financial management

submitted by the President.²⁸ The delayed budget increased economic uncertainty for businesses and individuals which led to a marked slowdown in investment and consumption spending. The delay also significantly reduced the ability of the government to deliver services to the public, ultimately hurting the country's economic recovery. In low-income countries such as Uganda, there are also often requests for supplementary budgets as poor expenditure planning leads to the need to raise revenues to cover unforeseen expenditures such as salary arrears for public servants.²⁹ Nigeria's president was forced to request new funds equivalent to around 10% of the original budget to cover subsidy payments when crude oil prices plunged in 2015, increasing the budget deficit significantly.³⁰

The failure of budgets to capture the broad interests of different population segments could also lead to social instability. Protests over national budgets are not uncommon in low-income countries where systemic corruption already severely weakened the trust between taxpayers and the governments. Recent examples include violent demonstrations across several cities in Haiti over proposed tax hikes on everyday products that are likely to have the greatest impact on the poor.³¹

- 2. Improving tax compliance.** Many low-income countries are struggling to deliver public services due to poor tax compliance, a serious problem exacerbated by high incidences of tax fraud and evasion. According to an OECD study, the overall tax-to-GDP ratios of Cameroon (16.1 percent), Rwanda (16.1 percent), Senegal, (20.1 percent), Côte d'Ivoire (17.8 percent), and South Africa (27.8 percent), were significantly below the OECD average of 34.4 percent.³² In Nigeria, only 17.5 percent of the adult labor force are registered taxpayers; VAT compliance is reported to be 12 percent; and tax as a percentage of GDP hovers around 6 percent.³³ Oxfam reports that the single tax avoidance practice of trade mispricing by G7-based companies alone cost Africa to miss out on estimated tax revenues of around US\$6 billion in 2010 – equivalent to three times the amount needed to plug the healthcare funding gap in Ebola-affected countries of Sierra Leone, Liberia, Guinea and at-risk Guinea Bissau.³⁴ In Uganda, an interview with a senior local economist reveals that there is substantial loss of revenue through i) undervaluation of goods at customs points, both inland and at border, and usually involves both the importers of

28 Abuja A and Jimoh A (2017). "2017 budget delayed due to grey areas." Available at: <https://guardian.ng/news/2017-budget-delayed-due-to-grey-areas/>

29 Akello J (2017). "Supplementary Budgeting: Government expenditure not informed by planning." Available at: https://www.newvision.co.ug/new_vision/news/1323888/supplementary-budgeting-government-expenditure-informed-planning

30 Economic Intelligence Unit (Nov 2015). President seeks approval for supplementary budget.

31 Delva J (2017). "Violent street protests break out in Haiti over tax hikes." Available at: <https://www.reuters.com/article/us-haiti-protests/violent-street-protests-break-out-in-haiti-over-tax-hikes-idUSKCN1BN34Y>

32 OECD, ATAF and AUC (2016), Revenue Statistics in Africa, OECD Publishing, Paris. Available at: <http://dx.doi.org/10.1787/9789264253308-en-fr>

33 Nigeria is estimated to have only 14 million registered taxpayers, out of a labour force of close to 77 million (going by national statistics). See Business Day Online (2017), "Nigeria targets 17m tax base with proposed new advocates". Available at: <https://www.businessdayonline.com/nigeria-targets-17m-tax-base-proposed-new-advocates/> For VAT compliance statistics, see PwC (2016), "Guess how many Nigerians pay tax and how out government spends the money" Available at: <https://www.pwc.com/ng/en/assets/pdf/tax-watch-june-2016.pdf>

Recently, Finance Minister Kemi Adeosun was quoted as saying Nigeria's tax to GDP ratio is at 6 percent – among the lowest in the world. See This Day (2017), "Adeosun: Nigeria's tax to GDP ratio among lowest in the world" Available at: <https://www.thisdaylive.com/index.php/2017/04/23/adeosun-nigerias-tax-to-gdp-ratio-among-lowest-in-the-world/>

34 In Uganda, an interview with a senior local economist reveals that there is substantial loss of revenue through i) undervaluation of goods at customs points, both inland and at border, and usually involves both the importers of good and customs' staff; and ii) deliberate tax avoidance by the wider business community by either rescheduling operation times for by operating through informal channels to avoid paying income taxes.

The challenges of low-income countries in public financial management

good and customs' staff; and ii) deliberate tax avoidance by the wider business community by either rescheduling operation times for by operating through informal channels to avoid paying income taxes.

- 3. Allocating public spending more efficiently and deliver services more effectively.** Delivering public services is at the heart of what governments do. Efficient public spending and service delivery must go hand in hand to build trust with citizens and promote a positive image of the public sector.³⁵ Advances in ICT and social media technologies have opened up new sources of information and helped to empower citizens, placing greater expectations of governments to ensure efficient service delivery. Sound PFM systems optimize technical and allocative efficiencies by ensuring that public spending is targeted, and programs are delivered in the most effective and cost-efficient manner.

Public service delivery captures a multitude of activities from the provision of quality healthcare and public education to various forms of government transfers and salary payments. One important area of public service delivery is government-to-person (G2P) payments, especially subsidies and direct cash transfers, which affect some of the most marginalized and vulnerable people.³⁶ For example, 8 percent of Nigeria's population receives G2P payments, and this percentage excludes those that collect government salaries. In India, the share of subsidies as a proportion of total government expenditure was almost in 20 percent in 2012, although it decreased to around 15 percent in 2016.³⁷ However, subsidies in low-income countries very often fail to reach the intended recipient due to fraud.³⁸ For instance, there are many incidents of "ghost beneficiaries" of fertilizer subsidies in Malawi and Ghana. And many of India's poor missed out on cooking gas subsidies due to a string of fake and duplicate claims. Delays in subsidy payments were found to contribute to fertilizer shortages and long queues at collection points in Ghana,

35 McKinsey & Company (2015). "Implementing a citizen-centric approach to delivering government services". Available at: <https://www.mckinsey.com/industries/public-sector/our-insights/implementing-a-citizen-centric-approach-to-delivering-government-services>

36 InterMedia (2015). Nigeria: FIU follow-up study on G2P payments. Financial Inclusion Insights, Applied Research for Digital Financial Inclusion.

37 The Hindu (2016). "Budget 2016: Where the money comes from and where it goes". Available at: <http://www.thehindu.com/business/Budget/Budget-2016-Where-the-money-comes-from-and-where-it-goes/article14130547.ece>

38 Although subsidy-related fraud is also common in advanced countries like Germany and Spain, the economic and social burden of misallocation in can be expected to be significantly higher in low-income countries.



The challenges of low-income countries in public financial management

Mali, Malawi and Senegal. Such delays were also found to have a negative impact on farm production.³⁹

4. **Reducing corruption in public procurement.** Public procurement refers to the process through which the public-sector purchases goods, services, or works from the private sector.⁴⁰ Countries either adopt a centralized or decentralized public procurement model. In a centralized model, a single government entity carries out the procurement functions on behalf of ministries and other state bodies. Meanwhile in a decentralized model, procurement responsibilities are devolved to the level of the individual spending ministries, local authorities or other public bodies covered by the procurement law.⁴¹

There are three key phases in the public procurement cycle: i) during the pre-tendering phase government bodies assess their needs and specify their requirements, plan their budgets, and decide on the choice of procurement procedure; ii) the tendering phase includes requests for proposals and bid submission, evaluation and award; and iii) the post-award phase includes contract management and payments.⁴² Public procurement is an area of concern in many low-income countries, as it is a government activity that is highly prone to corruption.⁴³ President Edgar Lungu of Zambia pinpointed public procurement as the channel where the government has been losing large sums of money through a range of unethical practices.⁴⁴

There are three key reasons why corruption in public procurement is of utmost concern to governments and development agencies:

- a. Public procurement accounts for a very large part of the economy: Estimates show that public procurement accounts for a large share of the economy in many low-income countries relative to countries in other income groups (14.5 percent of GDP on average versus 12.6% for high-income countries).⁴⁵ The importance of public procurement for the overall economy makes corruption particularly problematic, and investments in large-scale infrastructure projects is an area within public procurement that is most susceptible to corrupted practices. For example, the Construction Sector Transparency Initiative (CoST) estimates that the annual global losses in public infrastructure investments through mismanagement, inefficiency and corruption could reach US\$2.5 trillion by 2020.⁴⁶

39 Druilhe Z and Barreiro-Hurlé J (2012). Fertilizer subsidies in sub-Saharan Africa. Food and Agriculture Organization of the United Nations.

40 Djankov S, Islam A and Saliola F (2016). How Large is Public Procurement in Developing Countries? Peterson Institute for International Economics: Available at: <https://piie.com/blogs/realtime-economic-issues-watch/how-large-public-procurement-developing-countries>

41 OECD (2000). Centralised and Decentralised Public Procurement. SIGMA Papers, No. 29, OECD Publishing, Paris.

42 Each phase in the public procurement lifecycle presents a host of integrity risks that can lead to corrupt practices. Refer to OECD (2016). Preventing corruption in public procurement" for a more detailed discussion on corruption across the public procurement value chain.

43 OECD (2016). Preventing corruption in public procurement.

44 Lusakatimes.com (2015). "Public Procurement is riddled with corruption-President Lungu." Available at: <https://www.lusakatimes.com/2015/11/27/public-procurement-is-riddled-with-corruption-president-lungu/>

45 Djankov S, Islam A and Saliola F (2016). How Large is Public Procurement in Developing Countries? Peterson Institute for International Economics: Available at: <https://piie.com/blogs/realtime-economic-issues-watch/how-large-public-procurement-developing-countries>

46 CoST (2012), Press Release, Available at: <http://www.constructiontransparency.org/documentdownload.axd?documentresourceid=8>

The challenges of low-income countries in public financial management

- b. Public procurement corruption does not appear to wane despite many attempted reforms: Low-income countries have committed much effort to improve their public procurement processes. Common reforms include the creation of oversight committees, amendment of laws to introduce tougher penalties, establishing systematic and competitive procedure for proposals, and standardization of bid policies.⁴⁷ Despite such efforts, the lack of transparency in public procurement remains significant in these countries. For example, the share of tenders awarded that did not go through official tender processes increased from 14 percent in 2014 to 18.5 percent in 2015 in Burkina Faso⁴⁸, while 60 percent of all tenders in South Africa were subject to untoward influence.⁴⁹ Another example is Nigeria, where its former Minister of Sports and Youth Development claimed that irregularities in procurement processes account for over 70 percent of the government's total budget.⁵⁰
- c. Loss of trust in government: Public procurement corruption greatly undermines the private sector's trust in government. For example, foreign investors in Uganda have threatened to withdraw investments after complaining about the lack of transparency and possible collusion between competing business interests and government officials in tendering processes, as well as rampant practices of "under-the-table" payments linked to public contracts.⁵¹ Similarly, development aid and loan providers are wary of the misuse of funds and have increased pressure on governments to clamp down on corruption. In 2015 and 2016, international donors withheld aid to Tanzania following revelations that senior government officials siphoned public funds totaling around US\$180 million.⁵² Likewise, in 2014, a group of international donors including Norway and the UK's Department for International Development (DfID) suspended up to US\$150 million in scheduled aid payments to Malawi after a major corruption scandal was uncovered that involved government payments.

47 For example, South Africa developed a National Procurement Policy to address public procurement challenges. See: Policy strategy to guide uniformity in procurement reform processes in government Available at: https://www.environment.gov.za/sites/default/files/legislations/procurement_process_uniformstrategy.pdf

48 GAN Integrity (2017). "Burkina Faso Country Report." Available at: <http://www.business-anti-corruption.com/country-profiles/burkina-faso>

49 Business Tech (2016), "60% of tenders are corrupt in some way: Deputy Public Protector" Available at: <https://businesstech.co.za/news/general/116470/60-of-tenders-are-corrupt-in-some-way-deputy-public-protector/>

50 News Agency of Nigeria (2017), "Corruption in procurement makes up 70% of budget, says ex-Minister" Available at: <http://www.nan.ng/news/corruption-procurement-makes-70-budget-says-ex-minister/>

51 Please refer to US Department of State's Investment Climate Statements 2017. Available at: <https://www.state.gov/e/eb/rls/othr/ics/investmentclimatestatements/index.htm>

52 Business Anti-Corruption Portal (2017), Country profile: Tanzania. Available at: <http://www.business-anti-corruption.com/country-profiles/tanzania>

The challenges of low-income countries in public financial management

5. **Enhancing institutional accountability.** Governments and development agencies in most low-income countries are concerned about producing a comprehensive, timely and accurate picture of their financial accounts to promote their institutional accountability. Financial government reports are the core of internal and external audits, as these audits are compromised if the quality of financial reporting is poor. Broad access to financial reports is also necessary to energize public discussions on fiscal policy – an increasingly popular prescription to hold governments accountable for their spending decisions.

An analysis of data from the International Budget Partnership (IBP), which evaluates the availability of key budget documents in countries across the world, reveals that the majority of low-income countries do not produce or make available a comprehensive list of budget documents that are consistent with international standards.⁵³ For example, Tanzania does not produce either a mid-year review or a year-end report of its budget. Similarly, Burkina Faso does not produce a mid-year review, only a year-end report that is not made available for public use. PFM experts in Nigeria say hyperlinks to financial records on public websites are often broken or lead to the wrong documents, hindering the ability to conduct analysis.

In interviews with development agency experts, worries were also expressed over the poor quality of financial documents. For example, PFM experts in Sub-Saharan Africa frequently commented on the number of discrepancies in financial reports. A lack of reporting and accounting standards can weaken the quality of financial reports. However, experts are concerned that a lack of political will and a deliberate act of “window-dressing” are key reasons behind the poor quality of financial statements. For instance, in Kenya, records of spending around extra budgetary funds, as well as the financial activities of private-public partnerships (PPP) and state-owned government (SOEs), are often left out of official financial reports. Likewise, in Nigeria, so-called “Intervention Funds” are not accounted for in the Accountant General’s Financial Statements, creating opportunities for abuse.⁵⁴

53 The International Budget Partnership collaborates with civil society around the world to analyse and influence public budgets in order to reduce poverty and improve the quality of governance. The IBP’s website is available at: <https://www.internationalbudget.org/>

54 Presentation by Professor Eddy Omolehinwa: “Public Financial Management: Issues and Challenges on Budget Performance”. ICAN Symposium on Federal Government of Nigeria 2014. July 2014. Available at: http://icanig.org/ican/documents/PFM_by_OMOLEHINWA.pdf



Technologies with the potential to transform PFM



Technologies with the potential to transform PFM

The technology landscape has transformed almost every sector of the economy, including a range of government services. In this chapter, we explore the range of technologies that could be applicable to PFM and address the concerns raised in Chapter 1.

The digital revolution and its potential to transform PFM

The scope, scale, and economic impact of technology are accelerating. It took more than 50 years for half of American homes to have a telephone; in a little more than five years, the same percentage acquired a smart phone. It took radio 38 years to attract an audience of 50 million people; Facebook did so in 12 months, and Twitter in 9.⁵⁵ Over 3.5 billion people now use the internet, up from just one billion in 2005.⁵⁶ The volume of data is exploding: 90 percent of the data in the world today has been created in the last two years alone.⁵⁷ Digitization and big data are fueling new business models—from retail platforms like Alibaba and Amazon to car-hailing apps like Uber and GrabTaxi which has facilitated the shared economy.

While the adoption of computers has become widespread across government and delivered large efficiency gains, the rapid development of digital technologies is broadening the potential benefits to governments. The potential benefits to PFM are significant, driven by access to better information, and opening up more efficient mechanisms to delivery public services. For example:

- **Better and more timely information to enhance decision-making:** Greater storage capacity and computing power means that governments can now collect more information which can lead to vast improvements in areas such as detection of tax fraud and evasion. Electronic invoicing and use of high-frequency data is also providing more timely information to increase the responsiveness of government decision-making.
- **More efficient delivery of services:** Digital technologies have the potential to lower the costs of tax collection and compliance, and enhance the speed, targeting, and reliability of the delivery of government services. For example, electronic filing of tax returns has reduced the cost of compliance for taxpayers. Digitization of government payments has lowered administration costs, reduced opportunities for fraud, improved the targeting of welfare programs, and lowered the waiting time for recipients. Blockchain technology can help establish permanent, immutable records of identity, for citizens and businesses, that can minimize fraud and enhance the targeting of services.

55 McKinsey Global Institute (2014). Southeast Asia at the crossroads: Three paths to prosperity.

56 Statista. Accessed at: <https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/>

57 E27 (2015). "World's data volume to grow 40% per year & 50 times by 2020: Aureus". Available at: <https://e27.co/worlds-data-volume-to-grow-40-per-year-50-times-by-2020-aureus-20150115-2/>

Technologies with the potential to transform PFM

60 technologies have been identified that could address the five major PFM concerns

Drawing on the analysis of problems facing low-income countries in PFM in the previous chapter, a thorough literature review and set of interviews were conducted to understand the range of applicable technologies. Exhibit 3 below provides a snapshot of some of these sources.

Exhibit 3

A list of PFM-relevant technology applications was developed through a thorough scan of multiple sources

Academia and international think tanks	International development agencies	Government entities
     	      	     

SOURCE: AlphaBeta analysis

NON EXHAUSTIVE

Technologies with the potential to transform PFM

Five “families” or groups of technologies were identified with relevance to PFM:

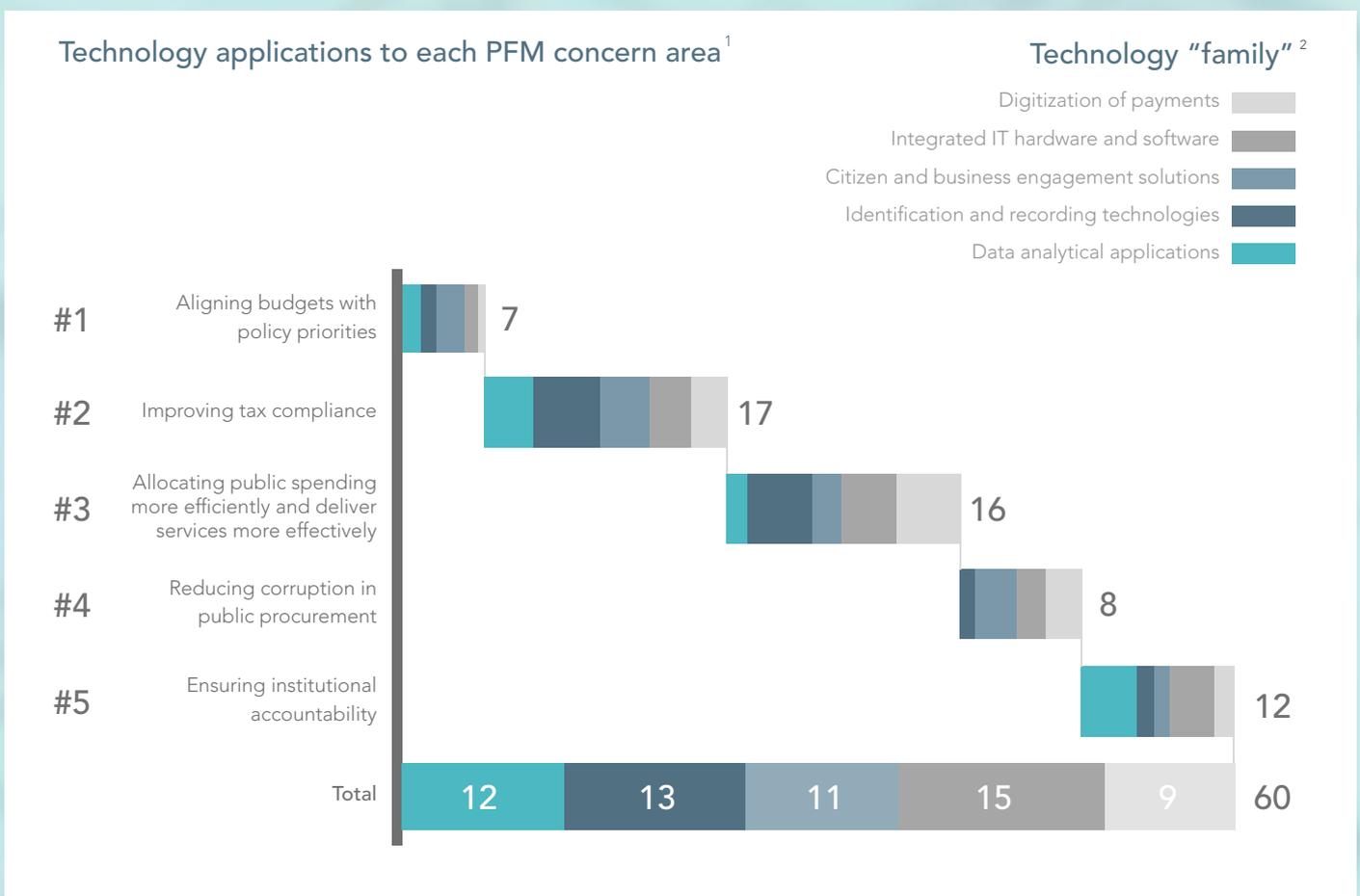
1. **Digitization of payments.** These are technologies that relate to transforming cash-based or in-kind payments into digital transfers. They include electronic transfers, internet banking, credit and debit cards, mobile wallets, smart cards, and e-invoicing.
2. **Integrated IT hardware and software.** These are technologies that help to integrate different PFM functions, such as budgeting, cash management, and reporting.
3. **Citizen and business engagement solutions.** These are technologies that support better engagement with citizens and businesses. They include fiscal transparency portals, integrated tax portals, e-government services portals, social media, mobile applications, Short Message Service (SMS), and digital publishing of budget proposals.
4. **Identification and recording technologies.** These are technologies that enhance recording of transactions and identification of key beneficiaries or actors. They include biometrics authentication, Geographic Information Systems (GIS), unique identification numbers, data recording technology, and Blockchain technologies.
5. **Data analytical applications.** These are technologies that support enhanced analytics of data related to PFM functions. They include data cleaning and filtering tools, data storage and management, data integration and blending platforms, data extraction and monitoring tools, and data analysis and visualization applications.

While most attention to date has focused on Integrated Financial Management Information Systems, or IFMIS (See Box 3 for further information), our research identified a range of other technology applications within these 5 “families” of technologies. In total, 60 technology applications have been identified with relevance to the PFM areas of concern (Exhibit 4).



Exhibit 4

60 technological applications across the 5 concern areas of PFM have been identified



¹ This exhibit measures the number of technology applications (i.e. the linkage of a technology to a specific area of PFM), rather than the number of technologies. One technology can have multiple applications to different PFM concern areas (e.g., big data could be applicable to multiple PFM concerns). The full list of technology applications can be found in the Appendix.

² A Technology "Family" refers to technologies that share similar characteristics in terms of their application.

SOURCE: AlphaBeta analysis

Box 3: Integrated Financial Management Information Systems (IFMIS)

The most famous IT-based solution in the PFM discourse is the Integrated Financial Management Information System (IFMIS). As many as 176 countries around the world have IFMIS to operationalize and automate core PFM functions such as budgeting, cash management, accounting and financial reporting.⁵⁸ IFMIS systems are a set of automation solutions that allow government finance and accounting staff to carry out their day-to-day operational tasks. This enables them to plan, prepare and approve budgets, approve and verify commitments, issue payment orders and payments, monitor and report on financial resources collected, and develop appropriate resource allocation and borrowing strategies.⁵⁹

Development agencies like the World Bank, IMF, and Inter-American Development Bank (IADB) play a critical role in supporting the implementation of these systems in many low-income countries through financial and technical assistance. For example, between 1984 and 2010, the World Bank financed 87 IFMIS projects in 51 countries at an average cost of \$25 million⁶⁰, while the IADB funded 47 IFMIS-related projects at an average cost of \$26 million.⁶¹

Throughout the years, these development agencies have also produced many studies assessing the relative strengths and weaknesses of IFMIS introduction across these countries. Many of the lessons for successful IFMIS implementation are similar to those highlighted in the case studies in this paper. For example, it is important to have a clear rationale for implementation and to identify the problems the system is intended to address. Furthermore, a phased approach to IFMIS implementation is essential and it is important to prioritize fundamental modules for budget execution and reporting.⁶² While the IFMIS is fundamental to automating PFM functions, this paper deliberately does not focus on IFMIS due to the already extensive coverage it has received in prior research.⁶³

58 Florian Misch, Brian Olden, Marcos Poplawski-Ribiero and Lamya Keiji (2017). Nowcashing: Using daily fiscal data for real-time macroeconomic analysis. Digital Revolutions in Public Finance (IMF publication), Chapter 6. Available at: http://www.elibrary.imf.org/view/IMF071/24304-9781484315224/24304-9781484315224/Other_formats/Source_PDF/24304-9781484316719.pdf

59 Hashim A and Moritz P (2018). Lessons from Reforming Financial Management Information Systems. A Review of the Evidence. World Bank Group. Independent Evaluation Group.

60 Dorotinsky W and Watkins J (2013). "Government Financial Management Information Systems." The International Handbook of Public Financial Management.

61 Una G, and Pimenta C (2016). "Integrated Financial Management Information Systems in Latin America: Strategic Aspects and Challenges." In Public Financial Management in Latin America. Inter-American Development Bank.

62 For a more in-depth discussion on the key principles of IFMIS implementation, please see: Hashim A and Moritz P (2018). Lessons from Reforming Financial Management Information Systems. A Review of the Evidence. World Bank Group. Independent Evaluation Group.

63 For further detail on IFMIS, we encourage readers to consult the following research: Cangiano M, Gelb A and Goodwin-Groen R (2017). "Integration of Digitalization and Public Financial Management – Initial Evidence." Chapter 12 of Gupta S, Keen M, Shah A and Verdier G (eds), Digital Revolutions in Public Finance. International Monetary Fund.

Technologies with the potential to transform PFM

Exhibit 5

Available technologies could transform PFM concern areas

The optimal application of technologies could lead to a range of positive impacts on PFM concern areas

PFM concerns	Demonstrated or potential benefits		EXAMPLES
 <p>Aligning budgets with policy priorities</p>	<p>3.5 months</p> <p>Time savings before fiscal stresses appear by analyzing daily fiscal data instead of quarterly fiscal data</p>	<p>Better capture citizens' needs</p> <p>Social media facilitated sharp increase in number of cities practicing participatory budgeting in the recent years</p>	<p>More efficient budget debates</p> <p>East Timor uses budget preparation modules to run simulations of spending scenarios in parliament</p>
 <p>Allocating public spending more efficiently and deliver services more effectively</p>	<p>Up to 3x</p> <p>Increase in annual property tax collection in Indian cities with Geographic Information Systems (GIS) mapping to update fiscal cadastres and monitor tax evasion</p>	<p>12.5%</p> <p>Rise in Brazil's Federal Tax collection through use of big data to audit corporate tax declaration</p>	<p>4.2 million</p> <p>MSMEs previously undetected were brought into the formal economy by the tax authority in Mexico mandating e-invoicing</p>
 <p>Improving tax compliance</p>	<p>US\$20 billion or 1% of GDP</p> <p>Estimated amount of savings if India digitizes all its G2P subsidy payments</p>	<p>US\$100 million per year</p> <p>Average cost savings to the Nigerian government over the last decade from Integrated Personnel & Payroll Information System which removed 60,000 "ghost" workers</p>	<p>15%</p> <p>Lower administrative costs for the World Food Program in Kenya through using electronic cash payments to food insecure households rather than in-kind distribution</p>
 <p>Reducing corruption in public procurement</p>	<p>2.5x</p> <p>The increase in number of bidders per public tender in Albania due to its e-procurement system</p>	<p>Over 70%</p> <p>Share of business survey's respondents who stopped all personal contact with public officials after e-procurement system was introduced</p>	<p>~1 million</p> <p>Unique visitors to Brazil's federal transparency portal each year which has info on public spending, sanctioned contractors & feedback channels</p>
 <p>Enhancing institutional accountability</p>	<p>>1,000</p> <p>Types of statutory and management reports that can be generated in real time by IFMIS reporting module in Kenya</p>	<p>52¹ to 66²</p> <p>Improvement in Mexico's Open Budget Survey score (out of 100) after enacting fiscal transparency portal in 2011. Marked improvement in overall transparency and accountability of budget processes</p>	<p>100 million</p> <p>Potential reduction in annual paper transactions in Dubai by moving paper-based recording systems to a public blockchain (i.e. distributed ledger)</p>

1 2012

2 2015

SOURCE: AlphaBeta analysis

Technologies with the potential to transform PFM

For example:

- **Aligning budgets with policy priorities.** Sound PFM requires budgets to be in line with the broad policy objectives a government has formulated in response to existing and projected economic conditions. Producing such budgets can be challenging if there is insufficient data available to properly analyze economic trends and design fiscal policy, or if budgetary constraints – such as fiscal rules or debt levels – limit government action. Technological applications can help verify alignment between policy objectives and funding of such policies by making more transparent the debate around the budget in all its critical phases - between line ministries and the Ministry of Finance (e.g. Finland), within the parliamentary debate, and by providing citizens the opportunity to participate and influence that debate.

For example, most countries already use some form of **budget preparation software** to help automate the budget production process. These solutions can go beyond the tabulation of spending proposals from public entities but also help legislative debates and negotiations. For example, East Timor uses budget preparation software to run live data simulations of different spending scenarios to better inform parliamentary budget debates.

Technologies can also help to produce more robust analysis of macroeconomic conditions and how they will impact fiscal policy, and also enable better engagement with citizens during the planning process. One area gaining prominence is participatory budgeting⁶⁴ which is now used in thousands of cities globally,⁶⁵ and the increasingly use of popular **social media** tools has helped to facilitate the dissemination of important information to citizens in many low-income countries. For instance, in Kenya, the International Budget Partnership uploads videos of budget deliberations between government departments and members of civil society onto YouTube, with the hope that these videos would stimulate further discussions among the wider public about upcoming budgets.⁶⁶ While the impact of social media on participatory budgeting outcomes is disputed by PFM experts, there is agreement that strong commitment to educate the public on the budget process has raised awareness and interest which puts pressure on governments to be more fiscally responsible. The effective use of **websites to publish relevant information** such as spending reviews and budget proposals can enhance transparency and improve the public debate on budget matters, and have the potential to better align government spending with the population's needs.

The International Monetary Fund (IMF) shows that access and **analysis of daily VAT revenue data** allows authorities to achieve 3.5 months “advanced warning” of potential fiscal stresses compared to when

64 Participatory Budgeting (PB) is a democratic process in which community members directly decide how to spend part of a public budget. The process was first developed in Brazil in 1989 and is now practiced in over 1,500 cities around the world. PB, as a form of participatory democracy, involves public meetings, outreach, discussion, and voting so that the public can be engaged in decision-making. See: PB Victoria Steering Committee 2017: Rulebook. Available at: <http://www.victoria.ca/assets/City~Hall/Current~Initiatives/Participatory-Budget/2017%20Participatory%20Budgeting%20Rulebook.pdf>

65 UN-Habitat (2008). Participatory Budgeting in Africa: A Training Companion with cases from eastern and southern Africa. Volume II: Facilitation Methods. United Nations Human Settlements Programme and Municipal Development Partnership for Eastern and Southern Africa.

66 International Budget Partnership Kenya (2017). “Deliberating Budgets: An example from Nairobi County, Kenya. Available at: <https://www.internationalbudget.org/publications/deliberating-budgets-nairobi-county-kenya/>

Technologies with the potential to transform PFM

traditional quarterly data is used.⁶⁷ Advanced data analytics are also used to strengthen strategic budgeting decisions by increasing the accuracies of scenario forecasting and robustness of cost-benefit analyses, although this mainly takes place in more advanced countries.

- **Improving tax compliance.** Many low-income countries are struggling to deliver public services due to poor tax compliance. As a result, tax revenues as a percentage of GDP is typically lower in low-income countries relative to more advanced ones. A key objective of a robust PFM system is to increase the financial stability of governments, including by fighting and preventing tax fraud and evasion, as well as improving the overall effectiveness and efficiency of tax collection. Technologies can help detect tax fraud and evasion, and transform the efficiency of the tax collection process. For example, **Geographic Information System (GIS)** mapping allowed authorities in the Indian city of Kanpur to increase the annual revenue from house taxes by more than three times compared to the previous collection system.⁶⁸ In Cartago, Costa Rica, the use of GIS to update fiscal cadastres helped authorities identify fraudulent tax declarations. As a result, local collection revenues increased by more than 300 percent over 10 years, more than offsetting the cost of implementing the new technology.⁶⁹ Big data techniques are able to be used to identify incidences of potential fraud or tax evasion. Brazil used **big data to audit** corporate tax declarations, where large business-to-business transactions are analyzed for inconsistencies between connected businesses, and flagged where fraud networks are identified. This has resulted in a 12.5 percent increase in federal tax collection since 2010.⁷⁰ **E-invoicing** has also proven effective in countries such as Mexico for combatting false invoicing and unrecorded transactions in the informal sector. Mexico introduced mandatory e-invoicing for all businesses in 2015 and the Monterrey Technology Institute estimates that the obligation for e-invoicing not only led to growth in income tax (6 percent for businesses and 21 percent for individuals), but also brought 4.2 million MSMEs previously undetected by the tax authority into the formal economy.⁷¹

Technologies can also help to improve tax compliance by making it easier for those who want to comply. These include **integrated digital tax portals** that allow taxpayers to file returns, track refunds, make payments, and review historical information all through one single access account, as well as the use of **Short Message Service (SMS)** to improve tax communication. Person-to-government (P2G) and business-to-government (B2G) **digital payments** is a technological application that has proven impact on improving tax compliance by increasing the convenience for payers and lowering the risk of late or non-payment. African cities such as Douala II in Cameroon and Kinondoni in Tanzania have reported tax revenue increases of over 50 percent within a few years of implementing mobile payment solutions.⁷²

67 Misch F, Olden B, Poplawski-Ribeiro M and Kejji L (2017). Nowcashing. Using daily fiscal data for real-time macroeconomic analysis. Digital Revolutions in Public Finance. IMF.

68 Kumar R (2012). "GIS Simplifying Property Tax Collection in India." Available at: <https://www.geospatialworld.net/article/gis-simplifying-property-tax-collection-in-india/>

69 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

70 Ernst and Young (2016), Tax administration is going digital: Understanding the challenges and opportunities. Available at: [http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/\\$FILE/EY-tax-administration-is-going-digital.pdf](http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/$FILE/EY-tax-administration-is-going-digital.pdf)

71 OECD (2017), Technology tools to tackle tax evasion and tax fraud. Available at: <https://www.oecd.org/tax/crime/technology-tools-to-tackle-tax-evasion-and-tax-fraud.pdf>

72 Uraia, The impact of smart technologies in the municipal budget: Increased revenue and reduced expenditure for better services. 2016

Technologies with the potential to transform PFM

- **Allocating public spending more efficiently and deliver services more effectively.** Delivering services to citizens is at the heart of what governments do, and the public trust in government depends on the quality of these services. Sound PFM systems optimize technical and allocative efficiencies by ensuring that public spending is targeted, and programs are delivered in the most effective and cost-efficient manner. Technologies can help transform the efficiency of government delivery of services and spending. Examples include the use of **biometrics** to address absenteeism in the public sector and the use of (government-to-government) **G2G digital payments** for salary payments, which greatly improves the accuracy of payments, as well as the convenience to the recipient to access the funds.

One application that has yielded significant impact is **digital G2P payments**, which can help governments improve targeting and reach of social transfers, both amongst the general population and within the family themselves; moreover, they reduce allocation inefficiencies connected with indirect (price) subsidies - where citizens with varying income levels receive the same level of subsidies. In Kenya, the World Food Program found that the costs of delivering electronic cash payments to food insecure households in Kenya was 15 percent cheaper than in-kind distribution.⁷³ In Brazil, “Bolsa Familia” digitized and consolidated various cash-transfer programs and managed to deliver 80 percent of benefits to the poorest quartile of the population, versus the previous share of 64 percent.⁷⁴ In Niger, evidence from a social transfer program shows that replacing cash with mobile payments increased the level of privacy and control of female recipients, tilting the balance of intrahousehold decision-making in their favor.⁷⁵ ⁷⁶ Another application that has considerably improved spending efficiencies is the use of **digital payroll and human resources systems**. Nigeria has already saved US\$ 1 billion over the last decade from an Integrated Personnel & Payroll Information System which removed 60,000 “ghost” workers.⁷⁷ Another area of opportunity is applying GIS technologies to government spending. For example, the Indian government used data from a multi-layered GIS platform to investigate fraud around welfare payments.⁷⁸ While the implementation of the program is still relatively nascent, its initial impact is encouraging.

Among other things, it led to a 20 percent reduction in cooking gas subsidies that residents fraudulently obtained.⁷⁹

- **Reducing corruption in public procurement.** Public procurement is one of the government activities most vulnerable to corruption and remains a serious concern for many low-income countries, both at the

73 CGAP (2013). World Food Programme's exploration of the in-kind to e-payments shift for food assistance in Kenya.

74 Lindert K, Linder A, Hobbs J, and Briere B (2007). “The Nuts and Bolts of Brazil's Bolsa Familia Program: Implementing Conditional Cash Transfers in a Decentralized Context.” SP Discussion Paper 0709, World Bank, Washington, DC

75 Aker J, Boumniel R, McClelland A, and Tierney N (2013). “How Do Electronic Transfers Compare? Evidence from a Mobile Money Cash Transfer Experiment in Niger.” Tufts University Working Paper. Retrieved at: <http://docplayer.net/53281481-How-do-electronic-transfers-compare-evidence-from-a-mobile-money-cash-transfer-experiment-in-niger.html>

76 There is a wide amount of literature demonstrating that, at a family level, money management in the hands of women (versus men) is associated with larger improvements in child health and larger expenditure shares of household nutrients, health, and housing. See, for example: Duflo E (2012). Women Empowerment and Economic Development. *Journal of Economic Literature* 50(4), pp.1051–1079.

77 Effective Institutions Platform (2015). A study of peer learning in public sector reforms. Available at: https://www.effectiveinstitutions.org/media/Peer_learning_study_final_p5v07OO.pdf

78 The DBT programme was launched in India in 2013. It aims to transfer various government subsidies directly into the bank accounts of recipients to reduce leakages and delays. More information: <https://www.geospatialworld.net/blogs/for-financial-inclusion-india-strikes-up-direct-benefit-transfer-through-gis/>

79 Roy R and Rai S (2017). “Fiscal Policy Consequences of Digitalization and Demonetization in India.” Chapter 11 of Gupta S, Keen M, Shah A and Verdier G (eds), *Digital Revolutions in Public Finance*. International Monetary Fund.

Technologies with the potential to transform PFM

national and subnational levels resulting in limited market competition. Some relevant technologies that could address corruption risks in public procurement include e-procurement systems, fiscal transparency portals, and smart contracts on blockchain networks. E-procurement systems have been found to increase transparency and the number of bidders, resulting in higher quality public purchases and lower costs. For example, after implementing e-procurement systems, the average number of bidders for each tender rose from 2.3 to 7.7 in Albania; from 1.8 to 2.1 in Georgia; and from 3 to 4.5 in Andhra Pradesh in India.⁸⁰ E-procurement processes can also help eliminate unnecessary documents, improve communication with suppliers, and lead to faster decision-making. Fiscal transparency portals improve transparency by enabling the public access to government revenue and expenditure information. An emerging technology with high potential impact is the use of smart contracts on blockchain networks to ensure that public transactions and agreements are properly authenticated, and that all transaction history is traceable, transparent, and irreversible.

- **Ensuring institutional accountability.** Strong PFM systems can result in higher transparency as they promote accountability by requiring governments to produce comprehensive, timely and accurate financial reports to allow for meaningful internal and external auditing. Technologies can help transform accountability through better reporting and auditing standards, and many of the abovementioned technologies can also help to increase transparency by raising the quality and access to information. However, it is also clear that there are limits to what technology can do, and a fundamental shift in mindsets, motivations and actions across public sector entities, underpinned by strong political will at the highest level, is required to cultivate strong institutional accountability. Some examples of technologies that apply in this area include commercially available audit software commonly known as **Computer Assisted Audit Tools and Techniques (CAATs)**, and accounting software that helps to standardize (or convert, say from cash-based to accrual accounting) classification formats and accounting rules to enhance reporting speed and standards.⁸¹ **Mobile applications** that give individuals an avenue to whistle blow and provide feedback are also developed to strengthen the monitoring and evaluation of public spending. While not prevalent in government yet, industry experts are excited by emerging technologies such as **blockchain**, which potentially has game changing impacts on transparency and accountability across functions such as data recording, accounting and auditing. Moreover, blockchain is also estimated to potentially halve recording costs of transactions by moving paper-based recording systems to a public blockchain (distributed ledger).

⁸⁰ Asian Development Bank (2013). E-Government Procurement Handbook.

⁸¹ Although accounting software can help to standardize accounting formats, it still fundamentally requires the country to go through the formal adoption (through legislation) of new accounting and reporting standards, such as accrual accounting. This, in itself, is not an easy task. Considerations include political pushback and the lack of technical expertise to understand, apply and interpret new standards, which can be counterproductive.

3

Making it happen: lessons learnt on capturing PFM opportunities



Making it happen: lessons learnt on capturing PFM opportunities

PFM reforms are littered with examples of an inability to capture the large potential gains initially envisaged. In order to better understand what it takes to capture the technology opportunities, this chapter draws on five case studies of different technological applications. Each case study explores the key requirements for successful implementation and the relevant lessons for low-income countries. The good news is that our analysis shows that the typical challenges faced are able to be overcome with thoughtful policy design.

Five case studies were chosen to better understand how to capture the technology opportunities in PFM

In order to understand how to capture the potential technology benefits in each of the PFM concern areas, a number of technology applications were explored in further detail through case studies, examining typical challenges faced in implementation and how countries have overcome those challenges. The case studies were selected based on several criteria:

1. **Relevance to PFM concerns.** The PFM technologies should have a good coverage of the five areas of PFM concern.
2. **Potential for significant impact.** The technology applications have proven impact in previous reforms or high potential to achieve impact (for applications that are still uncommon in PFM reforms) in a low-income country context.
3. **Limited exploration to date.** The technology applications have not been thoroughly explored in the past literature.

Based on these criteria, five PFM technology applications were selected for case studies:

1. Geographic Information System (GIS) adoption for increasing property tax revenues;
2. E-procurement adoption;
3. Big data analytics capability for identifying tax fraud and evasion;
4. Digital government-to-person payments; and
5. Blockchain for enhancing auditing.

Making it happen: lessons learnt on capturing PFM opportunities

In each case study, the potential benefits of the technology for addressing PFM concerns was explored, as well as the different levels to adoption based on the specific states of readiness of a country, and relevant lessons applicable to low-income countries.

Readiness framework helps to countries prioritize policies based on context

This report applies a “readiness framework” that is useful to help low-income countries understand what technological opportunities may be most appropriate for them to adopt to improve PFM functions given their current context; and also, the policy priorities for them to ensure the most impact in their given state of readiness and to transition to the next state of readiness.

In general, countries can be categorized under three broad states of readiness to use a particular technology efficiently: pre-readiness, basic readiness, and advanced readiness. The level of sophistication of technological use increases with the state of readiness of a country. In other words, a country’s state of readiness will dictate its ability to both broaden and deepen the use of technology to achieve the highest possible impact. In each state of readiness, there is a list of policy priorities that countries must tackle before transitioning to the next state. For example, in “pre-readiness”, these are the priorities for a low-income country to maximize the benefits to PFM in the state of readiness. To transition to the next state of readiness, low-income countries should then consider the list of policy priorities in the “basic readiness” stage (i.e. the next stage of readiness).



Geographic Information System (GIS)



Technological group: *Identification and recording technologies*

Key PFM concerns addressed: *1. Aligning budgets with policy priorities; 2. Improving tax compliance and 3. Allocating public spending more efficiently and deliver services more effectively*

The problem with tax fraud and evasion in low-income countries

Tax fraud and evasion is a global phenomenon. However, it is more prevalent in low-income countries due to their comparably low tax bases, higher borrowing costs, and gaps in monitoring and enforcement mechanisms. Inefficient tax collection is particularly common in low-income countries that have decentralized their fiscal systems in recent years.⁸²

This case study focuses on the use of technology to tackle fraud and evasion around property taxes – a core, but often underutilized source of revenue in many local jurisdictions across developing countries. McCluskey and Franzsen (2013) find that in many cities, property taxes raise over 20 percent of total revenues (including transfers from federal government) and an even larger share of local tax revenues. For example, money raised from property tax accounts for more than half the total tax revenue in South Africa’s Durban (55 percent) and in Manila, the capital of the Philippines’ (54 percent). In Malaysia’s capital, Kuala Lumpur, they make up almost the entire local tax revenue (93 percent).⁸³

Yet their revenue potential is far higher. Many municipalities in the developing world fail to capture a large number of properties and struggle to achieve collection rates above 20 percent.⁸⁴ These municipalities find it difficult to implement property taxes due to inaccuracies and gaps in cadastral databases, which contain essential data such as land value, land titles and ownership, building characteristics, but are often infrequently updated.⁸⁵ Uncertainty over tax liabilities is another hurdle in developing countries where sometimes more than half of a city’s population lives on land where title is unknown or disputed.⁸⁶

82 This is characterized by the shifting of revenue responsibilities to local governments.

83 McCluskey M and Franzsen R (2013). Property Taxes in Metropolitan Cities. Lincoln Institute of Land Policy

84 Jeremani E Presentation: Use of GIS in Revenue Enhancement. Kinondoni Municipal Council.

85 Sepulveda C and Martinez-Vazquez (2012). Explaining property tax collections in developing countries: the case of Latin America. Georgia State University.

86 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

How could technology address this problem?

A Geographic Information System (GIS) can be described as a computerized database that is designed to work with data referenced by spatial or geographical coordinates.⁸⁷ It has the capacity to interrelate data sets and contains tools to assist in the capture, storage, analysis and presentation of results.⁸⁸ A well-functioning GIS allows users to regularly update and assess all kinds of spatial property information, including ownership, building characteristics, land titles, business permits, traffic flows, services distribution, and income distribution. Consumers in low-income countries are rapidly embracing geospatial technology (for example, using Google Maps to find the best way to work), and governments have begun to catch up. Public sector adoption of GIS is growing, partly driven by fast-changing demographics that increase the need for both central and local governments to better understand the territorial dynamics required for efficient decision-making.⁸⁹

There is evidence that GIS enhances local property tax revenues by helping authorities to identify taxable properties and collect taxes more effectively. GIS applications can also improve non-tax revenues and other benefits related to public financial management (PFM). Benefits include:

- **Expanding the tax base and detecting tax evasion.** GIS can be used to optimize the collection of various local taxes.⁹⁰ These include value-added taxes (where are these goods and services sold?), excise taxes (where are these goods manufactured?), income taxes (where is the income earned?), and property taxes (where is the building located?).

The most common and impactful application for GIS would be to recover property taxes. However, GIS could also be used to improve the collection of related taxes (e.g. land value taxes), which residents in

87 Star J and Estes J (1990). *Geographic Information Systems: An Introduction*. Englewood Cliffs: Prentice Hall.

88 Ajala, D.O. (2000). Application of Geographic Information System (GIS) in the urban and regional planning. *Journal of the Nigerian Institute of Town Planners*. Vol. XIII

89 Uraia (2016). *The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services*. Uraia Nicosia Guidelines 2016.

90 Pens J (2009). *Geographic Information Systems: Pinpointing Lost Revenues*. Government Finance Review



Geographic Information System (GIS)

developing cities often fail to pay because of missing or disputed land and building permits. For example, many municipal governments in India have begun to use GIS and geocoding in surveys to improve the mapping, identification, and traceability of properties. The updated property data strengthens the ability of tax authorities to conduct tax assessments. Outcomes have been encouraging. For example, GIS mapping allowed authorities in the Indian city of Kanpur to increase the annual revenue from house taxes by more than three times compared to the previous collection system.⁹¹ In Cartago, Costa Rica, the use of GIS to update fiscal cadastres helped authorities identify fraudulent tax declarations. As a result, local collection revenues soared by more than 300 percent over 10 years, more than offsetting the cost of implementing the new technology.⁹² A feasibility survey for Kenya's capital Nairobi shows that GIS technology could help local authorities significantly improve collection rates in parts of the city where up to 98 percent of land parcels still owed tax.⁹³

There is also evidence that tax authorities can improve their audit capabilities when complementing GIS technology with satellite imagery. For example, tax fraud investigators in Greece used satellite photographs of Athens' affluent suburbs to locate country villas, swimming pools and properties, and found that there were five times more swimming pools than those declared.⁹⁴ This resulted in more effective income and property audits which helped the government claw back EUR1.8 billion in taxes and fines over six months. Similarly, the use of satellite imagery and GIS assisted tax authorities in Buenos Aires to uncover new constructions and undeclared housing upgrades that carried tax liabilities⁹⁵, while also detecting tax fraud in 20,000 farming establishments which have under-declared harvests worth over ARS150 million in evaded stamp duties.⁹⁶

- **Strengthening non-tax revenue collection.** GIS can also be used to optimize the collection of non-tax revenue, including fines, traffic tolls and license fees. Authorities in Cartago, Costa Rica, have switched to an automated system that integrates the city's GIS with a mobile application to issue parking and transit fines in real time. Details of parking infractions and fines are uploaded directly onto the GIS, limiting the likelihood of fraud, tax evasion and corruption. Results are encouraging: in just one year, the number of appeals declined from 72 to 18, the productivity of inspection agents went up 45 percent, and the revenue from traffic fines more than doubled.⁹⁷

Tax authorities in Singapore and Austria analyze GIS data to determine the amount and frequency of road tolls in congested traffic. Authorities also use GIS to bundle an array of person-to-government (P2G) payments in a bid to increase the payment morale. For example, authorities in the Indian city of Bhopal

91 Kumar R (2012). "GIS Simplifying Property Tax Collection in India." Available at: <https://www.geospatialworld.net/article/gis-simplifying-property-tax-collection-in-india/>

92 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

93 Presentation by Kihungu N (2009). "Using GIS to analyse land rates tax payment data". Available at: <http://geospatial.uonbi.ac.ke/sites/default/files/cae/engineering/geospatial/Njambi%20Presentation.pdf>

94 Steinvorth D (2010). "Finding swimming pools with Google Earth. Greek government hauls in billions in back taxes." Available at: <http://www.spiegel.de/international/europe/finding-swimming-pools-with-google-earth-greek-government-hauls-in-billions-in-back-taxes-a-709703.html>

95 News24 (2007). "Google Earth 'uncovers fraud'." Available at: <https://www.news24.com/SciTech/News/Google-Earth-uncovers-fraud-20070720>

96 Buenos Aires Herald (2014). "ARBA detects tax fraud in 20,000 farms." Available at: <http://www.buenosairesherald.com/article/160406/arba-detects-tax-fraud-in-20000-farms>

97 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

Geographic Information System (GIS)

use GIS to assign a unique property code to all commercial and residential buildings. This enables them to prepare one bill for each address, which includes not just property taxes but also non-tax charges such as water and electricity costs.

- **Enhancing the effectiveness of tax and audit staff:** As a tax audit tool, GIS has proved to reduce duplication of work and increase overall productivity and accuracy. The use of GIS in the US city of Westminster, Colorado, which relies heavily on sales taxes for revenue, allows auditors to verify 2000 times more source data (such as addresses on invoices) per hour to determine if taxes were paid correctly.⁹⁸ Research shows that the benefits of automating such audit tasks in Westminster far exceeded the costs of additional training, software and licensing. Meanwhile, a shift from hand-drawn to GIS-supported digital cadastral tax mapping has improved the accuracy, transparency and timeliness of tax data in the US city of Lake County, Florida.⁹⁹
- **Increasing transparency and accountability of tax authorities:** Door-to-door tax collection by public officials remains a feature in many low-income countries. However, the process is fraught with inefficiencies and prone to fraud, corruption and bribery, and GIS systems can help to counter those risks. For example, the Quezon province in the Philippines reported that the application of GIS to digitize land and property records has increased checks and balances in its taxation system, and greatly reduced the scope of individual discretion throughout the assessment to payment cycle.¹⁰⁰ In the Netherlands, where property taxes typically account for around one-sixth of local budgets, a GIS-enabled website has helped to boost the willingness of taxpayers to pay because it offers transparency. The site publicly lists the value of any privately-owned property in the country, essentially turning information on property taxes into a public good.¹⁰¹

Improving the productivity of public spending and service delivery: GIS can help governments allocate funds for public services more efficiently. For example, the Indian government used data from a multi-layered GIS platform to investigate fraud around welfare payments.¹⁰² While the implementation of the program is still relatively nascent, its initial impact is encouraging. Among other things, it led to a 20-percent reduction in cooking gas subsidies that residents fraudulently obtained.¹⁰³ Similarly, the use of GIS analysis in Italy helped to curb the amount of subsidies paid to farmers who deliberately overdeclared their land holdings in order to receive more money.¹⁰⁴ Authorities in Latvia also successfully used GIS to improve the mapping of more than 300,000 land parcels and their subsidy needs.

98 Pens J (2009). Geographic Information Systems: Pinpointing Lost Revenues. Government Finance Review.

99 Lake County Florida. GIS Collaborates with the Property Appraiser to create Digital Tax Maps.

100 Quezon City Government (2007). Quezon City: Competing on Strength, 2005–2006.

101 Reimerink L (2016). "How the Netherlands turns transparency with property values into trust with taxpayers." Available at: <http://citiscopes.org/story/2016/how-netherlands-turns-transparency-property-values-trust-taxpayers>

102 The DBT programme was launched in India in 2013. It aims to transfer various government subsidies directly into the bank accounts of recipients to reduce leakages and delays. More information: <https://www.geospacialworld.net/blogs/for-financial-inclusion-india-strikes-up-direct-benefit-transfer-through-gis/>

103 Roy R and Rai S (2017). "Fiscal Policy Consequences of Digitalization and Demonetization in India." Chapter 11 of Gupta S, Keen M, Shah A and Verdier G (eds), Digital Revolutions in Public Finance. International Monetary Fund.

104 The difference between the area declared for subsidies and the actual landholdings declined from 9 percent to just 2 percent in a few years since GIS was introduced to clamp down on fraud. See: Longley P, et al. (2001). Geographic Information Systems and Science. John Wiley & Sons

Geographic Information System (GIS)

GIS can also be used for strategic budgeting. Given that an estimated 90 percent of government data includes a spatial component, it is unsurprising that GIS has been an integral tool for city planning and the strategic allocation of developmental funds.¹⁰⁵ Interviews with GIS practitioners indicate that the technology can improve the quality of analysis and help governments, both locally and on the national level, to increase the robustness and productivity of their spending and investment proposals. Health authorities commonly use GIS to evaluate the costs and benefits of building public hospitals at different locations.¹⁰⁶ While the level of analytical sophistication differs across countries, the use of GIS has made these budget decisions more efficient and data driven.

What are the states of readiness to adopt the technology?

There are three broad states of readiness to utilize GIS adoption: pre-readiness, basic readiness, and advanced readiness (Exhibit 6). A country's state of readiness will dictate its ability to successfully adopt the technology at different levels of sophistication. A country must fulfil the enabling requirements in its state of readiness to have the highest chance of successful implementation at the corresponding level of adoption.

Countries in the "pre-readiness" state do not have many of the key enabling conditions in place to make use of GIS and may need to first focus on more traditional approaches while putting in place a set of basic reforms to reduce tax fraud and evasion; those in the "basic readiness" state can start to explore some basic use of GIS; and the countries in the "advanced readiness" state have the opportunity for advanced and integrated use of GIS across government to systematically track property tax fraud and evasion.

To effectively fight tax fraud and evasion using GIS, there is a specific set of enabling conditions that countries must fulfill in each state of readiness (Exhibit 6). These enabling conditions are additive – in other words, a country in the advanced state of readiness may reap the full potential of GIS only when it satisfies the key requirements in all three states. The higher the degree of fulfilling these requirements, the higher the likelihood of positive outcomes in each state.

105 Robinson M (2008). A History of Spatial Data Coordination. Federal Geographic Data Committee.

106 Shaw N (2012). "Geographical Information Systems and Health: Current State and Future Directions." Healthcare Information Research. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3402560/>

Exhibit 6

There are three states of readiness in Geographic Information System (GIS) adoption for increasing property tax revenues



Key requirements

- Cadastre registry in place
- Simple and feasible way to assess property value
- Fiscal autonomy at local level to carry out tax policies
- Improved legal framework for collection (e.g. exemption policies, stricter enforcement)
- Raise public trust via education
- Technical guidance from federal government as required
- Funding for hardware, software & related infrastructure
- Technical skills in Ministry of Finance and budget office (includes tech transfer)
- Cultivate data-driven culture
- Credible land and property surveys
- Data & classification standards
- Ease of use; proof of increased convenience and productivity
- Legislative support
- Additional infrastructure for mobile (e.g. devices, wireless)
- Conducive environment for data exchange (e.g. interoperability of public GIS systems)
- Skills to integrate and analyze multiple datasets
- Attract and retain GIS talent
- Open access to the public to increase trust

Country examples

-  Congo, Democratic Rep.
-  Burundi
-  Myanmar

-  Tanzania
-  Kenya
-  Indonesia

-  Singapore
-  India
-  Latvia

Geographic Information System (GIS)

Pre-readiness describes the state where a country does not have the key enabling conditions to make use of GIS technology, and instead more basic reforms are required to improve tax collection efficiency. The failure to acquire all the requirements in this state is key to why some countries generally failed when attempting some initial stage of GIS implementation (Myanmar is a good example). For countries in this state, there is usually a strong distrust between property owners and the tax office. Property owners who receive a tax bill are typically highly reluctant to pay it, while authorities typically lack systematic ways to identify and calculate tax liabilities. Enforcement is generally weak and in some cases non-existent. Some basic reforms are needed before countries in this group can deploy GIS technologies. First, a basic cadastre registry (with core data such as property titles) must be put in place. Second, an efficient and consistent way of valuing properties must be established. Third, the fiscal incentives of a decentralized government system must be aligned. In other words, if local governments are responsible for tax collection, they must equally be afforded some degree of fiscal autonomy over their expenditure.

Basic readiness describes the state where a country has the enabling conditions to successfully use some basic applications of GIS to meet limited, often siloed objectives (such as collecting data to track a building's footprint for tax purposes). There are a few features that characterize "basic usage". For example, attribute data of buildings and their related demographics are often built from scratch by sending land and property surveyors onsite to conduct physical checks and interviews, a process that can take many months or even years in some cases, depending on the coverage and depth of the surveys. In most cases, data collected has to be manually entered into the GIS via spreadsheets. The completed map will contain simple two-dimensional vector graphics, such as polygons that are representative of the actual physical landscape. Simple data analysis is used to calculate metrics such as percentage of buildings with unpaid taxes, late payments, tax effort and so on.

Based on a wide range of literature and expert interviews, we briefly discuss some of the key enabling conditions that countries need to fulfill to be considered ready in this state (Exhibit 6). They include requirements that are GIS implementation-specific and those that are specific to reducing property tax fraud and evasion:

- **Sufficient funding:** The shortage of funding has been widely described as a key obstacle to successful GIS implementation, especially at the local government level.¹⁰⁷ In general, funding can be grouped into direct and indirect costs, with direct costs relating to the price of the software and data acquisition. Indirect costs include training and a host of other costs linked to data creation, and depending on the type of data required, can include infrastructure and hardware such as better power supply, network connectivity and data centers. To be sure, the direct costs of GIS implementation are easier to estimate and need not be prohibitive. While care must be taken to compare costs of different project implementations due to inherent differences in scope, the Cartago programme was estimated to cost

107 Das A (2010). "South Africa: On a growth path with GIS." Available at: <https://www.geospatialworld.net/article/south-africa-on-a-growth-path-with-gis/>

Geographic Information System (GIS)

the government only about US\$600,000 (implying a very positive return on investment in annual terms¹⁰⁸), while the Kansas GIS Policy Board estimated that it spent a total of US\$2.2 million to develop a shared database of geographically-related information and to coordinate the use of that information among State, Federal, and local agencies.¹⁰⁹ Conversely, the indirect cost of GIS implementation is less uncertain and depends heavily on the existing conditions. For example, data creation and maintenance is likely to be costlier in low-income cities where spatial data and expertise is typically scarce. Further funding challenges arise because the costs to set up GIS infrastructure typically outweigh the immediate benefits of using GIS applications. These benefits only materialize in the longer term.¹¹⁰

- **Effective knowledge and technological transfer:** There is often a shortage of skilled GIS personnel in low-income and even more advanced countries which is compounded by the significant competition for the limited pool of available talent from the private sector.¹¹¹ The need to invest in quality training is a fundamental requirement for successful GIS implementation. Solution vendors and international consultants would need to be willing to transfer specialist knowledge to help increase the local talent pool. Unfortunately, the latter is often a challenge because of institutional arrangements whereby projects are funded by development agencies and are left uncompleted (so is the transfer of knowledge and technology to the recipient country) after funding ends.¹¹² Moreover, GIS training in higher learning institutions is often inadequate due to low demand, given the perception that GIS is not typically seen as a viable career choice.
- **Data-driven culture:** The core function of GIS is to improve the collection, storage and transmission of data to improve decision making in government. However, GIS can only be implemented successfully if decision-makers act on the basis of robust evidence and facts, rather than human discretion. Unfortunately, with the exception of isolated government agencies in some countries, a data-driven culture is still quite rare in most developing countries.
- **Credible land and property surveys:** Significant challenges to data collection and reporting can complicate the implementation of GIS in low-income countries. For example, building and land surveyors in developing countries may not be competent. In some cases, they may have been bribed to misreport findings. Interviews also reveal that it is not uncommon for tax personnel to be treated with hostility by property owners, making it difficult for them to collect the necessary data.

108 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

109 Silva E (1998). "Cost-Benefit Analysis of Geographic Information System. Implementation Justification. Available at: <http://gisweb.massey.ac.nz/topic/webreferencesites/Nature%20of%20GIS/CBA%20summary.htm>

110 Bishop I, Escobar F, Karuppanan S, Suwarnarat K, Williamson P, Yate P, Yaqub H (2000). Spatial Data Infrastructures for Cities in Developing Countries: Lessons from the Bangkok Experience. Cities 17 (2)

111 Raper J and Green A (1992). Teaching the Principles: Lessons from the GISTutor Project. International Journal of Geographical Information Systems.

112 Sahay S. and Walsham G (1997). Using GIS in developing countries: Social and Management Issues. UNIDO Publications: Vienna.

Geographic Information System (GIS)

- **Data and classification standards:** In low-income countries, properties are frequently misclassified, which can lead to erroneous tax assessments. Standards to classify, collect and manage property data are often inconsistent, which increases the likelihood that property owners misrepresent information to evade tax obligations. For example, the scale of base maps often varies, particularly where maps are hand-drawn without enforced guidelines. Such differences in detail can affect the accuracy of tax assessments.

Advanced readiness describes the state where countries have the enabling conditions to undertake advanced and integrated usage of GIS across government. Advanced implementation of GIS enables different government entities to seamlessly share data and analyses. Such coordination can lead to much more precise policy action to track property tax fraud and evasion. For example, one government department may have obtained and uploaded new labor market and other socio-economic data onto a centralized GIS server. The tax department could then incorporate the new data into their tax maps by geotagging relevant attribute data that allow auditors to more accurately detect tax fraud or evasion. Another feature of this advanced usage is the higher speed and quality of data collection. For instance, surveyors can use mobile GIS devices to update the database in real time if they spot a change in housing conditions or building modifications. The use of detailed satellite scans and other high-tech imagery could also be overlaid onto base maps, creating powerful visualization tools to help enhance the precision of property tax audits.

We briefly discuss some of these key enabling conditions, summarized in Exhibit 6, for countries to be considered ready in this advanced state:

- **Legislative support:** To truly succeed with advanced and integrated use of GIS technology, a country needs to invest a significant amount of money, time and effort. It needs to enhance its mobile and internet networks to allow for timely updates of GIS data and to improve public access. Integrated GIS technology cannot be put in place without the explicit backing of high level policymakers. Legislative support is particularly critical in relation to data and privacy laws, procurement of equipment, supplementary budgets, and the creation of specialized departments.
- **Collaboration between government departments:** A collaborative environment is a crucial prerequisite for the seamless sharing of data as part of an integrated GIS. However, reformers often meet strong resistance to collaboration between government departments.¹¹³ Interviews with GIS experts reveal a sense of bureaucratic protectionism particularly in low-income countries, resulting in significant limitations over where and how official data is utilized across government. This unwillingness to allow data to be scrutinized by other departments is sometimes the result of cultural norms. At other times, it is the result of heightened precaution to prevent potential data inaccuracies from spreading or because there is simply no official cooperation and data sharing mechanism in place. Countries need to overcome such hurdles if they want to target tax fraud and evasion in a more integrated way using GIS.¹¹⁴

113 Uraia (2016). The Impact of SMART Technologies in the Municipal Budget: Increased Revenues and Reduced Expenses for Better Services. Uraia Nicosia Guidelines 2016.

114 Kshetri N (2016). Big Data's Big Potential in Developing Economies: Impact on Agriculture, Health and Environmental Security. CABI

Geographic Information System (GIS)

- **Integration of public IT systems:** The integration of GIS with existing public systems is necessary to improve the overall functionalities of computer-based systems in government. For example, authorities can get real-time payment updates if they combine GIS-enabled property tax maps with payment modules of traditional IFMIS in one interface. This can increase their success in tracking property tax fraud and evasion.
- **Attraction and retention of GIS talent in public service:** A critical mass of skilled GIS users is needed to successfully implement an advanced and integrated system to reduce tax fraud and evasion. However, interviews reveal tax authorities in low-income countries often have difficulties in retaining GIS talent, as better career prospects and remuneration entice skilled people to work in the private sector. Leddy and Fuller (1996) found attrition rates of public servants with just moderate level of GIS skills were high in the Philippines.¹¹⁵

What does this mean for low-income countries?

Our review of the literature and interviews shows that some low-income countries have successfully used GIS to reduce tax fraud and evasion and improve public revenues. At the same time, there are also instances where the use of GIS has yielded little impact because technological reforms were poorly implemented, put on hold, and eventually even scrapped.

Based on the three states of readiness outlined in Exhibit 6, **most low-income countries would lie somewhere between “pre-readiness” and “basic readiness”**. However, **getting to advanced and integrated GIS usage is beyond the reach of most low-income countries at this point of time** – largely because they lack relevant infrastructure and critical skills. That said, advances in technology and open-source applications suggest costs for GIS will decline further in the future. Given strong existing evidence that GIS can lead to higher tax revenues, tax offices in low-income countries are well advised to work towards acquiring the key enabling conditions that will allow them to fully reap the projected benefits in their respective states of readiness.

We highlight several relevant lessons for low-income countries that are derived from the experiences of other countries and expert interviews:

- **Don't rush towards a fully integrated database.** Considering the implementation challenges, it is inadvisable for low-income countries to be overly ambitious and rush towards a fully integrated GIS system. Strategic databases targeted at specific problems can lead to significant benefits at much lower costs and have a much higher probability of successful implementation. Bangkok's experience in shifting to a GIS-supported tax system offers valuable insights. Teams from several government entities were put together to undertake the Bangkok Land Information (BLIS) project but quickly realized that it was very difficult,

115 Leddy, M and Fuller J. (1996). Assessment of the use of geographic information systems for spatial presentation and evaluation of USAID/Manila's environmental office programs. Washington, DC: U.S. Bureau of the Census.

Geographic Information System (GIS)

expensive and time consuming to create a common database. The teams took the decisive move to pursue their own databases but maintained strong collaboration in various government committees concerned with GIS technology – ensuring that they had a voice in the overall direction of GIS adoption and were at the forefront of developing regulations and standards that will be important for the longer term aims of having much more connected and collaborative systems.¹¹⁶

- **Be clear on the objectives and the critical data required.** It is essential to have clear objectives and a realistic plan when using GIS to achieve specific tax revenue targets. This can significantly reduce both the time and cost of data collection. It is important to distinguish core data from data that is less crucial. For example, core data to improve the assessment of land and property taxes could include the building type and tenure, the name of the owner, household size, location, and the number of floors; while data such as gender split, size of water pipes, and ease of access to public goods may not be as important.
- **Change the mindsets, not just the skills.** A recurring theme, particularly in low-income countries, is resistance to new technology due to a lack of technical skills and fears that machines might replace the majority of human workers. GIS technology is no different and recommendations of building simple, user-friendly systems, and to provide sufficient staff training apply. On-the-job training can equip employees with the necessary skills and lower their resistance, but a mindset change is equally important. One way to help staff embrace technological change is to use phased roll-outs and emphasize the convenience and increased productivity of new technology. An alternative is to publicly reward staff for increased productivity linked to GIS. For example, tax audit staff could be given a bonus for each case of property tax fraud they uncover using GIS.
- **Require technology providers to provide ongoing training.** A key challenge in implementing GIS technologies is the capability transfer between technology providers and government staff. The GIS implementation in Belo Horizonte, Brazil, is considered a successful case study in this area. Local provider Prodabel developed the city's new GIS system. Instead of relying on international technology transfer, Prodabel established and refined its expertise over time, and customized solutions based on the exact requirements of the municipal administration it is serving.¹¹⁷ The company set up a separate organization to serve different government departments, providing on-demand technical assistance and training. This allowed it to give departments the necessary confidence to integrate GIS into their existing work.
- **Improve traceability using unique property identification.** Once properties have been mapped with the help of GIS, authorities can tag them with unique identification numbers to facilitate the geo-referencing of data (such as tax liabilities, owner's name). This allows for easier and more timely updates of information in the GIS database. In Sierra Leone and Malawi, data collectors on field trips paint identification numbers onto buildings as a visual reference for document delivery, and to identify specific taxable buildings.¹¹⁸

116 Bishop I, Escobar F, Karuppnanan S, Suwarnarat K, Williamson P and Yate P, Yaqub H (2000). Spatial Data Infrastructures for Cities in Developing Countries: Lessons from the Bangkok Experience. *Cities* 17 (2)

117 Sahay S (2010). "GIS implementation in a Brazilian City: Lessons for developing countries." Available at: <https://www.geospatialworld.net/article/gis-implementation-in-a-brazilian-city-lessons-for-developing-countries/>

118 Fish P (2015). "Practical aspects of mobilising property tax: experience in Sierra Leone and Malawi." *Commonwealth Journal of Local Governance*. Available at: <http://epress.lib.uts.edu.au/journals/index.php/cjlg/article/view/4591/4920>

Geographic Information System (GIS)

- **Take advantage of new technology to collect better data.** Rapid technological innovation has increased options for low-cost data collection. Raster images have long been used to estimate attribute data such as population numbers.¹¹⁹ While these techniques were not very accurate in the past due to low quality images, remotely sensed and scanned images of very high resolutions are now much cheaper and accessible, making them a more useful data source. A project, led by the World Bank, used drones to identify land plots in Albania and successfully contribute to property rights reforms in the country. Combining such technologies with free open-source software can help to produce accurate and cost-effective maps that include updated ownership information for the registration of land and property rights.¹²⁰
- **Alleviate taxpayer anxiety through effective communication.** Property taxes are often the subject of contentious debate across the world and the use of GIS as a tracking device may further agitate those tensions. Constant dialogue with taxpayers is important to alleviate potential privacy concerns over the collection of their personal data. Authorities could highlight the benefits of GIS, including increased transparency and information for property buyers. Governments could also educate taxpayers on the rationale behind property taxes as an important tool in municipal management. Sierra Leone has begun to use GIS techniques in several regions to improve the collection and enforcement of property tax. In an example for effective communication, Council officials had to involve local chiefs – traditional authorities who command respect in their communities – to gain the acceptance of the people.¹²¹

119 Raster images are created using pixel-based programs or captured using cameras or scanners. They are stored as image files including JPEG, PNG, BMP etc. See also: Webster C (1996). The Potential of Urban Texture Measures in Monitoring Urbanisation from Space, GIS in Asia, Asia GIS/LIS, AM/FM and Spatial Analysis Conference. GIS Asia Pacific Hong Kong Geographic Association.

120 Kelm K. Using Geo-spatial Data to Secure Property Rights. World Bank Group. Available at: https://olc.worldbank.org/sites/default/files/WBG_BD_CS_GeoSpatial_Data.pdf

121 Fish P (2015). "Practical aspects of mobilising property tax: experience in Sierra Leone and Malawi." Commonwealth Journal of Local Governance. Available at: <http://epress.lib.uts.edu.au/journals/index.php/cjlg/article/view/4591/4920>





E-procurement systems



E-procurement systems

Technological group: *Citizen and business engagement solutions*

Key PFM concerns addressed: *4. Reducing corruption in public procurement*

The problem with public procurement in low-income countries

Public procurement is central to government service delivery and involves large sums of money, with the World Trade Organization (WTO) estimating that it accounts for around 10 to 15 percent of GDP in developing countries.¹²² Unfortunately, public procurement processes in many low-income countries are rife with corruption, which can occur in various forms, including bribery, embezzlement, fraud, and favoritism. The pervasiveness of corruption in public procurement not only causes monetary loss, but can also distort competition and lead to inefficiently priced markets with low-quality products, which could impair government efforts to deliver public services. For example, evidence that senior public officials in Tanzania had been siphoning US\$180 million (almost 3 percent of total government revenues) worth of public funds led international aid donors to withhold critical payments in 2015 and 2016.¹²³ Meanwhile, irregularities in Nigeria's procurement processes reportedly account for over 70 percent of the government's budget.¹²⁴ In South Africa, 60 percent of all tenders were found to be subject to untoward influence.¹²⁵ In India, surveys indicate that 40 percent of firms expect to bribe officials to secure government contracts.¹²⁶

122 World Trade Organization. "WTO and government procurement." Available at: https://www.wto.org/english/tratop_e/gproc_e/gproc_e.htm

123 GAN Integrity (2017). "Tanzania Country Report." Available at: <http://www.business-anti-corruption.com/country-profiles/tanzania>

124 News Agency of Nigeria (2017), "Corruption in procurement makes up 70% of budget, says ex-Minister" Available at: <http://www.nan.ng/news/corruption-procurement-makes-70-budget-says-ex-minister/>

125 Business Tech (2016), "60% of tenders are corrupt in some way: Deputy Public Protector" Available at: <https://businesstech.co.za/news/general/116470/60-of-tenders-are-corrupt-in-some-way-deputy-public-protector/>

126 GAN Integrity (2017). "India Country Report." Available at: <http://www.business-anti-corruption.com/country-profiles/india>



How could electronic procurement (e-procurement) systems address this problem?

An e-procurement system is essentially an integrated, centralized, and internet-enabled information system that automates and integrates all parts of the procurement process in order to improve efficiency, transparency and accountability.¹²⁷ These different procurement processes can be further be split into e-ordering, e-auctioning, e-bidding, e-tendering, e-informing etc.

The digitization of procurement functions has proved beneficial to increase transparency, oversight, and control.¹²⁸ In particular, e-procurement can increase:

- **Competition and quality of purchase.** Providing information of public tenders on the online system increases information access, which reduces information asymmetries between suppliers and procurement officials and can lead to greater competition. For example, empirical research shows that more transparent public procurement processes helped to increase the average number of bidders from 8.2 to 13.7 per tender in Japan.¹²⁹ In Albania, the average number of bidders per tender rose from 2.3 to 7.7, in Georgia it rose from 1.8 to 2.1 in India it increased from 3 to 4.5.¹³⁰

More competition among suppliers can improve the quality of public purchases by facilitating the entry of higher quality suppliers and instilling control mechanisms to ensure quality post-tender award. The latter could be especially relevant for low income countries where contract management is often weak. Lewis Faupel et al (2014) analysed the impact of e-procurement on the quality of contractors in public works using data on Indonesia and India. The authors found that e-procurement improves the average road quality in India and reduces delays in completion of projects in Indonesia.¹³¹

- **Oversight, audit, and overall accountability.** E-procurement systems, which grant interested bidders access to tender documents and related information, allow authorities to spot irregularities (including bid rigging and collusion) more easily. E-procurement systems also help to improve the overall accountability of public financing, serving as an open source of information for rival bidders and relevant stakeholders (e.g. foreign donors, international NGOs) to conduct investigative audits. In addition, conducting the entire procurement process electronically helps to reduce unnecessary contact between stakeholders in stages that are highly susceptible to corruption practices, including conflicts of interest during bid evaluation and contract award, as well as the possibility of accounting and invoicing fraud in the post-award stage.

127 Vaidya K. (2007). *Electronic Procurement in the Australian Public Sector: The Organisational Assimilation Process and Its Impact on Public Procurement Performance*. University of New England.

128 The shortcomings in a country's procurement system is a reflect other PFM failings including weak rule of law, financial compliance and budgetary procedures that have lack of internal controls and proper internal/external audit functions, resulting in issues including tax evasion and misappropriation of public monies.

129 Ohashi H (2009). *Effects of Transparency in Public Procurement Practices on Government Expenditure: A Case Study of Municipal Public Works*. *Review of Industrial Organization*, Vol. 34.

130 Asian Development Bank (2013). *E-Government Procurement Handbook*.

131 Lewis-Faupel et al. (2014). *Can Electronic Procurement Improve Infrastructure Provision? Evidence from Public Works in India and Indonesia*.

E-procurement systems

In Indonesia, surveys found that the country's e-procurement system INAPROC helped to reduce fraud and corruption in public tender processes.¹³² In Albania, the introduction of an e-procurement platform was seen as integral to promoting integrity, uniformity and competition in the country's public procurement processes.¹³³

- **Operational efficiencies and cost savings.** E-procurement systems can help to declutter and speed up bureaucratic decision-making by eliminating redundant and duplicated documents, and by improving communication.

In Albania, switching to e-procurement led to savings of 15 percent of recurrent expenditures in the first year (2009), 12 percent in 2010 and over 20 percent in 2011.¹³⁴ Authorities reported that the elimination of unnecessary documents and direct communication with suppliers shortened the completion of procurement procedures by up to a week.¹³⁵ As a result, both government and businesses saved money. More than 80 percent of businesses surveyed say their costs had declined following the launch of the new online platform.¹³⁶

Brazil has also achieved large efficiency benefits from e-procurement. Brazil's e-procurement system, Comprasnet, was introduced in 2000. Before the implementation of the system, tenders (from publication of tender to final adjudication) took more than four months on average. This was reduced to 20 days after the introduction of online auctions and facilitated the participation of a wider number of SMEs. Furthermore, the federal government saved 4 percent on its purchase of goods and service in the first year of implementation, where just 20 percent of total purchases went through Comprasnet.¹³⁷

132 Aditya W, Dekar U and Faishal A (2017). The Implementation of E-procurement System: Indonesia Evidence. Universitas Islam Indonesia.

133 The European Bank for Reconstruction and Development (2010). Regional Assessment of Public Procurement Legal Frameworks. Available at <http://www.ebrd.com/pages/sector/legal/procurement/assessment.shtml>

134 Public Procurement Agency Albania Annual Reports

135 Kashta R (2012). E-Procurement System in Albania, Impact and Lessons Learned. University of Tirana.

136 Ibid.

137 OECD (2003). Transparency in Government Procurement: The Benefits of Efficient Governance and Orientations for Achieving It. Working Party of the Trade Committee.



E-procurement systems

South Korea also harnessed efficiencies from switching to e-procurement. In 2012, more than 60 percent of its total public procurement worth US\$160 billion was generated through the e-procurement system KONEPS.¹³⁸ According to the Public Procurement Service South Korea (PPS), KONEPS led to public sector savings of US\$1.4 billion and private sector savings of US\$6.6 billion annually. These savings are a result of a decline in corruption and other illegal practices, but also come from the overall improved efficiency of the process. For example, average tender processing times (from receiving the bid to announcing the winner) have fallen from 30 hours to just 2 hours.

What are the states of readiness to adopt the technology?

A country's success in adopting e-systems to improve public procurement processes depends on its state of readiness with respect to the sophistication of the technology it is implementing. Three states of readiness can be distinguished: pre-readiness, basic readiness, and advanced readiness (Exhibit 7). A country must fulfil the enabling requirements in its state of readiness to have the highest chance of successful implementation at the corresponding sophistication of adoption.

The "pre-readiness" state is one where countries do not have most of the key enabling conditions in place to implement e-procurement systems successfully and may need to focus on more traditional approaches to make existing procurement processes more efficient and less prone to corruption while putting in place a set of basic reforms; countries under "basic readiness" have the conditions to explore some limited use of e-procurement technologies; and countries under "advanced readiness" have the opportunity for widespread and integrated use of e-procurement across government entities.

To implement the most efficient e-procurement systems under each state of readiness, there is a specific set of enabling conditions that countries must acquire in their respective states (Exhibit 7). These enabling conditions are additive – in other words, a country in the advanced state of readiness may reap the full potential of e-procurement systems only when it satisfies the key requirements in all three states. The higher the degree of fulfilling these requirements, the higher the likelihood of successful adoption in the respective states.

Exhibit 7

There are three states of readiness in electronic procurement adoption



Key requirements

- Clear and comprehensive legislation (e.g. processes, responsibilities, penalties)
- Basic expenditure control and payment system
- Central agency to manage procurement processes
- Independent audit with powers to enforce penalties
- Basic ICT infrastructure for governments and businesses
- Digital literacy of government and businesses
- Legislative framework for e-procurement that is consistent with public procurement laws
- Sufficient funding to achieve pre-defined objectives
- Change management strategy
- Political support at highest level
- High degree of internet penetration
- Interoperability across government departments and IT systems
- Favorable international trade agreements (e.g. FTAs)

Country examples

 Haiti

 Niger

 Nigeria

 Togo

 Liberia

 Brazil

 Korea

 Turkey

E-procurement systems

Pre-readiness describes the state where a country has so far shied away from adopting the technology, or are in the exploratory phase of conducting feasibility tests. Very often, a country that is still in this state would seek to improve on traditional approaches of procurement that are largely paper-based. The procurement process for countries stuck in this state is likely to be riddled with inefficiencies as information asymmetry allows for discretionary decision-making by procurement officials.¹³⁹ In these cases, countries could yield improvement from very simple actions such as allowing more time between the tender issuance and the award of the contract, posting tender requests and results in traditional media or on public noticeboards, training staff to be more discerning when evaluating tenders, improving administrative efficiencies such as compulsory and standardized filing of receipts for audit purposes, among others. As public procurement is one of many interconnected components within a PFM system, countries need to strengthen the basics of other components such as budget formulation, execution, control and evaluation to achieve sustained improvement in this pathway.

Governments still need to fulfill the enabling conditions shown in Exhibit 7 for any changes to be effective. These conditions include having clear and comprehensive public procurement legislation that sets the appropriate incentives for participants in the procurement process and to reduce ambiguities, having a basic payment system to facilitate settlement of funds (a stable and efficient banking sector is important), centralizing control over procurement processes such as disbursement of cash, having a degree of checks and balances to provide oversight over expenditure (i.e. having a Treasury Single Account arrangement) and developing basic financial literacy and basic accounting/reporting skills in staff.

Basic readiness describes the state of readiness where countries can start to benefit from the adoption of e-procurement systems in a limited to moderate extent. A typical scenario under this stage of adoption would be a phased rollout or pilot program, where only some government departments or some transactions (for example, only tenders over US\$10,000) switch to e-procurement systems.

To be sure, even countries in this state that are considered “model examples” for e-procurement adoption can have a large portion of public procurement that is often not routed through the system. This lack of transaction coverage is a major challenge in most low-income countries. For example, studies noted exemption loopholes in Georgia’s public procurement law, which allows for contracts to be tendered outside the electronic platform¹⁴⁰, leading to 45 percent of total public contracting being conducted through non-competitive means in 2012.¹⁴¹ One PFM expert described a “mismatch of transaction profile” in e-procurement systems in West Africa, where a large volume of small valued transactions are captured by the IT systems whereas the largest transactions are still done outside the platforms.

¹³⁹ One of our interviewees gave an example of a group of suppliers getting into physical altercations outside a government ministry in West Africa over accusations of collusive pricing, as well as more minor issues such as queue cutting.

¹⁴⁰ Huter, M and Chaturian, G (2014). OpenGov Voices: How Georgia is Handling Procurement Transparency.

¹⁴¹ Transparency International Georgia (2013). “Georgia’s E-procurement Platform is One of the Most Transparent in the World but Because of Loopholes, Too Many Contracts Bypass the System.”

E-procurement systems

Countries need to meet some key enabling conditions, also summarized in Exhibit 7, to be considered ready in this state:

- **Basic ICT infrastructure for government and businesses:** It is impossible for countries to digitize the procurement process without a basic level of functioning ICT infrastructure such as computers and internet access. Weak and intermittent network connections, frequent outages and outdated infrastructure (both hardware and software) are common challenges in low-income countries. Heavy capital investments are likely required to overcome these basic IT hurdles. Interviews also reveal that many of these countries struggle to implement e-procurement systems on a broad scale because of large disparities in the quality of national and regional IT infrastructure.
- **Digital literacy of potential users:** A lack of digital skills is a common challenge in low-income countries. Adebayo and Evans (2015) found that more than 70 percent of procurement officials surveyed in Nigeria agree or strongly agree that the lack of skills and knowledge is a key barrier to adopting e-procurement systems more widely.¹⁴²
- **A legislative framework for e-procurement:** Well-defined processes, rules and regulations are needed to guide the implementation of new technologies. Examples of provisions that need to be included are the use of e-signatures in online documents and privacy matters, particularly with the personal data of suppliers. The ideal framework should also have clear targets and timelines, while the legislation should include enforceable sanctions for non-compliance. For example, in Portugal, sanctions for non-compliance include fines for public sector managers who failed to implement new policies, and the voiding of any procurement contracts not formed through the e-procurement system.¹⁴³
- **Sufficient funding to achieve pre-defined objectives:** Surveys in both Nigeria and Kenya reveal that insufficient funding is a major challenge to e-procurement implementation.¹⁴⁴ Costs vary by country but generally include initial development expense, upfront investment in new infrastructure, operational costs, training expense and resources to build acceptance and awareness of the new system.¹⁴⁵ Insights drawn from PFM experts reveal that the development costs of an e-procurement system need not be prohibitive provided that the country already possesses some level of electronic accounting, reporting and payment systems. In other words, if a country already has a functioning IFMIS with the core basic modules, the cost to implement an e-procurement system may be marginal. This is corroborated by WTO statistics showing that Chile's public e-procurement system cost approximately US\$500,000 to build.¹⁴⁶ However, there are

142 Adebayo V and Evans R (2015). Adoption of e-Procurement Systems in Developing Countries: A Nigerian Public-Sector Perspective. Westminster Business School, University of Westminster.

143 European Bank for Reconstruction and Development (EBRD). 2015. Are you ready for eProcurement? Guide to Electronic Procurement Reform.

144 See: Adebayo, V and Evans, R (2015) Adoption of e-Procurement Systems in Developing Countries: A Nigerian Public-Sector Perspective. Westminster Business School, University of Westminster; and Matunga A, Nyanamba O and Okibo W (2013). The Effect of E-procurement Practices on Effective Procurement in Public Hospitals: A Case of KISII Level 5 Hospital. American International Journal of Contemporary Research.

145 OECD (2003). Transparency in Government Procurement: The Benefits of Efficient Governance and Orientations for Achieving It. Working Party of the Trade Committee.

146 Ibid.

E-procurement systems

potentially other significant costs associated with the change management process, including staff and supplier training and education.

- **Skills and mindsets aligned with change:** A key requirement for transition towards e-procurement is the willingness of potential users to use the new system. Adebayo and Evans (2015) found that almost 80 percent of procurement officials surveyed agreed that fear of change to a new system was the most important barrier to e-procurement implementation in Nigeria.¹⁴⁷ Often, there is a genuine apprehension that automated IT-based systems could replace human workers on the job. Second, there are concerns that public officials could face difficulties in understanding e-procurement systems. In interviews PFM experts also say cultural factors play a role, as many public procurement officials in developing countries are from an older generation that are less exposed to technology and distrust it. Even in a developed country like Italy, it is noted that purchasing personnel are often older, lower-skilled, and most resistant to ICT adoption.¹⁴⁸ It can be equally difficult to involve business leaders and to educate and convince suppliers of the benefits of public e-procurement systems likely to incur costs to train staff and upgrade existing infrastructure to be able to comply.

Advanced readiness describes the state where a country fulfills all the conditions that allows it to successfully adopt an e-procurement system that is not just widely used across all government departments but is also reflected by high overall transaction coverage. Moreover, the e-procurement system is also well-integrated with other governmental IT systems which can yield efficiencies and informational benefits. KONEPS is a good example of a fully integrated, end-to-end system which covers the entire procurement cycle electronically and where all related documents are available and exchanged online.

Countries need to acquire several key enabling conditions, also summarized in Exhibit 7, to be considered ready in this state:

- **Political support at the highest level:** Sweeping technological reforms that are integrated across government entities requires strong coordination and is also likely to raise strong resistance. This makes high-level political backing (i.e. cabinet level) a prerequisite to overcome stakeholder concerns. In Singapore, strong political leadership from the Ministry of Finance ensured that the e-procurement system (GeBiz) reached its goal of moving the entire public-sector procurement process online as an interactive “one-stop, non-stop” platform for governments and businesses.¹⁴⁹
- **High degree of internet penetration:** Countries that have advanced readiness will need to possess very strong ICT infrastructure, including a high degree of internet penetration and systems capable of processing vast amounts of data quickly and securely.

¹⁴⁷ Adebayo V and Evans R (2015). Adoption of e-Procurement Systems in Developing Countries: A Nigerian Public-Sector Perspective. Westminster Business School, University of Westminster.

¹⁴⁸ Bof F and Previtali P (2007). Organisational Pre-Conditions for e-Procurement in Governments: the Italian Experience in the Public Health Care Sector. The Electronic Journal of e-Government Volume 5 Issue 1.

¹⁴⁹ Centre for Public Impact (2016). “GeBiz: government e-procurement system in Singapore.” Available at: <https://www.centreforpublicimpact.org/case-study/government-e-procurement-system-singapore/>

E-procurement systems

- **Interoperability and security across government departments and IT systems:** IT systems and standards, particularly regarding data formats, must be aligned and interoperable.¹⁵⁰ Linking e-procurement systems to other public registries can improve the efficiency of tender processes, for example by filling out documents automatically ('auto-filling'). More importantly, linking e-procurement systems to tax registries can help authorities recognize if a supplier has outstanding tax liabilities which could be used to exclude the supplier from the tender process. The IT system architecture also needs to address concerns over the secure transmission of sensitive data, including company details, bank account numbers and personal contact numbers. Likewise, on the government's side, records must be secured to prevent unauthorised access that could lead to tampering and contamination of the audit process.
- **Favorable international trade agreements:** Countries are able to reap greater benefits of e-procurement systems if they have free and open markets. Free trade agreements (FTAs) have the potential to open up a broader market for the government, and expand access to the lucrative government procurement market for suppliers.¹⁵¹ Value-for-money is the primary aim of most procurement regimes, and governments used favorable tariff structures to access higher quality and more efficient goods and services to improve the competitiveness of their tender processes.¹⁵² The Agreement on Government Procurement (GPA) is a plurilateral agreement within the framework of the WTO, which has opened up a market for procurement activities worth an estimated US\$1.7 trillion annually, and complements several existing bilateral and regional agreements. For instance, the Australia New Zealand Government Procurement Agreement (ANZGPA), North American Free Trade Agreement (NAFTA), the Common Market for Eastern and Southern Africa (COMESA), and more recently, Singapore and the European Union's 2013 FTA all cover tariff-free access to good under government procurement.^{153 154}

¹⁵⁰ Interoperability refers to the ability of different organizations' database to be free and securely exchanged.

¹⁵¹ The WTO estimates that government procurement accounts for 10-15% of the GDP of an economy on average. See World Trade Organization (2017). "WTO and government procurement" Available at: https://www.wto.org/english/tratop_e/gproc_e/gproc_e.htm

¹⁵² World Trade Organization (2017). "Agreement on Government Procurement" Available at: https://www.wto.org/english/tratop_e/gproc_e/gp_gpa_e.htm

¹⁵³ Dawar K and Evenett S (2010). Government Procurement. World Bank Group. Available at: <http://siteresources.worldbank.org/INTRANETTRADE/Resources/C17.pdf>

¹⁵⁴ Ministry of Foreign Affairs Singapore (2013). "Business Times: EU-S'pore FTA shows free trade is the way to go" Available at: https://www.mfa.gov.sg/content/mfa/media_centre/singapore_headlines/2013/201301/news_20130102.html



What does this mean for low-income countries?

Most governments have settled on some form of e-procurement adoption, albeit with varying degrees of sophistication. Given the existing conditions in low-income countries, it is perhaps unsurprising that the vast majority of them are still in the basic state of readiness. In fact, many are still struggling to fulfill most of the conditions required to implement and use e-procurement systems at moderate levels. It is therefore **unrealistic and overly ambitious to expect these countries to transition to fully integrated e-procurement platforms**. This explains why despite the growing adoption of e-procurement systems, inefficiencies and corruption in public procurement systems remain rife in many low-income countries.

While the focus should be on getting the basics right (i.e. fulfilling the enabling conditions of the first two states of readiness), low-income countries could also lay the ground for more advanced use of electronic systems in the future. For example, it would make sense for all low-income countries to increase ongoing efforts into modernizing their overall ICT architecture and improving the digital education of citizens – partly because of the high cost and time required. Similarly, it would be unrealistic for most low-income countries to immediately strive for the achievements seen in more advanced countries like Portugal¹⁵⁵ and Estonia¹⁵⁶, which have implemented highly interoperable procurement systems. However, these countries could still focus on i) keeping their IT systems simple and flexible and ii) standardizing forms and data requirements across departments. Such moves would go a long way in achieving a reasonable level of interoperability in the long run.

There are several lessons that have emerged from country experiences that are applicable to low-income countries to boost their general states of readiness for e-procurement adoption:

- **Clear objectives and expectations.** It is crucial to understand the intended outcome and timeframe of moving to a digital procurement system, as it shapes funding decisions, training requirements and communication with the public. Typical decisions governments need to make are whether small, recurrent expenditure like office stationery from existing suppliers should be included or whether the platform should simply serve to source new suppliers. Should the platform be an integrated system which covers every phase of the procurement process? Should it only cover tenders for infrastructure projects or tenders above a certain value? What kind of procurement mechanisms are to be introduced – auctioning, reverse auctioning or both?

¹⁵⁵ Portugal operates five licensed and privately-operated e-procurement platforms which are linked to a central public contracts registry portal called BASE. BASE ensures interoperability with the licensed platforms by receiving information on all procurements proceedings occurring on those platforms and publishing all the data on its portal. Portugal is also planning to record more supplier data by creating a national platform for suppliers, and linking the data to entities such as the tax authority, social security, and justice registers. See: http://ec.europa.eu/regional_policy/sources/good_practices/GP_fiche_18.pdf

¹⁵⁶ In Estonia, interoperability is achieved thanks to X-road, a data-exchange layer for public information systems, which enables secure data exchange between public databases, and between institutions and citizens. The country's e-procurement system is linked via X-road to the nation's criminal records database, business register, tax registry, among others – which enables background checks on suppliers to be conducted quickly and thoroughly. See: Estonian Ministry of Economic Affairs and Communications (2001). Interoperability of the State Information System.

E-procurement systems

- **Be flexible on financing.** As highlighted earlier, depending on the starting conditions and state of readiness of a country, the cost of developing e-procurement systems need not be prohibitive for many countries. Adhering to the first lesson on having clear objectives would also limit unnecessary costs. Countries have explored different ways of financing e-procurement systems. Many governments have funded the initial development cost, but eventually adopted a self-funding model by burdening private operators with the cost. In Singapore, the Ministry of Finance funded the initial development and operational costs of GeBIZ, built by the Defence Science and Technology Agency (DSTA), for the first two years, after which the responsibility to manage, operate and fund the system was deferred to DSTA. Instead of requesting funds from ministry, DSTA was to recover costs through fees collected from users of the e-procurement system.¹⁵⁷ Similarly, e-procurement systems in Georgia and Turkey are funded by income generated from tender registration fees. Specifically, KIK in Turkey charges 0.05 percent of the public contract value as a fee for using the system, and has reported significant increase in fee collection as control over spending on public contracts improved.¹⁵⁸
- **Build staff skills (and promote a mindset shift).** Procurement officials will need new skills to work with the new electronic system. These new skills include basic computer competencies, familiarity with the e-procurement platform, ability to troubleshoot or request for help when necessary, and making digital payments, must complement traditional (paper-based) procurement skills such as tender preparation and contract management. Officials also need significant support to help them mentally accept the technological change. For example, Albania provided continuous training to its procurement officials.¹⁵⁹ In the second half of its first year of implementation, a total of 76 training sessions were conducted for almost 1,500 participants (including government officials and suppliers).
- **Adopt a phased rollout.** Implementation in stages, starting with stakeholders that are best equipped to do so, can help to reduce costs, allow time for feedback, troubleshoot flaws in the system, reduce expectations and demonstrate the technology's benefits. All these factors may reduce the level of resistance at a broader level. In Turkey, the national public procurement authority Kamu İhale Kurumu (KIK) put in a lot of thought to smooth the transition to e-procurement.¹⁶⁰ It allowed ample time (7 months) before launching a pilot tender to allow contracting authorities and suppliers to register on the Electronic Public Procurement Platform (EPPP). It set up a call centre to assist all stakeholders with the registration and to help them navigate the various functionalities of the EPPP. KIK also provided multiple reminders prior to launch. It offered face-to-face training sessions with contracting authorities, as well as easily accessible online training resources and manuals. Meanwhile, Albania limited the initial test phase to public entities with technical and administrative capacities to assuage some of the uncertainties and scepticism over the switch to e-procurement. This laid the foundation for a broader rollout in subsequent phases.

¹⁵⁷ Centre for Public Impact (2016). "GeBiz: government e-procurement system in Singapore." Available at: <https://www.centreforpublicimpact.org/case-study/government-e-procurement-system-singapore/>

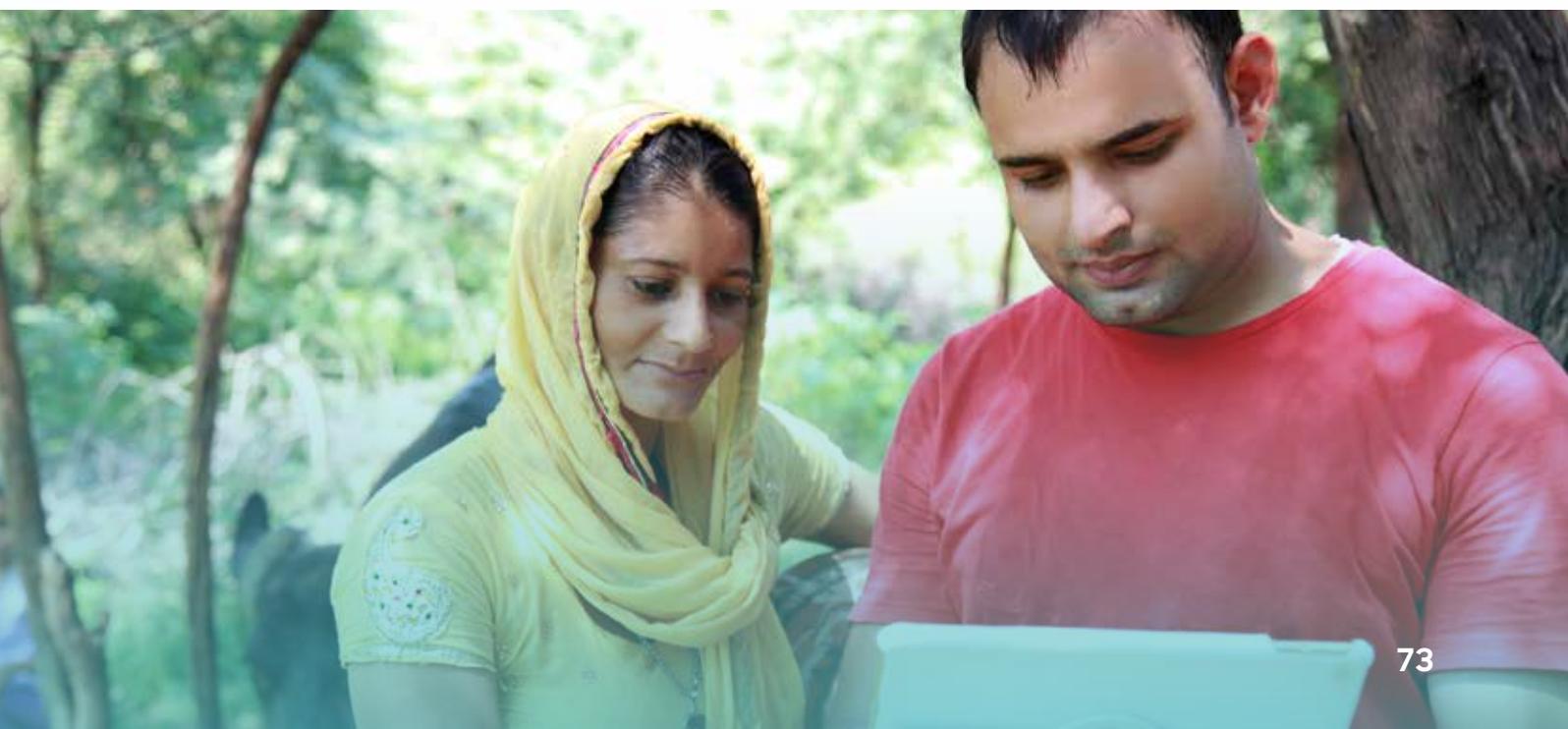
¹⁵⁸ Public Procurement Authority. 2012. EPPP 2011 Annual Report.

¹⁵⁹ Interviewees have stressed the importance of continuous training to reinforce knowledge and familiarity of new technology, and also in departments with high turnover.

¹⁶⁰ European Bank for Reconstruction and Development (2015). Are you ready for eProcurement? Guide to Electronic Procurement Reform.

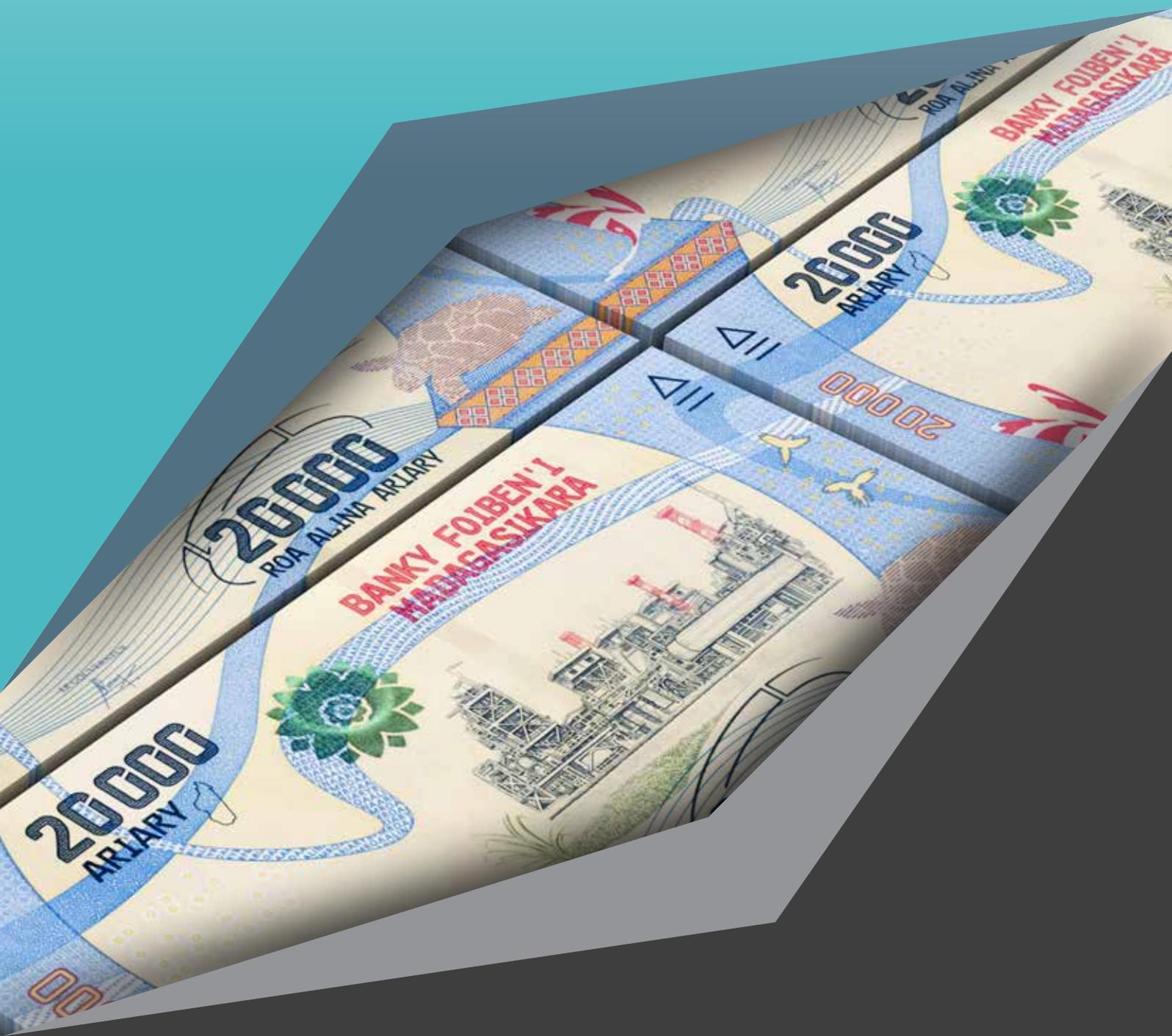
E-procurement systems

- **Create a user-friendly design.** System design should be as simple as possible to attain a higher level of buy-in from contracting authorities and suppliers. This is particularly necessary in countries where human capacity to operate IT systems is low. A less complicated, user-friendly platform that is no frills and built to meet the exact objectives defined in the business case will also be more affordable. Furthermore, the system designers should increase the convenience to users as much as possible. One of the common complaints of e-procurement systems is that e-catalogues are often confusing and lack effective search and filter functions, which makes it difficult for buyers to find products. It is also advisable to avoid path dependency by affording flexibility into the design of the e-procurement system, simply because objectives can change over time which will require new functionalities.
- **Communicate, communicate, communicate!** Constant communication with users is an important element of change management. The volume of users drives the success of e-procurement implementation. Channels must be available to engage users and help them solve their problems, be it through simple call stations, training programmes or other features. Effective dispute resolution channels for suppliers are also important. Part of the challenge of change management is to get users to trust that the new system is more transparent and leads to more equitable opportunities. Allowing suppliers to appeal tender award decisions in a systematic and open manner goes a long way to gaining that trust. For example, authorities in Albania were fully aware that they needed to fully engage the business community to successfully transition to e-procurement. Hence, part of the reason why the Albania's implementation was conducted in phases was to allow time to gauge, assess and respond to the reactions of parts of the business community, before pushing it out to a wider audience. The first phase in 2008 essentially became a test bed where strong efforts were taken to incorporate feedback into the technical design of the e-procurement system to make it as user-friendly as possible.



3.3

Big data analytics to improve tax compliance



Technological group: *Data analytical applications*

Key PFM concerns addressed: *2. Improving tax compliance*

The problem with tax fraud and detection in low-income countries

Tax fraud and evasion – not declaring and/or not fully paying tax liabilities – is costing governments billions in lost revenue each year.¹⁶¹ The reasons for tax fraud and evasion are broadly the same across countries¹⁶²: individuals and businesses are either unwilling to pay their fair share hoping that the tax contributions of others will pay for a public service (“free-rider” effect), or they do not trust that their taxes will end up increasing their personal well-being.¹⁶³ While tax fraud and evasion is widespread across the world, it tends to be more entrenched in low-income countries, where tax administrations are often inefficient and inequitable.

Many developed countries have begun to use sophisticated data recording and analytics in recent years to detect and prevent tax crimes. Modern data tools allow tax authorities to more effectively map complex relationships between individuals, businesses and tracked transactions, and can result in the recovery of billions of dollars in tax revenue.¹⁶⁴ However, many low- and lower-middle income countries have not yet made use of such monitoring technologies, partly because of cost and technical constraints and because their economies are still primarily cash-based.¹⁶⁵

For instance, Nigeria suffers from significant tax evasion – only 17.5 percent of the adult labour force are registered taxpayers, just 12 percent of registered businesses pay VAT, and the government’s overall tax revenue as a percentage of GDP hovers around 6 percent (compared to the OECD average of over 34 percent).¹⁶⁶ Meanwhile, India is trying to recover large amounts of “black money”, undeclared assets stashed

161 World Economic Forum (2017), “Which countries are worst affected by tax avoidance?” Available at: <https://www.weforum.org/agenda/2017/04/which-countries-are-worst-affected-by-tax-avoidance/>

162 Tax fraud involves the making of a false representation to the tax authority while tax evasion is generally taken to mean behaviour that involves some blameworthy act or omission that results in an avoidance or shortfall of tax. Available at: <https://www.ato.gov.au/about-ato/access,-accountability-and-reporting/in-detail/foi/fraud-and-evasion-guidelines/?page=5>

163 The economists Allingham and Sandmo first theorized the cost-benefit analysis taxpayers undertake in their seminal 1972 work. See Michael G Allingham and Agnar Sandmo (1972), Income tax evasion: A theoretical analysis. *Journal of Public Economics* 1 (1972), pp. 323-338. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.588.5382&rep=rep1&type=pdf>
Income tax evasion: Georgina Kaplanoglu (2015), Why do people evade taxes? New experimental evidence from Greece. Available at: https://www.researchgate.net/publication/273579477_Why_do_people_evade_taxes_New_experimental_evidence_from_Greece

164 OECD (2017), “Technology offers critical solutions to prevent, identify and tackle tax evasion and tax fraud, says OECD” Available at: <http://www.oecd.org/tax/technology-offers-critical-solutions-to-prevent-identify-and-tackle-tax-evasion-and-tax-fraud-says-oecd.htm>

165 Oxford University Centre for Business Taxation (2009), Tax evasion, tax avoidance and tax expenditures in developing countries: A review of the literature. Available at: https://www.sbs.ox.ac.uk/sites/default/files/Business_Taxation/Docs/Publications/Reports/TaxEvasionReportDFIDFINAL1906.pdf

166 Nigeria is estimated to have only 14 million registered taxpayers, out of a labour force of close to 77 million (going by national statistics). See Business Day Online (2017), “Nigeria targets 17m tax base with proposed new advocates” Available at: <https://www.businessdayonline.com/nigeria-targets-17m-tax-base-proposed-new-advocates/>
For VAT compliance statistics, see PwC (2016), “Guess how many Nigerians pay tax and how out government spends the money” Available at: <https://www.pwc.com/ng/en/assets/pdf/tax-watch-june-2016.pdf>
Recently, Finance Minister Kemi Adeosun was quoted as saying Nigeria’s tax to GDP ratio is at 6 percent – among the lowest in the world. See This Day (2017), “Adeosun: Nigeria’s tax to GDP ratio among lowest in the world” Available at: <https://www.thisdaylive.com/index.php/2017/04/23/adeosun-nigerias-tax-to-gdp-ratio-among-lowest-in-the-world/>

Big data analytics to improve tax compliance

overseas, with over US\$180 billion uncaptured by the tax net in 2015 – equivalent to approximately 75 percent of total taxes collected that year.¹⁶⁷

How could big data analytics address this problem?

Big data analytics is one of the new technological applications that governments can use to detect tax fraud and evasion more effectively than traditional methods of transaction monitoring, anti-money laundering (AML) or due diligence (DD).¹⁶⁸ Big data comprises extremely large, often heterogenous and unrelated streams of information from multiple sources. Computer algorithms can analyze these data troves to reveal patterns and trends, and to gather meaningful insights about the complex interactions between people and businesses.¹⁶⁹

There are three distinct phases of big data analytics for tax purposes:

- 1. Data generation and recording:** To identify potential tax fraud, big data analytics requires access to a range of data from various devices with data recording capabilities – such as electronic cash registers, ATMs, credit cards, desktop computers, laptops, tablets, smartphones, cameras, and microphones. Poorer countries do not generally have a problem with data generation and access, with Cisco estimating that the global average number of “connected” devices or devices with data recording capabilities per capita will rise from 2.3 in 2016 to 3.5 in 2021, with the majority of growth coming from developing countries.¹⁷⁰
- 2. Data collection:** Tax authorities using big data analytics do not only collect tax records and financial transaction data, but also data from other government agencies, financial institutions and other third-party providers. Many also draw on publicly available information, including social media content, audio-visual recordings, text files, mobile data (such as geolocation data), clickstream analytics (such as user behavior on e-commerce websites), media coverage, and data from machine-to-machine communication.¹⁷¹ A challenge is that big data is often unstructured, which means it contains information that doesn’t fit pre-defined data models or file types.¹⁷² For instance, video recordings from a teller machines’s closed-circuit camera or pictures posted on social media are inherently not in a “tax-ready format”. It requires further efforts to match them with taxpayer activity.

167 Hindustan Times (2015), “India’s share in global black money pool is \$181 billion” Available at: <http://www.hindustantimes.com/india/india-s-black-money-share-in-the-global-pool-as-much-as-181-bn/story-sEvO65bft0RWzletl83fJP.html>

For details on the original study, see Banca D’Italia (2015), “What do external statistics tell us about undeclared assets held abroad and tax evasion?” Available at: <https://www.bancaditalia.it/pubblicazioni/altri-atti-convegni/2015-analysis-household-finances/presentazioni/3.Sanelli.pdf>

168 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

169 SAS (2017). “Big Data: What it is and why it matters” Available at: https://www.sas.com/en_sg/insights/big-data/what-is-big-data.html

170 CISCO (2017). The Zettabyte Era: Trends and Analysis. Available at: <https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/vni-hyperconnectivity-wp.html>

171 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

172 IBM (2014). “Untangling the definition of unstructured data” Available at: <http://www.ibmbigdatahub.com/blog/untangling-definition-unstructured-data>

Big data analytics to improve tax compliance

3. **Data analysis:** Tax analytics can identify existing fraud and also anticipate potential fraud by building predictive risk profiles of taxpayers.¹⁷³ Once big data has been collected, analytics software “cleanses” the data. It seeks for matches between the unstructured information and existing records of a taxpayer’s personal and business activities to identify high-risk cases for auditing. For example, algorithms can compare a taxpayer’s declared income with information of spending patterns from social media posts – such as photos of lavish holidays and expensive cars – and highlight discrepancies that may signal tax fraud. To identify patterns that are statistically relevant, the data must inherently also be “big” or consist of millions of data points. Analytics then helps authorities to prioritize the best strategies for tax recovery, for example, by targeting the corporate tax evasion in the most at-risk sector.

Many countries have been using big data analytics to successfully detect tax evasion and fraud:

- **Personal income tax.** Big data can be used to build comprehensive taxpayer profiles and allow authorities to easily detect a mismatch between actual and self-reported behavior. For instance, geospatial data can be used to identify where taxpayers live and work, and social media posts reveal spending patterns. Italy uses a data tool called the Redditometro to check whether a taxpayer’s spending pattern matches available records on where and how that person lives.¹⁷⁴ Meanwhile, India recently started using big data analytics to track “black money” as part of a government initiative called “Project Insight”. Algorithms trawl through information from social media sites and the country’s national biometric ID scheme to identify potential mismatches between a taxpayer’s stated expenses and actual spending patterns. Results are fed back into the national socio-economic database where they contribute to a “taxpayer risk indicator”.¹⁷⁵ Big data enables revenue authorities to cover “blind spots” in the economy – tax fraud that traditional techniques fail to identify or that hasn’t even occurred yet. For example, Estonia uses big data analytics for predictive modelling. Its software matches information on citizens from government databases with transaction patterns (banks, tax receipts etc.) to forecast the probability of fraud and evasion.¹⁷⁶
- **Corporate tax.** Analytical software can help authorities to identify the most profitable strategies for corporate tax collection and recovery. For instance, the UK government has built a strategic risk analysis tool, incorporating the big data stored on 13 central government databases.¹⁷⁷ They also use a product called COSAIN to automate the collation and filtering of information related to different taxpayers on

173 This case study covers existing and predictive analytics, being most relevant to the PFM concern addressed, i.e., detection of tax fraud and evasion. See OECD (2016), *Advanced analytics for better tax administration: putting data to work*. Available at: http://www.keepeek.com/Digital-Asset-Management/oeecd/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#.Wgvl52iCxPY

174 Fisco e Tasse (2017). Redditometro. Available at: <https://www.fiscoetasse.com/redditometro>

175 Live Mint (2017), “Project Insight: Taxmen to snoop social networking sites to trace black money” Available at: <http://www.livemint.com/Politics/ae3dQ52YwHooYxQKZ7pVtJ/Project-Insight-Taxmen-to-snoop-social-networking-sites-to.html>

176 The Estonian Tax and Customs Board has set the following target in its 2020 Strategic Plan: to leverage on predictive analytics to radically change its mindset from being an agency of control and monitoring to one that is a consultancy-style advisory service to taxpayers. See The Conversation (2017). “Welcome to e-Estonia, the tiny nation that’s leading Europe in digital innovation” Available at: <https://theconversation.com/welcome-to-e-estonia-the-tiny-nation-thats-leading-europe-in-digital-innovation-74446> For more on Estonia’s model of e-government, see Government Digital Service Team (2013), “Government as a data model: what I learned in Estonia” Available at: <https://gds.blog.gov.uk/2013/10/31/government-as-a-data-model-what-i-learned-in-estonia/> To learn more about e-Estonia, visit <https://e-estonia.com/>

177 Digital McKinsey (2014). Public sector digitization: the trillion-dollar challenge. Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/public-sector-digitization-the-trillion-dollar-challenge>

Big data analytics to improve tax compliance

social media and websites.¹⁷⁸ For instance, the data tool is able to track cases where a multinational business fails to disclose partners in tax havens but analytics mined through online information identifies a connection between them. Her Majesty's Revenue Commission (HMRC) recovered a total of GBP2.6 billion in additional tax revenue in 2014-15 with 40 percent fewer staff – significantly improving audit success rates and enabling a leaner audit team.¹⁷⁹ Brazil has emerged as a leader in the use of big data for corporate tax audits. Its digital bookkeeping system, SPED, analyzes large business-to-business transactions for inconsistencies and flags potential shell company networks. Since moving to the new system in 2010, Brazilian tax authorities have used data analytics to effect a 50 percent increase of close to R\$3 million per average value of individual audits undertaken (or size of suspected tax fraud), resulting in a 12.5 percent increase in federal tax collections.¹⁸⁰

- **VAT and other taxes.** Russia's tax authorities use big data technologies to increase their Value Added Tax (VAT) revenue, which in recent years has been falling short of expectations (over 12 percent gap between expected and actual tax collection in 2015). Data analytics match digital VAT files with incoming transaction data to spot payment irregularities. Fraudulent returns are then isolated, connected organizations identified, and targeted audits undertaken.¹⁸¹ As part of its big data approach, Mexico introduced mandatory e-invoicing for all businesses in 2015 to combat false invoicing and unrecorded transactions in the informal sector. Mexican businesses are required to issue electronic invoices to customers and retain digital records. These sales invoices are then provided to the tax authority where various data techniques are applied to uncover irregularities in the invoices. The Monterrey Technology Institute estimates that the obligation for e-invoicing not only led to growth in income tax collected (6 percent for businesses and 21 percent for individuals), but also brought 4.2 million MSMEs previously undetected by the tax authority into the formal economy.¹⁸²

178 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

179 Capgemini (2017). "Business intelligence technology helps HMRC increase yield" Available at: https://www.capgemini.com/resources/hm_revenue/

180 Ernst and Young (2016). Tax administration is going digital: Understanding the challenges and opportunities. Available at: [http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/\\$FILE/EY-tax-administration-is-going-digital.pdf](http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/$FILE/EY-tax-administration-is-going-digital.pdf)

181 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

182 OECD (2017). Technology tools to tackle tax evasion and tax fraud. Available at: <https://www.oecd.org/tax/crime/technology-tools-to-tackle-tax-evasion-and-tax-fraud.pdf>

What are the states of readiness to adopt the technology?

Our assessment confirms the potential of using big data analytics to detect tax fraud and evasion in both advanced and lower income countries. There are three broad states of readiness to utilize big data analytics to improve tax systems: pre-readiness, basic readiness, and advanced readiness (Exhibit 8). A country's state of readiness will dictate its ability to successfully adopt the technology at the corresponding level of sophistication. A country must fulfil the enabling requirements in its state of readiness to have the highest chance of successful implementation at that level of adoption.

Countries that are in the pre-readiness state do not have many of the key enabling conditions in place to make use big data analytics, and consequently, still predominantly use less sophisticated forms of data analysis, such as manual data entry, simple spreadsheets, and visual matching of datasets to identify tax crimes. Those that are in the basic state of readiness are ready to begin using big data analytics to detect tax evasion and fraud, albeit at a limited scale, often in partnership with private sector firms. Countries that are in the advanced state of readiness can look to apply big data analytics on a wide scale – not just to identify fraud, but also to prevent it by creating predictive risk profiles of taxpayers.

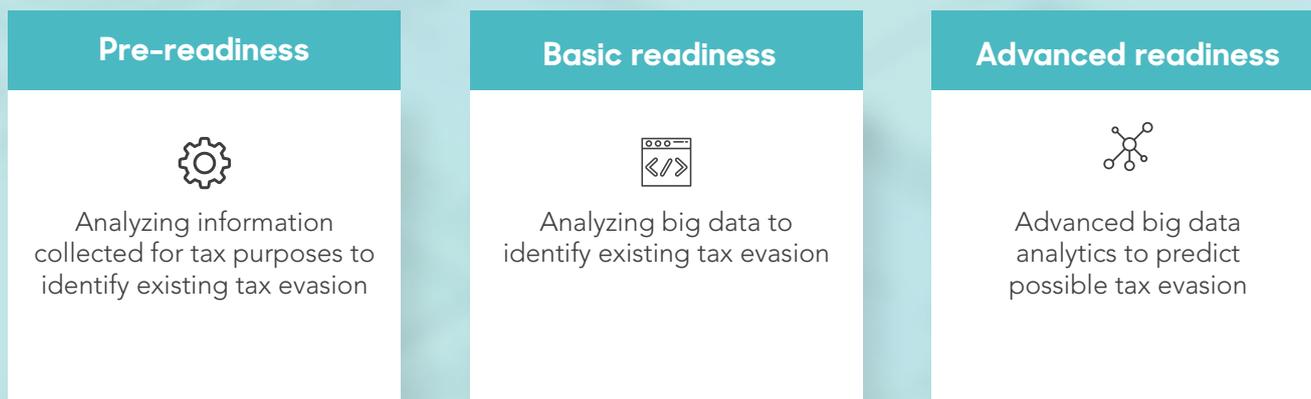
Traditionally, authorities have made limited use of unstructured data due to technical and cost constraints to derive value from such vast amounts of information. Advancement in big data tools (data generation, recording and analytics) has opened up new opportunities for all countries, albeit at varying degrees. However, so far only more advanced countries with a significant level of digitization have embraced big data analytics on a broad scale to fight tax crimes.¹⁸³ While the potential for adoption clearly differs across countries with lower levels of income, expert consensus is that most can achieve more using data analytics than they currently have.

To effectively adopt the form of data analytics under each state of readiness, there is a specific set of enabling conditions that countries must first acquire in those respective states (Exhibit 8). These enabling conditions are additive – in other words, a country in the advanced state of readiness may reap the full potential of big data analytics only when it satisfies the key requirements in all three states. The higher the degree of fulfilling these requirements, the higher the likelihood of positive outcomes in each state.

¹⁸³ Due to poor data quality, the economic costs of using big data in low and middle income countries often outweigh the benefits. See World Bank (2016). "Attention governments: Big Data is a game changer for businesses" Available at: <https://blogs.worldbank.org/opendata/attention-governments-big-data-game-changer-businesses>

Exhibit 8

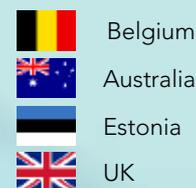
There are three states of readiness in the adoption of big data analytics for identifying tax fraud and evasion



Key requirements

- Clear and comprehensive tax legislation (e.g. processes, responsibilities, penalties)
 - Basic ICT capabilities to initiate digitization of tax data
 - Clear data governance strategy
 - Central revenue authority with independent mandate
 - Anti-money laundering / due diligence systems, with multilateral cooperation
- ICT infrastructure required to generate and collect big data from multiple source
 - Upgraded data analysis capabilities for government
 - Skills development for tax enforcement officials to use big data analysis software
 - Data-driven culture
 - Sufficient funding to achieve pre-defined objectives
- High penetration of devices with data recording capabilities
 - Comprehensive legislation on data privacy and IP protection
 - Multi-functional task force to enable interoperability across all digital government databases
 - Advanced data storage and processing infrastructure
 - Advanced mining and analytics software for predictive models that generate risk profiles

Country examples



Big data analytics to improve tax compliance

Pre-readiness describes the state where a country does not have the prerequisites to use big data analytics to identify tax fraud and evasion. A typical scenario of data analysis for countries with these conditions would involve less sophisticated processes such as manual data entry, simple spreadsheets, and visual matching of datasets. These countries would start to utilize existing data that is already in public sector hands, which would include income data that existing in work registries, which could be matched with spending information based on utilities, real estate and other assets. For countries in this state of readiness, reforms should focus on improving existing legislation, processes and capabilities to identify existing and historical tax fraud from traditional sources of (paper-based) taxpayer data such as tax filing, company books and authorized third-party sources providing transactional information. Key enabling conditions needed to derive positive impacts at this state include:

- **Clear and comprehensive tax legislation.** Tax evasion is often favored by three legislative shortcomings: complex and ambiguous tax codes, inefficient filing and payment processes, and insufficient or improperly imposed penalties.¹⁸⁴ These gaps in the legislation need to be filled to fight tax evasion and fraud more effectively. A complex and ambiguous tax code creates significant compliance costs for taxpayers and can also affect the quality of audits.¹⁸⁵ Inefficient filing and payment processes can lead to unintended human errors which increase audit and enforcement costs.¹⁸⁶ Research found that taxpayers in 22 out of 54 African countries spend significantly more time to file their declarations (around 400 hours) than usual in low- and middle-income countries (average of around 290 hours) – having to complete lengthy paperwork and enduring long queues to submit them.¹⁸⁷ In many low-income countries, a complex tax code and unsystematic application of penalties is an endemic issue that encourages tax fraud and evasion, particularly among corporate taxpayers.¹⁸⁸ Studies have shown that many taxpayers consciously calculate the trade-off between tax dodging and risk of detection.¹⁸⁹
- **Basic ICT capabilities to initiate digitization of tax data.** Countries in this state of readiness need to have some basic information and communication technology in place, including computers and an internet connection, to more effectively detect tax crime. Tax officers also need to possess the skills and accounting knowledge, so they can begin to digitize tax data (typically done by converting paper documents into digital spreadsheets). Tax authorities in this phase also begin to encourage taxpayers to digitize their tax

184 GIZ (2011). Addressing tax evasion and tax avoidance in developing countries. Available at: https://www.taxcompact.net/documents/2011-09-09_GTZ_Addressings-tax-eva-sion-and-avoidance.pdf

185 Saad (2013). Tax knowledge, tax complexity and tax compliance: taxpayers' view. *Procedia – Social and Behavioral Sciences* 109 (2014) 1069-1075. Available at: https://ac.els-cdn.com/S1877042813052294/1-s2.0-S1877042813052294-main.pdf?_tid=7854ec26-cdcd-11e7-8a69-00000aab0f27&acdnat=1511166983_2a38ee2813e272b7e868741b16330d0f

186 Multiple studies across the developing world note that e-filing of taxes reduces previous inefficiencies such as bureaucratic delays, document preparation costs and opportunity cost of time.

187 See data tables prepared by the World Bank for "Time taken to prepare and pay taxes (hours)", available at: <https://data.worldbank.org/indicator/IC.TAX.DURS?locations=NG>

188 Tax experts state that tax compliance from small and medium enterprises (SMEs) is negatively impacted when large corporations are perceived to or actual pay little to no taxes. Research corroborates this observation; in many countries, SMEs pay taxes at higher rates than large companies and do not enjoy the same ad-hoc exemptions and penalties for avoidance. See Winnie Ojochogwu, Atawodi, and Stephen Ojeka (2012). Factors that affect tax compliance among small and medium enterprises in North Central Nigeria. *International Journal of Business and Management*, Vol.7, No.12m June 2012. Available at: https://www.researchgate.net/publication/266349181_Factors_That_Affect_Tax_Compliance_among_Small_and_Medium_Enterprises_SMEs_in_North_Central_Nigeria

189 A wealth of literature on "optimal tax evasion" behaviour builds on Kahneman and Tversky's seminal Prospect Theory, describing how risks of detection and expected outcomes build into individual taxpayers' decision-making. See Daniel Kahneman and Amos Tversky (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263-291, March 1979. Available at: https://www.princeton.edu/~kahneman/docs/Publications/prospect_theory.pdf

Big data analytics to improve tax compliance

declarations and file them electronically via online channels. Many authorities now also require companies to keep their tax records in a digital format. Such “e-filing” can significantly reduce the time and cost of managing tax issues, detecting fraud and enforcing penalties. The majority of governments that use basic analytics have enabled e-filing to facilitate audit case selection.¹⁹⁰ For instance, the Rwanda Revenue Authority has succeeded in reaching 90 percent of tax filings through online channels, and is using this data to flag high-risk sectors in the economy.¹⁹¹

- **Clear data governance strategy.** Experts also indicate the need for revenue authorities to be clear about their data governance strategy.¹⁹² This would include having some basic regulation on data protection and privacy, and rules to oblige public entities to make data available to the tax authorities for reuse within the public sector. For example, the digitization of tax data requires revenue authorities to ensure new e-filing systems are integrated into the existing ICT infrastructure and that tax data is stored securely. They also need to clarify data access rights. For example, the Uganda Revenue Authority used a clear data governance strategy to develop its integrated e-filing system.¹⁹³
- **Central revenue authority with independent mandate.** Countries in this pre-readiness state also need to establish revenue authorities with independent mandates to be able to more effectively reap the benefits of basic data analytics. Efficient tax systems typically operate with a “hub-and-spoke” system where the central revenue body is responsible for setting standards, best practices and processes, and decentralized tax offices at the regional level are responsible for the execution. However, the reality in many low-income countries is often marked by split responsibilities between government ministries and departments for various parts of the tax collection and enforcement process. For instance, the creation of the Ministry of Budget and National Planning in Nigeria has led to conflicts between the new ministry and the Ministry of Finance, which, through the Federal Inland Revenue Service (FIRS) has traditionally exercised oversight over the tax enforcement process.¹⁹⁴

190 World Bank Group and PwC (2016). *Paying Taxes 2016*. Available at: <https://www.pwc.com/gx/en/paying-taxes-2016/paying-taxes-2016-chapter-1.pdf> and Ernst and Young (2016), *Tax administration is going digital: Understanding the challenges and opportunities*. Available at: [http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/\\$FILE/EY-tax-administration-is-going-digital.pdf](http://www.ey.com/Publication/vwLUAssets/EY-tax-administration-is-going-digital/$FILE/EY-tax-administration-is-going-digital.pdf)

191 East African Revenue Authorities (EARA; 2017). *Comparative Revenue Analysis 2015/16*, and AllAfrica (2017), “Rwanda: 2017/18 budget – RRA to collect more taxes without imposing levies” Available at: <http://allafrica.com/stories/201706120055.html>

192 Data governance is an organization’s overarching approach to collecting / acquisition, managing and archiving data. See SAS (2017), “Data governance framework: What is it and do I already have one?” Available at: https://www.sas.com/en_sg/insights/articles/data-management/what-is-a-data-governance-framework.html#

193 Tata Consultancy Services (2017). “Uganda deploys next gen e-Tax system” Available at: <https://www.tcs.com/uganda-revenue-authority-integrated-tax-system>

194 Punch Nigeria (2016). “Finance ministry, budget office meet over clash in functions” Available at: <http://punchng.com/finance-ministry-budget-office-meet-clash-functions/>

Big data analytics to improve tax compliance

- **Robust anti-money laundering (AML) and due diligence (DD) systems with multilateral cooperation.** It is well documented that the majority of tax fraud and evasion is committed by a small number of wealthy individuals and corporates.¹⁹⁵ Undeclared assets are often stashed overseas in countries with little or no tax obligation. Tax authorities need to have access to international data sources to successfully retrieve these assets from global tax havens. International conventions such as Basel III and the OECD's Base Erosion and Profit Shifting (BEPS) framework outline basic requirements for AML / DD systems. Signatory countries can access and share information with each other to better detect tax fraud and evasion.¹⁹⁶

Basic readiness describes the scenario where a country has sufficient conditions to start using big data analytics (with moderate levels of success) to detect tax fraud and evasion, albeit at a limited or very targeted scale. Tax authorities in this state of readiness typically have put in place some basic requirements to improve their data analytics capabilities. For example, they may have gained access to large, often unstructured data (e.g. social media analytics) to improve their existing methods of detecting tax crimes. They may have also contracted private sector experts to train tax officers and improve overall analytical capabilities. However, the scope of big data analytics for tax purposes in these countries remains narrow, often tied to particular sectors or taxpayer groups. India's "Project Insight" and Mexico's mandatory VAT e-invoicing system can serve as examples.

Countries in this state of readiness can use big data analytics to identify existing tax crimes, and are focused on broadening their overall data capabilities. The key enabling conditions for this state of readiness include:

- **ICT infrastructure to generate and collect big data.** Big data relies on a wide array of data-recording devices, such as electronic cash registers, ATMs, credit cards, desktop computers, laptops, tablets, smartphones, cameras, or microphones. For these devices to function efficiently, countries need to have a conducive ICT infrastructure, including reliable broadband or mobile internet connection. Businesses – from banks to mobile phone providers – also need to have adequate IT networks in place to collect, store and process the data generated by these devices. Sound legal structures are needed to ensure governments adhere to privacy and intellectual property (IP) laws when collecting taxpayer-related data from these businesses or other public sources, including business directories and newspaper articles.
- **Improved data analytics technology.** Tax authorities need higher technical capabilities to derive valuable insights from large data masses. They can choose from a range of analytical software, some of which can be tailored to specific government needs. Open-source software, software that is developed, tested and improved through public collaboration, can be a cost-effective solution.¹⁹⁷

195 CNN (2014). "You pay taxes, and rich corporations don't" Available at: <http://edition.cnn.com/2014/07/16/opinion/pease-tax-avoidance/index.html>

196 The BEPS framework has voluntary membership, extending to many non-member countries. The multilateral instrument requires countries to enact mandatory Country-by-Country tax reporting requirements and shares this filing information with signatories. See OECD (2017). Multilateral Convention to Implement Tax Treaty Related Measures to Prevent BEPS. Available at: <http://www.oecd.org/tax/treaties/multilateral-convention-to-implement-tax-treaty-related-measures-to-prevent-beps.htm>

197 OECD (2016). Advanced analytics for better tax administration: putting data to work. Available at: http://www.keepeek.com/Digital-Asset-Management/oecd/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#WgvL52iCXpY

Big data analytics to improve tax compliance

- **Skills development.** Big data projects in many low-income countries are challenged by a lack of digital skills in tax authorities that is exacerbated by strong private-sector competition for talent.¹⁹⁸ Countries with basic state of readiness need to provide adequate training opportunities to ensure tax officers have the necessary technical skills to successfully use big data analytics software and to interpret the results. Overall, research finds that the use of analytics technology in tax authorities also lifts workplace productivity, as staff spend more time on analyzing computer-generated results and less time on sifting through files and spreadsheets to identify tax fraud and evasion.
- **A data-driven culture.** To effectively fight tax fraud and evasion with the help of modern technology, government officials must adopt a culture of “evidence-based policy making”. However, it is still uncommon in many low-income countries to make policy decisions on the basis of rigorous quantitative evidence.¹⁹⁹ A paradigm shift at the highest level of government may be required to increase the adoption rate of big data analytics for tax purposes. For instance, in Colombia, resistance to data use was found to be one of the leading barriers to the implementation of big data solutions. Even in developed countries such as Switzerland, cultural barriers are perceived just as obstructive as technical challenges.²⁰⁰
- **Sufficient funding** is required for upgrading ICT infrastructure, staff training, and change management.²⁰¹ Cost estimates vary greatly and depend on country-specific requirements but is expected to be relatively high, especially in low-income countries starting from a much lower base. Change management costs in can also be particularly high due to stronger levels of resistance and high turnover rates as employees often leave the public service for better-paid jobs in the private sector soon after acquiring a certain level of technical skills.

198 Digital McKinsey (2011). Big data: The next frontier for innovation, competition, and productivity. Available at: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation>

199 Overseas Development Institute (2005). Evidence-based policymaking: What is it? How does it work? What relevance for developing countries? Available at: <https://www.odl.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/3683.pdf>

200 OECD (2016). Advanced analytics for better tax administration: putting data to work. Available at: http://www.keepeek.com/Digital-Asset-Management/oecd/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#.WgvL52iCxPY

201 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

Big data analytics to improve tax compliance

Advanced readiness describes the state of readiness where conditions are available for countries to adopt more sophisticated forms of big data analytics not just to detect existing tax fraud and evasion, but also to pre-empt it. Tax authorities of countries with such levels of readiness have the conditions to use extensive data mining and processing techniques, as well as predictive analytics to map out complex relationships between taxpaying entities, often across borders. Countries with advanced readiness have typically built up a high degree of ICT penetration, data digitization, and strong data collaborations across government agencies. These countries focus on continued innovation in data sourcing and application. Key enabling conditions for advanced big data analytics adoption include:

- **High penetration of data-recording devices.** The more data, the more likely it is for authorities to detect tax fraud and evasion. Countries in this state of readiness, such as Australia, Belgium, Estonia and the UK, have a high concentration of devices per person that produce large amounts of structured and unstructured data, including smart sensors, smartphones and computers. Data-rich environments with billions of data points are favorable for big data analytics for two reasons: i) it effectively reduces “noise” (chance patterns, confounding factors etc.), allowing for easier detection of suspicious activity that might warrant a tax audit; ii) the sheer volume of data disincentives tax analysts and managers to tamper the data as there is a high chance of being discovered.²⁰²
- **Data privacy and security.** Countries with advanced readiness have robust privacy frameworks in response to rising concerns over the misuse of private data, which could derail data collection efforts by governments.²⁰³ Businesses are also wary of losing their competitive advantage if their transaction data is leaked. However, many countries have insufficient cybersurveillance laws at the moment²⁰⁴ that is impeding a seamless transmission of data from private to public entities. The OECD has recently released global data safeguard standards for exchange of information for tax purposes, which covers a wide range of data requests which could ostensibly be requested from different organizations.²⁰⁵ While regulation on data privacy and security is important, modern infrastructure is required to complement regulations. For example, secure data systems require massive storage facilities which can be slow to navigate, creating the need to for tax authorities to establish clear internal data access rights and usage structures.
- **Multi-functional government taskforce.** For a country to be ready to embrace integrated use of big data analytics, all government departments – beyond just tax enforcement – need to be invested. Assembling a multi-functional taskforce, with members from different departments and ministries, can go a long way in achieving this goal. Examples from around the globe show that such taskforces are most effective when

202 OECD (2016). Advanced analytics for better tax administration: putting data to work. Available at: http://www.keepeek.com/Digital-Asset-Management/oecd/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#_WgvL52iCxPY

203 European Data Protection Supervisor (2015). Meeting the challenges of big data. Opinion 7/2015. Available at: https://edps.europa.eu/sites/edp/files/publication/15-11-19_big_data_en.pdf

204 OpenGovAsia (2017). “Report from UN Special Rapporteur on the right to privacy highlights concerns over big data and open data” Available at: <http://opengovasia.com/articles/8174-report-from-un-special-rapporteur-on-the-right-to-privacy-raises-concerns-over-big-data-and-open-data>

205 OECD (2017). Standard for Automatic Exchange of Financial Account Information in Tax Matters. Automatic exchange of information. Available at: <http://www.oecd.org/tax/transparency/automaticexchangeofinformation.htm>

Big data analytics to improve tax compliance

they are given the autonomy to flexibly identify priority areas for big data analytics, make key financial decisions and set process standards. Taskforce members would need to have a strong understanding of the business culture, as well as sound policy and technical skills.²⁰⁶

- **Advanced mining and predictive analytics software.** A key enabling condition under the advanced readiness state is the use of advanced predictive analytics software such as “social network analysis” (SNA) to assist in risk profiling. For example, Ireland, Malaysia, the Netherlands and Singapore have used this tool to identify VAT carousel fraud – a cross-border fraud scheme that is estimated to cost Europe up to US\$132 billion in tax revenues per year.²⁰⁷ SNA software identifies risky taxpayers by analyzing historical and real-time data for abnormal patterns and deviations to make predictions about potential fraud hotspots.²⁰⁸ Belgium has used big data analytics in conjunction with data analytics firm SAS to combat to identify elaborate fraud networks from intercommunity transactions, company data and unstructured data, helping it to recover over US\$1 billion annually.²⁰⁹ Meanwhile, authorities in Australia, Canada, Norway and the UK use risk modelling based on predictive analytics to assess expected taxpayer payments prior to the tax filing season. These advanced software use techniques such as multiple regression analysis and neural networks.²¹⁰ The OECD notes that best practices for such analysis include the use of big data platforms and technologies such as commercial Hadoop and enterprise NoSQL databases, which are seamlessly integrated with the legacy infrastructure in tax systems. OECD members use a mix of commercial software solutions as well, including SAS, SPSS, IBM Modeller, SQL, Oracle Data Miner, and Stata.²¹¹

What does this mean for low-income countries?

The systematic use of big data analytics to identify tax fraud and evasion is so far confined to advanced countries. In the developing world, such technologies have yet to gain a stronger foothold because many countries are not ready yet, and it would be **impractical for lower income countries to invest in big data systems without strengthening their existing tax systems first**. A more realistic step for these countries would be to should start to utilize existing data that is already in public sector hands, such as income data that exists in work registries, which could be matched with spending information based on utilities, real estate and other assets. In parallel, they should work towards acquiring the enabling conditions required under the pre-

206 Jill Dyche (2015). The New IT: How technology leaders are enabling business strategy in the digital age. Excerpt available at: https://www.sas.com/storefront/aux/en/spnewit/68375_excerpt.pdf

207 VAT carousel fraud or “missing trader fraud” is the process by which a merchant fails to remit tax to the tax authority, despite having sold the goods. Such fraud occurs is orchestrated by business networks; conspirators in one country jurisdiction sell goods to accomplices across tax-free jurisdictions, who then sell the goods to third-party buyers and collect the requisite VAT, but do not remit it. The third-party eventually sells the goods tax-free back to the original conspirator, and then files for a refund on the VAT never remitted to begin with.

208 OECD (2016). Advanced analytics for better tax administration: putting data to work. Available at: http://www.keepeek.com/Digital-Asset-Management/oecd/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#.WgvL52iCxPY

209 SAS (2017). “Q&A: How hybrid fraud detection cut losses by 98%” Available at: https://www.sas.com/en_us/customers/tax-fraud-belgium.html#

210 Amir Gandomi and Murtaza Haider (2014). Beyond the hype: Big data concepts, methods and analytics. Journal of Information Management. Available: https://ac.els-cdn.com/S0268401214001066/1-s2.0-S0268401214001066-main.pdf?_tid=b28d0a78-cb88-11e7-a094-00000aab0f01&acdnat=1510917543_891579a20c514c354ed539cd5596171c See also Firmex (2013), “7 big data techniques that create business value” Available at: <https://www.firmex.com/thedealroom/7-big-data-techniques-that-create-business-value/>

211 OECD (2016). Advanced analytics for better tax administration: putting data to work. Available at: http://www.keepeek.com/Digital-Asset-Management/oecd/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#.WgvL52iCxPY

Big data analytics to improve tax compliance

readiness state, which would lay the groundwork for them to use big data analytics as an effective tool to fight tax crime in the future.

Low-income countries can learn several lessons from the experiences of other countries globally:

- **Recognize the value of existing data.** Many governments have access to a large stockpile of information, but are not using this data for efficiently for tax purposes. For instance, as many as 176 countries around the world have implemented Integrated Financial Management Information Systems (IFMIS) to operationalize and automate PFM functions – from budget preparation and payments to accounting and financial reporting.²¹² These systems contain up-to-date information on different streams of revenue collection as well as payment details of any transactions with government entities. This allows revenue authorities to be alerted to potential discrepancies (such as irregular shortfall of tax collection in a given month) that can be actioned upon, and also a good understanding of counterparties' revenue profiles. Other IT systems operated other departments, such as the customs department, may also contain a host of useful information on taxpayers, including contact information, and transactions and accounts data, which can significantly complement data collected in IFMIS. Many other socio-economic databases, such as the census or welfare program accounts, can be similarly useful for tax authorities to construct taxpayer profiles.²¹³
- **Improve system compatibility and data governance.** Low-income countries can prioritize two key tasks in this area. First, there is a need to standardize data formats, definitions and values (also called metadata or input data) across digital platforms. This move would make data from different databases more compatible and ultimately easier to share and analyze. Second, there is a need to establish data sharing and usage protocols between government agencies.²¹⁴ To ensure data integrity, accessibility and standardization, the data capacity of national statistics organizations (NSOs) can be strengthened. Kenya and South Africa have developed very competent NSOs which produce regular, reliable data to inform the tax process. This has included working with other ministries and external stakeholders to collect data, consolidate duplicate data, harmonize data and to build dashboards to facilitate access and interpretation of the data.
- **Determine objectives of any big data initiatives in advance; allocate funding by priority.** Data experts have highlighted that the costs of implementing big data analytics systems can be high. In low-income countries especially, building big data capabilities could require capital investments in many different areas such as the design of entirely new data storage platforms (e.g. external cloud solutions and physical data centers), data exploration tools and dashboards with analytical outputs.²¹⁵ Therefore, it is critical that

212 Florian Misch, Brian Olden, Marcos Poplawski-Ribiero and Lamya Keiji (2017). Nowcashing: Using daily fiscal data for real-time macroeconomic analysis. Digital Revolutions in Public Finance (IMF publication), Chapter 6. Available at: http://www.elibrary.imf.org/view/IMF071/24304-9781484315224/24304-9781484315224/Other_formats/Source_PDF/24304-9781484316719.pdf

213 For instance, India's national identity program, Aadhar, which covers over 95 percent of the population, has enabled the construction of a detailed socio-economic database with unique IDs for each taxpayer, data on income levels, household and contact information, employment data and other socio-economic indicators.

214 Driss Kettani and Bernard Moulin (2014). E-Government for Good Government in Developing Countries: Empirical Evidence.

215 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

Big data analytics to improve tax compliance

government officials are clear about their objectives when trying to identify spending priorities. To help with their decision-making, it is necessary to thoroughly assess the quality of available data available, the capability of existing IT infrastructure, training requirements, the feasible time horizon and the tax revenue stream that stands to gain most.

For low-income countries, it may be best to target the largest tax evaders – the “big fish” – like Indonesia did, for greatest impact. Authorities there collected significant amounts of data during a recent tax amnesty program – 2.6 billion data points and are now working towards matching data points with taxpayer identification numbers, with the aim of constructing detailed tax profiles for the largest taxpayers (primarily family businesses) by 2019.²¹⁶ Likewise, India’s data-driven approach towards tax crimes are focused on targeting individuals and that are expected to yield the highest tax penalties.²¹⁷

- **Implement a phased rollout for data analytics systems.** A phased rollout is critical to ensure the success of a big data tax adoption in low-income countries. Such a move would prioritize key stakeholders, reduce cost and enable efficient troubleshooting. It can also reduce unrealistic expectations and demonstrate positive impact which is important to reduce resistance in stakeholders. Administrations in low-income countries that have successfully introduced some level of big data analytics have adopted an iterative, “test-and-learn” approach to remain agile as it adapts to new methods and incorporates user feedback.²¹⁸ Experts advocate for capacity building and producing reliable output first – as seen in Indonesia, which has committed to upgrading the tax authority’s IT systems first, before setting clear targets for deployment and finally implementing a limited rollout of big data technology.²¹⁹ India’s “Project Insight” will also be implemented in phases – the first phase focuses on migrating existing data and tax files to a central system; the second will focus on data mining, cleaning and processing, creating individual profiles and targeting strategies; and the final phase, which will go live in May 2018, will utilize advanced analytics to create risk profiles and pre-empt defaults.²²⁰
- **Leverage open source software.** Experts have stressed the value of using open-source software as an affordable test bed for tax data analytics. They also highlight the potential of such platforms to encourage more citizens and businesses to participate in the process of designing tax policy. Research indicates that governments often use open-source software in the early stages of advanced tax analytics, as it is free to use, customizable and linked to a large peer support network.
- **Involve the private sector.** Many developing countries are home to a large private sector comprising

216 The Jakarta Post (2017). “Tax office to deploy big data next year” Available at: <https://www.pressreader.com/indonesia/the-jakarta-post/20170425/281977492507652>

217 OpenGovAsia (2017). “Indian government to detect tax evasion using analytics on traditional data and social media information ” Available at: <http://opengovasia.com/articles/7863-indian-government-to-detect-tax-evasion-using-analytics-on-traditional-data-and-social-media-information>

218 The advent of big data analytics and artificial intelligence is touted as the “Fourth Industrial Revolution”, providing business, government and society a powerful new means of raising global income levels and improving quality of life around the world. See World Economic Forum (2016). “The Fourth Industrial Revolution: what it means, how to respond” Available at: <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond>

219 OECD (2016). Advanced analytics for better tax administration: putting data to work. Available at: http://www.keepeek.com/Digital-Asset-Management/oced/taxation/advanced-analytics-for-better-tax-administration_9789264256453-en#.WgVL52iCxPY

220 Bloomberg Technology (2017). “Holiday posts on Instagram are tipping off India’s taxman” Available at: <https://www.bloomberg.com/news/articles/2017-07-27/instagram-posts-will-soon-help-sniff-out-tax-evaders-in-india>

Big data analytics to improve tax compliance

innovative, multinational business-to-consumer (B2C) firms. These firms can contribute to a country's big data expertise if governments can provide the right incentives. Private sector businesses, particularly telcos and large fast-moving consumer goods firms, have already brought their big data capabilities to developing economies. For instance, as of 2014, 40 percent of businesses in Nigeria and Kenya were in the planning stages of a big data project to understand their consumers and business environment better, and 12 percent had launched such projects, just short of the global averages at the time.²²¹ Past experience has showed that involving the private sector in building up a government's digital capabilities has been fruitful. For instance, the e-Estonia digital government system was designed from scratch with the aid of the country's best software engineers from the private sector.²²²

- **Collaborate with external partners within and outside government.** Data is often siloed in different parts of the government bureaucracy, with little data sharing between departments. Additionally, third-party databases are rich sources of behavioral insights that tax authorities can leverage. However, many third-party providers are reluctant to share such information, highlighting the need for data-sharing programs. Africa offers two examples for a successful collaboration between universities and tax authorities – the IBFD Centre for Studies in African Taxation (CSAT) and the African Tax Institute under the University of Pretoria.²²³
- **Focus on shifting mindsets.** Moving towards greater use of big data analytics for tax purposes may require a fundamental mindset change in government authorities. Communication with all staff is essential to smoothen the transition, and create a greater acceptance for the new technology.²²⁴ A potential solution that developing countries could adopt is the appointment of a Chief Information Officer or Chief Data Officer at tax authorities: executives who own the communication process, present the business case for IT and business functions to work in tandem, and bring together a multi-functional team to implement big data initiatives across the organization.²²⁵ Canada offers a good example for successful change management: senior managers focused on communicating the value of analytics in plain terms to all staff. They explained the simple logic behind big data analysis techniques and the relevance of each function in the overall strategy. South Africa's experience also reveals the importance of providing incentives to facilitate change and encourage tax officers to learn new statistical and computing skills. The country is regarded as a leader in incentivizing a data-driven approach, linking performance rewards to the use of data in decision-making. Such performance-based incentives help users overcome resistance and allow the new technology to unfold its productivity benefits faster.

221 African Business Review (2014). "Big data in Africa: IBM dissects a developing trend in a developing market" Available at: <http://www.africanbusinessreview.co.za/technology/1783/Big-Data-in-Africa-IBM-Dissects-a-Developing-Trend-in-a-Developing-Market>

222 The Conversation (2017). "Welcome to E-Estonia, the tiny nation that's leading Europe in digital innovation" Available at: <https://theconversation.com/welcome-to-e-estonia-the-tiny-nation-thats-leading-europe-in-digital-innovation-74446>

223 See IBFD Centre for Studies in African Taxation: <https://www.ibfd.org/About-IBFD/IBFD-Centre-Studies-African-Taxation-CSAT>; and African Tax Institute, University of Pretoria: <http://www.up.ac.za/african-tax-institute>

224 The Wall Street Journal (2014). "The big mystery: what's big data really worth?" Available at: <https://www.wsj.com/articles/whats-all-that-data-worth-1413157156>

225 OECD (2016). Technologies for better tax administration: A practical guide for revenue bodies. Available at: <http://www.oecd.org/publications/technologies-for-better-tax-administration-9789264256439-en.htm>

3.4.4

Digitization of existing & potential G2P payments



Digitization of existing & potential G2P payments

Technological group: *Digitization of payments*

Key PFM concerns addressed: 3. *Allocating public spending more efficiently and deliver services more effectively*

The problem with G2P payments in low-income countries

Government-to-person (G2P) payments include cash payments related to social programs as well as wages, pensions, and other payments. The potential benefits of these programs, however, are often severely diminished by high transaction and administration costs; corruption and fraud; and a lack of targeting to the intended beneficiaries:

- **High transaction costs.** The manual processes involved in collecting, counting, recording, and transporting cash can create high administrative costs and significantly reduce the amount of available funds. These costs can range between US\$75 and US\$130 per year per recipient.²²⁶
- **Opportunities for corruption and fraud.** A lack of transparency and multiple “handover” points create significant opportunities for corruption and fraud associated with G2P payments. For instance, it has been estimated that out of the US\$21 billion that India spent on food subsidies in 2016, 54 percent of wheat subsidies, 48 percent of sugar subsidies, and 15 percent of rice subsidies never reached the intended beneficiaries.²²⁷ Even in Spain, a 2009 national census uncovered that local municipalities were inflating their registered population with up to 9 percent of “ghost” residents to boost subsidies received from the central government.²²⁸
- **Lack of targeting.** A further challenge is that many G2P payments are not well targeted to their intended beneficiaries, which reduces their potential social impact. For example, it has been estimated that in 2010, the wealthiest quintile of the world’s population reaped 43 percent of the benefits of fuel subsidies programs whilst the poorest quintile only received 7 percent of the benefits.²²⁹

226 McKinsey Global Institute (2016). “Digital finance for all: Powering inclusive growth in emerging economies”.

227 Radcliffe D (2016). “Digital Payments as a Platform for Improving State Capacity”, Center for Global Development. Available at: <https://www.cgdev.org/sites/default/files/digital-payments-platform-state-capacity.pdf>

228 R. Reinikka and J. Svensson, (2002). “Explaining Leakage of Public Funds”, Centre for Economic Policy Research (CEPR), Discussion Paper 3227; and R. Reinikka and J. Svensson (2003). “The Power of Information: Evidence from a Campaign to Reduce Capture”, World Bank; and Dirk Foremny, Jordi Jofre-Monseny, and Albert Solé-Ollé (2005) ““Hold that Ghost”: Local Government’s Cheating on Transfers”, – presentation at Cesifo Area Conference on Public Sector Economics.

229 Javier Arze del Granado, David Coady, and Robert Gillingham (2010). “The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries.” IMF Working Paper 10/202.

How could digital payments address this problem?

Internet access and mobile connectivity are providing the opportunity to reduce the problems described above by shifting the form of these payments from in-kind, cash, or paper-based methods (such as vouchers) to electronic ones. These payments can be classified into three categories:²³⁰

1. **Electronic Funds Transfer (EFT)-based instruments:** direct credit and debit transfers that go directly from one account to another.
2. **Card-based payment instruments:** credit-, debit-, scratch- and charge-card payments that typically involve a physical plastic card and are initiated, authorized, authenticated, cleared, and settled electronically.²³¹
3. **Electronic money (e-money)-based instruments:** online money with payment instructions initiated via the internet, mobile money, and prepaid cards. These instruments involve the payer maintaining a pre-funded transaction account with a payment service provider (which could be either a bank or non-bank).²³²

Digitizing G2P payments brings four main benefits:

- **Lower administration costs.** The cash and goods involved in G2P transfers are often difficult and expensive to collect, store, move and transfer to beneficiaries. Digitization of G2P payments can help significantly reduce these administrative costs:
 1. Digitizing payments helped save US\$1.17 per transaction for the Ti Manman Cheri social assistance program in Haiti, and halved the cost per of the 4Ps social-benefits program in the Philippines.²³³
 2. In India, changing subsidies for liquefied petroleum gas (LPG), from in-kind to digitized cash has conservatively saved the government more than US\$1 billion (even accounting for the fall in fuel prices).²³⁴
 3. In Kenya, the World Food Program found that the costs of delivering electronic cash payments to food insecure households in Kenya was 15 percent cheaper than in-kind distribution.²³⁵

230 Committee on Payments and Market Infrastructures (CPMI) And World Bank (2015). Consultative report: Payment Aspects of Financial Inclusion. Available at: <http://www.worldbank.org/en/topic/paymentsystemsremittances/brief/pafi-task-force-and-report>

231 These cards are generally, but not necessarily, associated with a bank account. Brazil's program Bolsa Familia allowed recipients to receive grants on a limited-purpose instrument called Social Card, i.e. a non-transactional virtual account that does not allow deposits and indefinite storage like a bank account, but which allowed beneficiaries to withdraw money at over 36,000 ATM points of a government bank. Source: CGAP (2011). Brazil Country Report. Available at: http://www.cgap.org/sites/default/files/CGAP-G2P-Research-Project-Brazil-Country-Report_0.pdf

232 CGAP (2015). "DaviPlata: Taking Mobile G2P Payments to Scale in Colombia". Available at <http://www.cgap.org/blog/daviplata-taking-mobile-g2p-payments-scale-colombia>

233 Zimmerman J, Bohling K, and Parker S (2014). "Electronic G2P Payments: Evidence from Four Lower-Income Countries" Consultative Group to Assist the Poor, Washington, DC.

234 Microsave, "G2P payments - India's key to financial inclusion". Multipliers of Prosperity. Available at: <http://partners.wsj.com/metlife/multipliers/articles/g2p-payments-india-key-to-financial-inclusion/>

235 CGAP (2013). "World Food Programme's exploration of the in-kind to e-payments shift for food assistance in Kenya".

Digitization of existing & potential G2P payments

- **Increased transparency.** Digitization of payments helps address the problems of leakage and fake “ghost” recipients, since it creates a digital record of the money issued and received, imposing stricter standards of identifications and proof of entitlement at all stages.²³⁶ In India, switching the payment of social security pensions from manual cash pay-out to smart cards resulted in a 47 percent reduction in the incidence of bribe rates, as well as a reduction of ghost recipients of 11 percent.²³⁷ Another example is in Sierra Leone when the government used digital means to pay health workers during the height of the Ebola crisis. In the process, digitizing payments delivered cost savings of more than US\$10 million by eliminating double-payment, reducing fraud, removing the costs of physical cash transportation and security, and cutting travel costs for Response Workers. Related benefits include reduced payment times from over one month to around one week, putting an end to payment-related strikes.²³⁸
- **Allocated efficiencies through better targeting of payments.** Digital payments help governments improve targeting and reach of social transfers, both amongst the general population and within the family themselves; moreover, they reduce allocation inefficiencies connected with indirect (price) subsidies - where citizens with varying income levels receive the same level of subsidies. Three examples help illustrate these points:
 1. In Brazil, “Bolsa Familia” digitized and consolidated various cash-transfer programs and managed to deliver 80 percent of benefits to the poorest quartile of the population, versus the previous share of 64 percent.²³⁹
 2. In Niger, evidence from a social transfer program shows that replacing cash with mobile payments increased the level of privacy and control of female recipients, tilting the balance of intrahousehold decision-making in their favor.^{240 241}
 3. In 2010, Iran pioneered the replacement of indirect subsidies to energy products with direct dividend transfers to the population. The International Monetary Fund (IMF) has estimated that out of the US\$50-US\$60 billion savings achieved from removing the price caps, US\$30 billion was redistributed to the general population in freely usable cash, and another US\$10–15 billion was provided to enterprises investing in energy efficiency.²⁴²

236 Klapper L(2014). “The Opportunities for Digitizing Payments; How Digitization of payments, transfers, and remittances contributes to the G20 Goals of broad-based economic growth, financial inclusion, and women’s economic empowerment.” World Bank, Better Than Cash Alliance, Gates Foundation, G20, Global Partnership for Financial Inclusion.

237 Cangiano P, Muralidharan K, Niehaus P, Sukhtankar S (2014). “Payments Infrastructure and the Performance of Public Programs: Evidence from Biometric Smartcards in India”. NBER working paper 19999. Available at: <http://www.nber.org/papers/w19999.pdf>

238 Better Than Cash Alliance (2016). Saving Money, Saving Lives: A Case Study on the Benefits of Digitizing Payments to Ebola Response Workers in Sierra Leone. Available at: https://btca-prod.s3.amazonaws.com/documents/186/english_attachments/BTCA-Ebola-Case-Study.pdf?1502739794

239 Lindert K, Linder A, Hobbs J, and Briere B (2007). “The Nuts and Bolts of Brazil’s Bolsa Familia Program: Implementing Conditional Cash Transfers in a Decentralized Context.” SP Discussion Paper 0709, World Bank, Washington, DC

240 J. Aker, R. Boumijel, A. McClelland, and N. Tierney (2013). “How Do Electronic Transfers Compare? Evidence from a Mobile Money Cash Transfer Experiment in Niger.” Tufts University Working Paper. Available at: <http://docplayer.net/53281481-How-do-electronic-transfers-compare-evidence-from-a-mobile-money-cash-transfer-experiment-in-niger.html>

241 There is a wide amount of literature demonstrating that, at a family level, money management in the hands of women (versus men) is associated with larger improvements in child health and larger expenditure shares of household nutrients, health, and housing. See, for example: Esther Duflo (2012). “Women Empowerment and Economic Development.” *Journal of Economic Literature* 50(4), pp.1051–1079.

242 Guillaume D, Zyttek R and Reza Farzin M (2011). “Iran – The Chronicles of the Subsidy Reform.” International Monetary Fund Working Paper. Available at: <https://www.imf.org/external/pubs/ft/wp/2011/wp11167.pdf>

Digitization of existing & potential G2P payments

- **Easier liquidity management in public accounts.** Digital payments improve timeliness and accuracy of in-year budget execution reports, since electronic transactions are easier to track and reconcile with the overall government account.²⁴³ Moreover, digitization helps staggering payments in time, reducing the difficulty of mobilizing large amounts of liquidity at the same time, as experienced by “Familias en Accion” in Colombia prior to digitization.²⁴⁴

Digitizing G2P payments can also deliver additional benefits to recipients:

- **Faster service delivery.** The lag time between payment decision and disbursement is virtually non-existent for digital payments, whilst it may take up to several days of administrative and logistic procedures to deliver cash, especially in remote areas.²⁴⁵ This is particularly troublesome for beneficiaries of public programs who are often cash-strapped, and may take up payday and informal loans to bridge this gap to cover monthly expenses.²⁴⁶ For example, when the Indian state of Andhra Pradesh introduced biometric identify with e-payments for subsidies in 2010, it reduced lag by 10 days (29% reduction from 34 days).²⁴⁷
- **Lower travel costs for beneficiaries.** For beneficiaries living outside urban areas, withdrawing a government cash transfer could mean facing a significant amount of travel to reach the designated location of payment, often a bank branch or a money transfer operator located in an urban center. Digital payments can drastically reduce the associated time and travel costs. For example, in Niger, recipients of mobile transfers saved 16 hours of travel and waiting time compared to people enrolled in the same social program who were being paid in cash.²⁴⁸
- **Increased security.** Recipients of cash-based transfers are often vulnerable to crime and robbery, especially for regular payments of relatively large sums (such as pensions and other social transfers). Digital payments reduce these risks, since electronic funds are cheaper and safer to store and can be withdrawn in smaller amounts.

243 Cangiano M, Gelb A, and Goodwin-Groen R (2017). “Digitization of Government Payments as a Key Tool of Modern Public Financial Management”. Paper prepared for the conference “Digital Revolutions in Public Financial Management.”

244 CGAP (2015). “DaviPlata: Taking Mobile G2P Payments to Scale in Colombia”. Available at <http://www.cgap.org/blog/daviplata-taking-mobile-g2p-payments-scale-colombia>

245 The speed of money delivery can be particularly crucial in emergency situations, such as health epidemics or natural disasters, where cash availability can be crucial to buy essential goods.

246 Klapper L (2014). “The Opportunities For Digitizing Payments; How Digitization of payments, transfers, and remittances contributes to the G20 Goals of broad-based economic growth, financial inclusion, and women’s economic empowerment. World Bank, Better Than Cash Alliance, Gates Foundation, G20, Global Partnership for Financial Inclusion.

247 Mint on Sunday (2016). “The economics of the MGNREGS”. Retrieved at: <http://www.livemint.com/Sundayapp/ueWD2KvNelmsOGEupZND6K/The-economics-of-the-MGNREGS.html>

248 Based upon an average daily agricultural wage, this amount of savings would be enough to feed a family of five for five days. Source: J. Aker, R. Boumniel, A. McClelland, and N. Tierney (2013). “How Do Electronic Transfers Compare? Evidence from a Mobile Money Cash Transfer Experiment in Niger.” Tufts University Working Paper. Available at: <http://docplayer.net/53281481-How-do-electronic-transfers-compare-evidence-from-a-mobile-money-cash-transfer-experiment-in-niger.html>

Digitization of existing & potential G2P payments

- **Accelerated financial inclusion.** Digital payments offer a good incentive and channel for people to have access to financial instruments for the first time.²⁴⁹ An analysis of “Oportunidades”, a social transfer program in Mexico, shows that accounts opened for this purpose increased frequency of remittances received through formal payment channels.²⁵⁰ The first step is usually enabled by simpler instruments such as m-money and prepaid cards, which do not necessarily require bank accounts but still allow beneficiaries to achieve some form of financial inclusion.²⁵¹

There is evidence the digital transfers have also raised levels of formal financial inclusion: in Pakistan, when the National Identity Agency, United Bank Limited and Visa partnered to help families affected by a conflict and an internal flood, they distributed aid on Visa prepaid cards and installed terminals in local businesses to accept payment cards. As a result of the program, not only was US\$300 delivered to each vulnerable family in a fast and efficient way, but over 270,000 new bank accounts were also created and stayed open, giving access to secure and reliable financial services to citizens that were previously financially excluded.²⁵²

A recent survey of more than 600 households in the state of Rajasthan in India sought to assess the perceptions, user experience and benefits of the Aadhaar biometric identification scheme which underpins the statewide initiative to go digital and shift cash payments to bank transfers. A key finding is that the payments reforms have spurred financial inclusion in Rajasthan, with virtually all households now having at least one bank account.²⁵³

The social benefits of financial inclusion are potentially significant. Past research has found that individuals who become financially-included benefit from a 5 to 15 percent improvement in productivity and income, which is a conservative estimate compared with what has been witnessed in nations such as Kenya (which experienced a 5 to 30 percent improvement).²⁵⁴

249 There is a wide amount of literature covering various regions of the world which describes the benefits associated with a higher number of accounts and financial services used, in terms of lower transaction costs, higher proximity to intermediaries and higher incentives to save. See, for example: Franklin Allen, Asli Demircuc-Kunt; Leora Klapper, Maria Soledad Martinez Peria (2012). “The Foundations of Financial Inclusion: Understanding Ownership and Use of Formal Accounts”. Policy Research Working Paper, No. 6290. Available at: <https://openknowledge.worldbank.org/handle/10986/12203>

250 Masino S and Niño-Zarazúa M (2014). “Social Service Delivery and Access to Financial Innovation.” UNWIDER Working Paper 2014/034. Available at: https://mpr.ub.uni-muenchen.de/53430/1/MPRA_paper_53430.pdf

251 These instruments are cheaper to leverage on mobile (as most people have it and infrastructure is easier to implement) as opposed to a traditional banking system

252 Visa Viewpoints Blog (2013). “Aid Disbursement: Extending Relief & Bringing People Into the Formal Financial System”. Available at: <https://www.visa.com/blogarchives/us/tag/united-nations/index.html>

253 Gelb A, Mukherjee A, Navis K, Thapliyal M and Giri A (2017). “What a New Survey of Aadhaar Users Can Tell Us About Digital Reforms: Initial Insights from Rajasthan”. Center for Global Development. Available at: <https://www.cgdev.org/sites/default/files/what-new-survey-aadhaar-users-can-tell-us-about-digital-reforms.pdf>

254 McKinsey Global Institute (2014). “Southeast Asia at the crossroads: Three paths to prosperity”.

What are the states of readiness to adopt the technology?

Our review of the benefits of digital G2P payments systems confirms the high potential to optimize public spending and improve service delivery. There are three broad states of readiness to adopt digital G2P payments: pre-readiness, basic readiness, and advanced readiness (Exhibit 9). A country must fulfil the enabling requirements in its state of readiness to have the highest chance of successful implementation at the corresponding level of adoption.

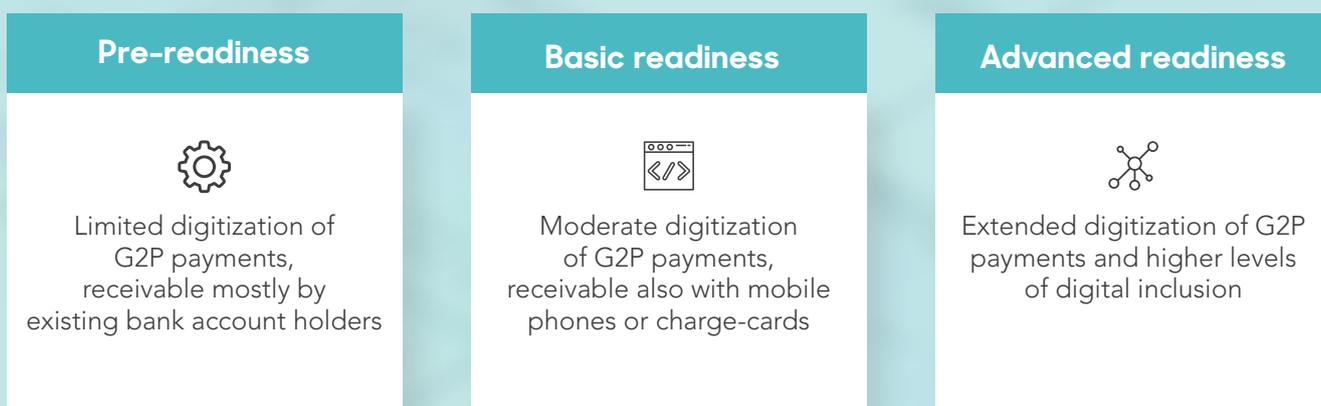
The state of pre-readiness is one where a country has the conditions to only adopt very limited applications of digital G2P payments: transfers are digitized only for a restricted number of government cash transfer programs that were previously paid in cash and received mostly by existing bank account holders. Countries under the basic state of readiness are ready to adopt a wider digitization of G2P transfers, perhaps by including government programs that would have the most impact (for example replacing energy subsidies or in-kind food distribution) and receivable through other electronic instruments such as mobile phones or charge-cards. Finally, countries under the advanced readiness have the opportunity to implement extensive digitization of G2P payments in the country: all G2P transfer programs can be digitized (assuming there is a clear benefit in doing so) and high levels of digital penetration ensure that a very large share of the population can receive them.

For effective adoption of technology under each state of readiness, there is a specific set of enabling conditions that countries must fulfill. These enabling conditions are additive – in other words, a country a country in the advanced state of readiness may reap the full potential of digital G2P payments only when it satisfies the key requirements in all three states. The higher the degree of fulfilling these conditions, the higher the likelihood of successful implementation of digital G2P payments in each respective state.



Exhibit 9

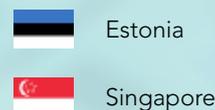
There are three states of readiness to digitize government-to-person (G2P) payments



Key requirements

- Clear and updated beneficiary lists
- Basic transparency measures to improve accountability
- Secure & efficient logistics and payment network
- Reliable ICT infrastructure
- Legislation and regulations for non-bank financial operators
- Staff capacity and training to operate new systems
- Trust and capabilities of beneficiaries
- Buy-in from other stakeholders
- Political support at highest level
- Widespread adoption of digital financial services
- Shared database across government departments
- Interoperability across payment systems

Country examples



Digitization of existing & potential G2P payments

Pre-readiness describes the state of readiness where conditions are available only for very limited forms of G2P digital payments. Countries in this state may find that it is still more efficient for most G2P transfers to remain largely cash-based, and only a few government transfers programs are digitized. Recipients of digital payments are mostly existing bank account holders who are able to receive electronic bank transfers, while other beneficiaries still receive their payments in cash or in-kind.

The typical G2P transfer process in countries within this state of readiness is one riddled with inefficiencies: for example, government agencies send coupons by mail and then beneficiaries must go to participating provision shops/post-offices to exchange them for cash or food – spending time traveling that could be more productively used. Additionally, low levels of transparency during payment and withdrawal leave room for corruption and leakage. Countries in this state of readiness can immediately improve the effectiveness of G2P transfers by fulfilling some of the basic key enabling conditions:

- **Clear and updated beneficiary lists.** Updated beneficiary lists with clear criteria for inclusion in each government transfer program are a crucial starting point.²⁵⁵ For example, there is still the question of how accurate the BPL/APL (below and above poverty line) designations are in India. These needs to be clearly defined since they affect the accuracy of census data, registries and beneficiary lists. Interviews with experts in Nigeria highlighted that general accountants of government programs in some Nigerian states would regularly include their family members and friends in the list of beneficiaries, although they did not meet the eligibility criteria for these benefits.
- **Basic transparency measures to improve accountability.** Basic transparency measures to increase accountability of public sector officers and intermediaries can be introduced. For example, regular changing of positions for payment officers and a system of “spot checks” conducted by third parties including interviews of beneficiaries, services providers, banks, local and regional offices.^{256 257}
- **Secure and efficient logistics and payment network.** Movements of goods and cash require a safe and efficient logistics network (e.g., armored vehicles and security guards) to reduce leakage, crime and transport costs, while a stable and reliable banking and remittance infrastructure needs to be in place to remove middlemen and enable timely transfer from government accounts to end-points such as final beneficiary bank accounts or intermediary agents. This should include a dense network of “cash-out” facilities and agents where beneficiaries can easily withdraw payments.

255 An evaluation of Uganda's SAGE program found that most of the complaints relate to appeals on selection (47.7% of cases) and queries on selection criteria (32.5%). Source: Fred Merttens, Esméralda Sindou, Ramlatu Attah and Chris Hearle (2016). “Evaluation of the Uganda Sage Program”. Endline programme operations performance – final report. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/607525/Evaluation-of-Uganda-Social-Assistance-Grants-for-Empowerment.pdf

256 This system is even more effective if the legislation empowers independent auditors to punish misbehaving subjects as well as beneficiary representatives to flag issues and complaints as they arise – for example, on beneficiary lists, amount and timeliness of benefits delivery.

257 Arulpragasam J, Fernandez L, Matsuda Y, Olfindo R, and Stephens M (2011). “Building Governance and Anti-Corruption in the Philippines’ Conditional Cash Transfer Program”. World Bank Report 60234. Available at: <http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan047837.pdf>

Digitization of existing & potential G2P payments

Basic readiness describes the state of readiness where countries are ready to extend the use of digital payments across programs that were not previously digitized by equipping new recipients with the means to receive payments digitally. These programs could include resource subsidies or in-kind distributions where potential savings could be significant. One example is Iran's shift from indirect fuel subsidies to direct cash transfers to selected households. Beneficiaries should be able to receive payments not just through electronic instruments that are linked to their bank accounts, but also through mobile money, e-wallets or smart cards. Key enabling conditions needed to achieve this state of readiness include:

- **Reliable ICT infrastructure.** Reliable electronic equipment, software and services to connect, manage and operate payment centers and terminals is critical. These range from secure servers and datacenters to mobile and broadband infrastructure, as well as appropriate processing software. Without these, it is very difficult to scale up and broaden successful G2P digital payment solutions. For example, in Brazil, the roll-out of "Bolsa Familia" was hampered by prolonged periods of blackouts due to the volume of data to be processed.²⁵⁸ In Nigeria, many G2P recipients see cash as more convenient than digital payments given the long lines at bank branches due to system outages and connectivity problems from the central system.²⁵⁹

Digital payments experts are of opinion that a related and crucial component of ICT infrastructure is the availability of a unique *digital ID* system. This ensures that recipients can be identified and authenticated digitally (e.g. on an internet banking platform) so that funds can be dispensed accurately. For example, the successful transition away from cash-based payments in the state of Rajasthan leverages heavily on the national Aadhaar biometric identification scheme. Conversely, Tanzania ran into problems when testing approaches for shifting from cash to digital payments as they do not have their ID system in place.

- **Legislation and regulation for non-bank financial operators.** A common and promising non-bank payment mechanism is mobile money, which allows mobile users to receive, accumulate, withdraw, and transfer payments via dedicated functions on their mobile phones – without the need of having a formal bank account. Alternatively, some programs have used "smart" cards, i.e. plastic cards with an electronic chip capable of enabling payments. For these non-banking systems to work, it is often necessary for a private mobile or payments operator to take the lead by investing in infrastructure and services to collect and store data, identify and authorize users (through the card itself, an identity number, biometric information, and / or a PIN code), transfer money through a central account to users, update credit balances, forecast and manage liquidity demand at end points, and provide customer assistance. For non-bank financial players to support digital G2P payments, it is necessary to have in place a clear regulatory framework to authorize and oversee their operations. The challenge is that innovative financial products could also be disruptive, hence regulators (and companies) need to be flexible, open, and creative to stimulate innovation and

258 Medium (2017). "Brazil's National ID System—disorganised and dysfunctional". Available at: <https://medium.com/@privacyint/brazils-national-id-system-disorganised-and-dysfunctional-e1c3f51d6c0a>

259 Finclusion Blog (2015). "G2P Needs to Work for Consumers". Available at: <http://finclusion.org/blog/g2p-needs-to-work-for-consumers.html>

Digitization of existing & potential G2P payments

experimentation in new mechanisms for financial inclusion, whilst ensuring customer protection and a level playing field with incumbents.

- **Staff capacity and training to operate new systems.** A Microsoft survey of over 1,200 Information Technology leaders in the Asia Pacific found that the main barrier to digital transformations in the region is the lack of a digitally skilled workforce.²⁶⁰ Staff capacity and training has been identified as one of key challenges to digitize several G2P payment programs in developing countries, such as Haiti, Colombia, and the Philippines, where officers and staff have struggled both to learn how to operate the digital system and to manage the procurement and reporting processes from central agencies.²⁶¹
- **Trust and capabilities of beneficiaries.** First-time users of digital payment systems often lack trust in digital finance as they lack familiarity with the technology, or even with SMS literacy.²⁶² For example, the first m-PESA pilot in Kenya revealed the need for extensive customer training on mobile phone basics.²⁶³ Similarly, in Haiti, program managers underestimated the need for recipient training on mobile payments.²⁶⁴ Beside phone usage, another trust-related problem has been registration of identification data such as biometric information. To illustrate, interviews with Public Finance Management (PFM) experts in Nigeria have revealed people's reluctance to register their fingerprints, even with the promise of safer, reliable G2P transfers.
- **Buy-in from other stakeholders.** Radical changes often encounter opposition from people or organizations deeply entrenched in the status quo. For example, Ghana's public-sector unions slowed down the government's plan to pay all salaries via the "e-Zwich" digital system because they claimed not to have been consulted in advance of the roll-out.²⁶⁵ In India, implementations of digital payment programs regularly encountered opposition from front-line entities that were traditionally delivering them because the new changes hindered their ability to profit fraudulently.²⁶⁶

Advanced readiness describes the state of readiness where a country has the opportunity to adopt digital payments for all its all government transfer programs as long as it makes economic and efficiency sense. Digital G2P payments adoption at this level state leads to shorter lag times between the government and the recipients, achieve complete operability across payment platforms, and creates an overall system where allocative inefficiency are minimized.

260 Microsoft Asia Blog (2017). "80% of business leaders believe they need to be a digital business to succeed: Microsoft study". Available at: <https://news.microsoft.com/apac/2017/02/20/80-of-business-leaders-believe-they-need-to-be-a-digital-business-to-succeed-microsoft-study/>

261 CGAP and UKAID (2013). "Striving for E-payments at Scale - The Evolution of the Pantawid Pamilyang Pilipino Program in the Philippines". Available at: http://www.cgap.org/sites/default/files/eG2P_Philippines.pdf

262 CGAP (2015). "DaviPlata: Taking Mobile G2P Payments to Scale in Colombia". Available at <http://www.cgap.org/blog/daviplata-taking-mobile-g2p-payments-scale-colombia>

263 Proudly Made in Africa (2014). "M-Pesa: The Safaricom Story". Available at: http://www.proudlymadeinafrica.org/images/uploads/docs/M-Pesa_CaseStudy_June14_synopsis.pdf

264 CGAP (2014). "Case Study: Mobile Money-Based Government-to-Person Payments in Haiti". Available at: <http://www.cgap.org/publications/case-study-mobile-money-based-government-person-payments-haiti>

265 Citi FM Online (2016). "Gov't suspends payment of salaries via e-zwich after protests" Available at: <http://citifmonline.com/2016/06/05/govt-suspends-payment-of-salaries-via-e-zwich-after-protests/>

266 Cangiano M, Gelb A, and Goodwin-Groen R (2017). "Digitization of Government Payments as a Key Tool of Modern Public Financial Management". Paper prepared for the conference "Digital Revolutions in Public Financial Management."

Digitization of existing & potential G2P payments

Some of the key enabling conditions that countries need to acquire to reach an advanced level of readiness are:

- **Political support at the highest level.** Senior government sponsorship and coordination is crucial for the digital payments agenda to be widely adopted across government. For example, the Mexican government would have struggled to carry its payment digitization program, prioritizing and solving emerging issues, without the technical knowledge and expertise of a core group of dedicated high-level officers at the Federal Treasury.²⁶⁷ In retrospect, Ghana's government missed this decisive step when it was not able to effectively resist the pressure from public sector unions to slow down the implementation of its e-Zwich program, that required aggregation of different ID registries.
- **Widespread adoption of digital financial services.** A country aspiring to digitize all or most of its G2P payments must ensure that its citizens are able to receive them. Following the Enhancing Financial Innovation and Access (EFInA) classification of a "financially served population", there are two main ways to work towards this requirement.²⁶⁸ First, by growing the share of population with bank accounts ("banked" or "formally included"), with strong incentives or regulations to compel banks to expand their network and reach low-income, financially illiterate customers living in remote areas. Second, by increasing the share of people who have or use financial products and services provided by formal financial institutions which go beyond deposit accounts, such as mobile money in Kenya or smart-cards in Ghana. Apart from reliable network coverage and user skills - already discussed in the previous section - a key challenge is ensuring effective access. For example, in the Philippines, the digital GCASH program found that only 20 percent of the recipients in payout areas had a mobile phone.^{269 270}
- **Shared database across government departments.** Inefficiencies could persist if government agencies keep their databases siloed, leaving room for beneficiaries to overlap in different registries and receive payments multiple times. For example, in Ghana, 98 percent of people report having at least one form of ID, but their biometric data is stored in nine separate databases. Experts have argued that this lack of centralization in identification databases has hampered the development of an integrated digital payments ecosystem across the country.²⁷¹

267 Cangiano M, Gelb A, and Goodwin-Groen R (2017). "Digitization of Government Payments as a Key Tool of Modern Public Financial Management". Paper prepared for the conference "Digital Revolutions in Public Financial Management".

268 EFInA (2016). "Key Findings: EFInA Access to Financial Services in Nigeria (A2F) 2016 Survey" Presentation available at: <http://www.efina.org/ng/assets/A2F/2016/Key-Findings-A2F-2016.pdf>

269 CGAP and UKAID (2013). "Striving for E-payments at Scale - The Evolution of the Pantawid Pamilyang Pilipino Program in the Philippines". Available at: http://www.cgap.org/sites/default/files/eG2P_Philippines.pdf

270 In the context of the TMC conditional cash transfer program, operators in Haiti started distributing free devices to beneficiaries without one, but had to abandon free phone distribution due to difficulties in registration and administration. CGAP (2014). "Case Study: Mobile Money-Based Government-to-Person Payments in Haiti". Available at: <http://www.cgap.org/publications/case-study-mobile-money-based-government-person-payments-haiti>

271 Cangiano P, and Janis W and Shah R(2016). "Accelerators to an Inclusive Digital Payments Ecosystem". Better Than Cash Alliance, UNCDF.

Digitization of existing & potential G2P payments

- **Interoperability across payments systems.** Interoperability refers to the ability for payments to flow from an end user that is the customer of one bank to an end user that is a customer of another.²⁷² Increased penetration of digital payments can only occur if users can ubiquitously withdraw money and transfer them to various accounts (banked or non-banked).

What does this mean for low-income countries?

Most low-income countries remain in the state of pre-readiness, where conditions are appropriate to only digitize payments in very selected transfer programs for a limited audience with existing means of receiving payments (e.g. internet banking). Hence, first and foremost, they should strive to have all of those basic enabling conditions – even those not directly connected with digital payments technology - in place to successfully pilot digitization before scaling up.

That said, it is not unreasonable for these countries to already work towards achieving basic readiness for digital G2P payments, considering that some of these conditions are not mutually exclusive and that it can take significant time to expand the breadth and capacity of financial and digital networks, and to build a capable and skilled implementation team. Past experiences in Latin America and Africa and (such as m-PESA in Kenya or Familias en Accion in Colombia) demonstrate that digital G2P payments are best implemented with a steady yet phased approach, and high degree of private sector involvement and communication with beneficiaries and other stakeholders.

Moreover, as argued by PFM experts studying the experience of India and Mexico, large-scale digitization of G2P payments is best implemented in parallel or together with other PFM programs such as nation-wide IDs, to exploit synergies in terms of widespread financial inclusion, subject identification and political momentum.²⁷³

²⁷² CGAP (2013). "Interoperability in Electronic Payments: Lessons and Opportunities". Available at: <http://www.cgap.org/publications/interoperability-electronic-payments-lessons-and-opportunities>

²⁷³ Cangiano M, Gelb A, and Goodwin-Groen R (2017). "Digitization of Government Payments as a Key Tool of Modern Public Financial Management". Paper prepared for the conference "Digital Revolutions in Public Financial Management".



Digitization of existing & potential G2P payments

There are several lessons that have emerged from country experiences that are applicable to low-income countries wishing to adopt a greater level of digital G2P payments:

1. **Champion digitization in the public sector.** The necessary reforms to implement and spread digitization of G2P payments will often encounter strong opposition from influential incumbents who are deeply vested in the status quo, as well as inertia from various public administration offices. To push them forward, it is often critical to get traction from the highest offices of the political system. For example, Mexico was able to drive efficiency and financial inclusion by combining digitization of G2P payments with broader PFM modernization through the constant commitment of various governments to prioritize “innovation of digital services through democratization of public services”.²⁷⁴ Three steps were crucial: in 2007, the Mexican Parliament approved a law obliging banks to offer basic financial services; in 2010, a Presidential Budget Decree mandated all government departments to shift to centralized electronic payments – de facto imposing implementation of e-payments at full scale; and in 2013, the President launched a new five-year plan merging the agenda of e-payments and PFM modernization.
2. **Adopt a phased roll-out.** Infrastructure capacity and staff capabilities to support G2P payment digitization are usually built over time. For this reason, low-income countries should resist the temptation and political pressure to quickly expand scope and reach of successful pilot projects, otherwise service quality may suddenly drop without the right conditions in place. Two country examples provide interesting illustrations of this point:
 - a. In the Philippines, when the Department for Social Welfare and Development succumbed to the political pressure to rapidly expand the 4P program from 6,000 recipients in 2008 to 3 million by 2011. As a result, program officers struggled to balance the need of making accurate and timely payments while keeping in place rigorous processes for data collection, targeting and monitoring.²⁷⁵
 - b. In Haiti, Prime Minister Lamothe expanded the conditional cash transfer program TMC from the capital to the whole country in a very short time to assist those impacted by the hurricane. Despite the good intentions, the program implementation was undermined by a lack of experience in the core team to meet the targets of the expanded scope, and the lack of an adequate agent network in place outside the capital.²⁷⁶

274 Cangiano M, Gelb A, and Goodwin-Groen R (2017). “Digitization of Government Payments as a Key Tool of Modern Public Financial Management”. Paper prepared for the conference “Digital Revolutions in Public Financial Management”.

275 CGAP and UKAID (2013). “Striving for E-payments at Scale - The Evolution of the Pantawid Pamilyang Pilipino Program in the Philippines”. Available at: http://www.cgap.org/sites/default/files/eG2P_Philippines.pdf

276 CGAP (2014). “Case Study: Mobile Money-Based Government-to-Person Payments in Haiti”. Available at: <http://www.cgap.org/publications/case-study-mobile-money-based-government-person-payments-haiti>

Digitization of existing & potential G2P payments

3. **Build digital skills in staff and users.** Stakeholders should equip their staff with the necessary skills to implement digital payments, such as knowing how to analyze and operate large databases, as well as process electronic payments in newly designed and evolving systems. Webinars and skill-based modular courses could be a particularly efficient and cost-effective way to train staff.²⁷⁷ Users should also be educated on how to comfortably use digital payment portals and instruments: educational campaign customized for subjects with various levels of financial and digital literacy can encourage adoption and improve sound behaviors, such as PIN protection and phishing avoidance. For example, the World Food Program in Kenya designed posters with pictures depicting payment procedures and self-protection rules, which were displayed prominently in agents' and merchants' shops.²⁷⁸
4. **Adapt product design to beneficiary needs.** Product design and choice can play a decisive role in increasing the adoption of digital payments, especially among beneficiaries who are unable to read or write, let alone using a phone or an ATM. For example, in Colombia, Davivienda became the first bank to offer card-less withdrawals from ATMs, creating a solution based on a personal identification number (PIN) generated by users when requesting access to their funds.²⁷⁹ In Ghana, the underlying technology of the e-Zwich payment system was conceived to work in areas with low levels of connectivity and beneficiary literacy: fingerprints are captured at enrolment, then de-duplicated and stored in the system and on a smartcard; when beneficiaries go to withdraw money with the smartcard, the ATM is equipped with a biometric technology that matches their fingerprints with the ones stored on the smartcard and issue the funds without requiring any signature or PIN.²⁸⁰
5. **Establish two-way communication channels to increase trust and transparency.** Two-way communication can play a key role to increase trust and overall buy-in of digital G2P payments. India, Kenya and Uganda offer examples of how what low-income countries did to increase adoption and efficiency of their digital G2P payments. One key reason for Aadhaar's success in India has been its communication strategy, which carries many lessons that are relevant to other low-income countries. They include i) strong and consistent messaging that appeals to both rational and emotional feelings of citizens;²⁸¹ ii) creating a sense of need for people to "want" to obtain and use the service and iii) customized marketing strategies tailored to different audiences.²⁸² In Kenya, a hotline was established for recipients who were part of the program for digitizing food assistance payments, where they could ask questions, express

277 See, for example, "Skill-based modular courses" at Singapore PACE Academy, Available at: https://www.sp.edu.sg/wps/portal/vp-spws/lut/p/a0/04_Sj9CPykssy0xPLMnMz0vMAfG-jzOL9LJwdDU2CDbwsDJydDRxDLswNLxcjdyNzfULsh0VAQOxZeUI/?WCM_GLOBAL_CONTEXT=

278 CGAP (2014). "Case Study: Shifting Food Assistance in Kenya to E-Payments". Available at: <http://www.cgap.org/publications/case-study-shifting-food-assistance-kenya-e-payments>

279 CGAP (2015). "Going Mobile with Conditional Cash Transfers". Available at: <https://www.cgap.org/sites/default/files/Working-Paper-Going-Mobile-with-CCTs-Jun-2015.pdf>

280 The system can also work offline, since ATM records the last 10 transactions on the card and vice versa; when connectivity is back, the system reconciles the card balance with the underlying account. Source: Keith Breckenridge (2010). "The World's First Biometric Money: Ghana's E-zwich and The Contemporary Influence Of South African Biometrics". Cambridge University Press. Africa, 80(4), 642-662.

281 LiveMint (2017). "The epic marketing challenge for UID". Available at: <http://www.livemint.com/Politics/x7AtsSk1VlOrtjKGUaJM0I/The-epic-marketing-challenge-for-UID.html>

282 Exchange for Media (2010). "UIDAI Unveils Brand Name & Logo; Communication Strategy In Next Few Months, Says Nandan Nilekani". Available at: http://www.exchange4media.com/others/uidai-unveils-brand-name--logo;-communication-strategy-in-next-few-months-says-nandan-nilekani_37955.html

Digitization of existing & potential G2P payments

concerns, and report grievances without fear of reprisal.²⁸³ In Uganda, when the central government started broadcasting on the radio and publishing on local newspapers the amount of monthly transfers to districts, it was able to reduce leakage in education grants from 80 to 20 percent.²⁸⁴

6. **Recognize the role of private companies and incentivize them.** The most critical steps in product design, network management and expansion can often be overcome by private sector expertise and resources. In Kenya, this has been demonstrated by the role of Vodafone in designing and testing the m-PESA application and by Safaricom's ability to leverage on its airtime resellers to create a network of deposit agents in rural areas. In Colombia, Daviplata and Redeban managed to find a solution to perform mobile banking operations only via SMS commands on existing SIM cards, without the need to replace them with new ones - an operation that would have costed a significant amount of resources and create severe inconveniences for the users. Acknowledging the importance of private sector contributions, governments (and donors) in low-income countries can play a key role in stimulating them with four key interventions:
 - a. Apply a risk-based approach to banking regulations. In India, regulators increased entry into serving low-income segments by applying less stringent due-diligence requirements to small accounts and basic service offerings.²⁸⁵
 - b. Encourage collaborations for infrastructural investments. Planning to ensure availability of mobile coverage in areas with a population density of at least 80 people per square kilometer, the Malaysian Communications and Multimedia Commission relaxed competition-regulations and encouraged Mobile Network Operators to partner in network-sharing and spectrum-pooling agreements. This drove down the level of capex needed and helped to triple penetration rates from 2010 to 2015.²⁸⁶
 - c. Award long-term contracts. In Colombia, Davivienda's investment in an expanded agent network was facilitated by a long-term contract with the government program "Familias en Accion", which helped the operator grow its user base to 2.2 million wallets by June 2014.²⁸⁷
 - d. Reward innovation. In Haiti, the Gates Foundation and USAID awarded US\$4 million to the first two operators launching m-money products in the market. These "scaling awards" aimed at increasing the number of transactions in a financial sector that was already inadequate before the earthquake.²⁸⁸

283 CGAP (2013). "Cash for Assets World Food Programme's Exploration of the In-Kind to E-Payments Shift for Food Assistance in Kenya". Available at: http://www.cgap.org/sites/default/files/eG2P_Kenya.pdf

284 Reinikka R and Svensson J, (2002) "Explaining Leakage of Public Funds", Centre for Economic Policy Research (CEPR), Discussion Paper 3227; and Reinikka R and Svensson J (2003), "The Power of Information: Evidence from a Campaign to Reduce Capture", World Bank

285 Industry players have argued that, from 2007 to 2014, the relaxation of "know-your-customer" norms allowed Indian banks and technology-enabled business correspondents model, to open over 200 million no-frills bank accounts in nearly 300,000 villages. Business Standard (2014). "Relaxation in KYC norms a big boost for financial inclusion". Retrieved at: http://www.business-standard.com/article/finance/relaxation-in-kyc-norms-a-big-boost-for-financial-inclusion-114061201052_1.html

286 GSMA (2015). "Rural coverage: strategies for sustainability". Retrieved at: <https://www.gsmainelligence.com/research/?file=53525bcdac7cd801eccef740e001fd92&download>

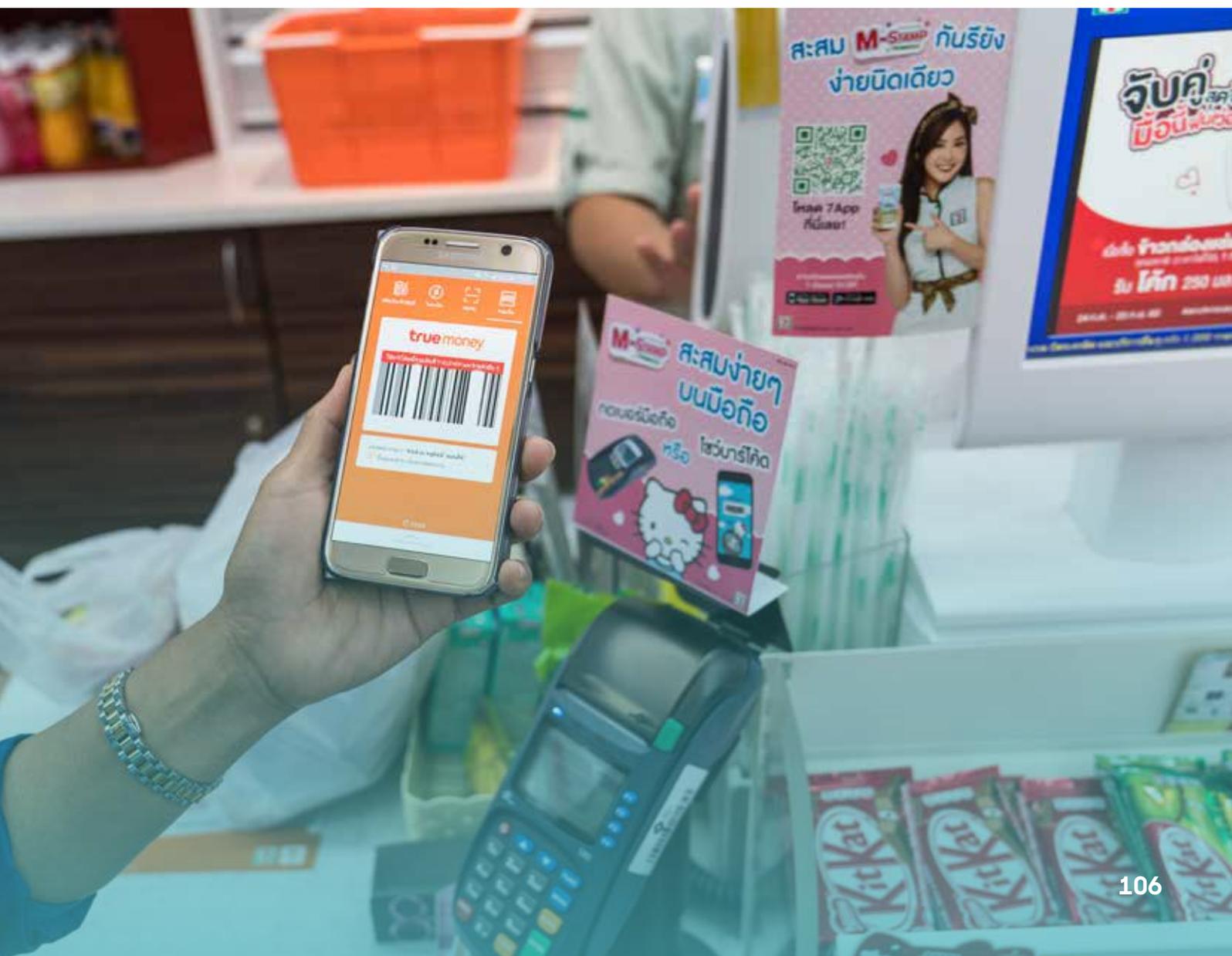
287 CGAP (2015). "DaviPlata: Taking Mobile G2P Payments to Scale in Colombia". Retrieved at <http://www.cgap.org/blog/daviplata-taking-mobile-g2p-payments-scale-colombia>

288 CGAP (2014). "Case Study: Mobile Money-Based Government-to-Person Payments in Haiti". Retrieved at: <http://www.cgap.org/publications/case-study-mobile-money-based-government-person-payments-haiti>

Digitization of existing & potential G2P payments

- Expand interoperability.** To increase the amount of service points where customers can withdraw transfers, the financial system should have in place agreements among different operators, high degrees of technical interoperability on a common platform, and low interchange fees. Public institutions can play a decisive role to kick start this process. For example, in India, the Reserve Bank promoted the National Payments Corporation, which launched a Unified Payment Interface facilitating the instant transfers of funds between all users of the mobile platform.²⁸⁹

²⁸⁹ Cangiano M, Gelb A, and Goodwin-Groen R (2017). "Digitization of Government Payments as a Key Tool of Modern Public Financial Management". Paper prepared for the conference "Digital Revolutions in Public Financial Management."





Blockchain technologies



Technological group: *Identification and recording technologies*

Key PFM concerns addressed: *iii) Allocating public spending more efficiently and deliver services more effectively; iv) Reducing corruption in public procurement; and v) Enhancing institutional accountability*

Challenges with institutional accountability of public financial records in low-income countries

Core to enhancing institutional accountability is the ability of governments to keep proper records of their expenditures in order to facilitate monitoring and evaluation by auditing bodies.²⁹⁰ International best practice suggests that governments should publish eight budget reports at different points in the budget cycle to ensure transparency and accountability.²⁹¹

In many low-income countries, there are multiple points where the integrity of the public financial accounts might be compromised. First, these financial records (e.g., payment details of public infrastructure projects) might be not tracked at all due to the lack of public registries, resulting in a complete lack of transparency on how the funds are spent. Second, this information might be recorded in paper-based ledgers, making it vulnerable to human recording errors, misplacement, fires, theft, and natural disasters. A massive earthquake destroyed the majority of the public records in Haiti in 2010.²⁹² Third, even if there are practices to record transactions on digital platforms such as spreadsheets, these platforms are still susceptible to breaches and many are operating in “silos”, meaning that different agencies use different software, causing compatibility issues that compromise attempts to consolidate the information.²⁹³ An example of a technical breach happened in Bangladesh; the accounts in the Central Bank of Bangladesh were hacked in 2016, resulting in a loss of US\$81 million.²⁹⁴ Fourth, despite the roll-out of Integrated Financial Management Information Systems (IFMIS) which are intended to automate record public financial data, technical skills to operate and maintain the IT systems are still required, which can be challenging in many low-income countries as most public sector workers remain lowly skilled.²⁹⁵ Furthermore, citizens and auditors are still required to trust that the information keyed into the IFMIS is accurate. There are numerous cases in low-income countries where this trust has been

290 Andrews M, Cangiano M, Cole N, Renzio P, Krause P, and Seligmann R (July 2014). This is PFM, CID Working Paper No. 285.

291 International Budget Partnership (2010), Guide to Transparency in Government Budget Reports: Why are Budget Reports Important, and What Should They Include? Available at: <https://www.internationalbudget.org/wp-content/uploads/Guide-to-Transparency-in-Government-Budget-Reports-Why-are-Budget-Reports-Important-and-What-Should-They-Include-English.pdf>

292 The Independent (2011), “The rift over the real cost of Haiti’s earthquake”. Available at: <http://www.independent.co.uk/news/world/americas/the-rift-over-the-real-cost-of-haitis-earthquake-2291471.html>

293 US Aid (2008), Integrated Financial Management Information Systems. Available at: http://pdf.usaid.gov/pdf_docs/Pnadc595.pdf, The World Bank (2017), “Financial Management Information Systems (FMIS)”. Available at: <http://www.worldbank.org/en/topic/governance/brief/financial-management-information-systems-fmis>, and IMF (2017), Digital Revolutions in Public Finance. Available at: http://www.elibrary.imf.org/view/IMF071/24304-9781484315224/24304-9781484315224/Other_formats/Source_PDF/24304-9781484316719.pdf

294 Reuters (2016), “Bangladesh Bank official’s computer was hacked to carry out \$81 million heist: diplomat”. Available at: <https://www.reuters.com/article/us-cyber-heist-philippines/bangladesh-bank-officials-computer-was-hacked-to-carry-out-81-million-heist-diplomat-idUSKCN0YA0CH>

295 Brendan E. Asogwa (2012), “The challenge of managing electronic records in developing countries: Implications for records managers in sub Saharan Africa” Records Management Journal, Vol. 22 Issue: 3, pp.198-211. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/09565691211283156?fullSc=1&journalCode=rmj>

violated, such as the US\$700 million land registry fraud in India.²⁹⁶

The monitoring of public financial accounts can be further hampered by the sheer time and effort required to aggregate relevant data, particularly if there are inconsistent accounting methods used across agencies. There could also be a lack of cooperation and trust from the auditees and internal auditing bodies might lack the financial independence, resources, and power to tackle ministries or officials who are non-compliant. Furthermore, these internal auditing officers might also be corrupted, resulting in a vicious cycle of non-transparent tracking and monitoring of public financial records.

The decentralization of fiscal authority to regional and district levels of government, can amplify these concerns due to the large number of entities involved. For instance, in Ghana, there are more than 30 ministries and over 140 public agencies.²⁹⁷ Under these units, there are approximately 154 districts and over 600 zones which also receive funds from the Ministry of Finance to administer public services such as education, social welfare, and public sanitation.²⁹⁸ Each individual unit consists of a finance team with accounting officers that records, tallies, and oversees all information on financial stocks and flows.

How could blockchain technologies address these challenges?

Blockchain refers to a form of peer-to-peer online distributed ledger, amongst computer nodes, which is made up of a continuously growing list of records (called blocks) linked and secured to each other using cryptography. This decentralized ledger is shared across all computer nodes (which refer to participants) in a blockchain where each participant will be able to view all the records on the blockchain and no one can alter the data retroactively.²⁹⁹ The blockchain is constantly updated (approximately every 10 minutes) across nodes, ensuring that each participant receives the most recent copy of the ledger. There are several encryption methods under cryptography: the most familiar in the blockchain literature would likely be the proof-of-work facilitated by the mining of cryptocurrencies such as Bitcoin.³⁰⁰ Other encryption methods include proof-of-stake.³⁰¹ Blockchain allows participants to communicate with one another without the need for a centralized administrator. This reduces the need to rely solely on centralized authorities and could significantly improve the

296 WU Global Tax Policy Center (2017), "Blockchain 101 for Governments". Available at: http://www.un.org/esa/ffd/wp-content/uploads/2017/10/15STM_Blockchain-101.pdf

297 Government of Ghana (2017), "Government Institutions". Available at: <http://www.ghana.gov.gh/index.php/governance/government-institutions> and Audit Service Ghana (2017), "About Us". Available at: <http://www.gaudit.org/gas/site/home>

298 Commonwealth Local Government Forum (2016), Ghana. Available at: http://www.clgf.org.uk/default/assets/File/Country_profiles/Ghana.pdf

299 Changing one block in the network is impossible because of in-built cryptography features such as digital signatures. See: BBVA (2017), "Is blockchain really immutable?". Available at: <https://www.bbva.com/en/blockchain-really-immutable/>

300 Proof-of-work, which is a form of encryption methods, is obtained by using raw computing power to solve mathematical algorithms. The first node which solves the algorithm will be issued the proof-of-work. See CIO (2016), "If I only had 5 minutes to explain blockchain". Available at: <https://www.cio.com/article/3112773/it-industry/if-i-only-had-5-minutes-to-explain-blockchain.html>, Learn Cryptography (2017), "Proof of Work System". Available at: <https://learncryptography.com/cryptocurrency/proof-of-work-system> and Satoshi Nakamoto (2008), Bitcoin: A Peer-to-Peer Electronic Cash System. Available at: <https://bitcoin.org/bitcoin.pdf>

301 Proof-of stake compares the level of cryptocurrencies held by different nodes. While it seems more efficient than proof-of-work, the level of security is still questionable. Furthermore, the private sector is continuously innovating to experiment with other encryption methods – PwC working with other technology partners on the Vulcan Digital Asset Services platform. See: Pisa M and Juden M (2017), "Blockchain and Economic Development: Hype vs. Reality". Available at: https://www.cgdev.org/sites/default/files/blockchain-and-economic-development-hype-vs-reality_0.pdf and Coin Desk (2016), "With Vulcan Project, PwC Wants Banks to Rethink Bitcoin". Available at: <https://www.coindesk.com/digital-asset-service-pwc-vulcan-bitcoin/>

Blockchain technologies

way governments in low-income countries handle their operations. For instance, corrupt officials can no longer cover their tracks as others also have access to the information.

The two main types of blockchains are public and private blockchains. For the public blockchain, anyone in the world can join the distributed network as long as he or she has internet access and the required software while each node in the private blockchain will need to be granted access by a single entity to participate. Each participant in a public blockchain is anonymized (others identify him or her via the encryption keys) while those in a private blockchain are known to each other.³⁰² An example of a public blockchain is the Bitcoin network while an example of a private blockchain is the online platform that stores sensitive information such as health records in Estonia. In both types of blockchains, it is important to obtain a critical mass of users to ensure decentralization and prevent collusion.³⁰³ There are other kinds of blockchains in between these two extremes such as a permissioned blockchain that allows a selected group of stakeholders to govern the network (sometimes also known as a consortium blockchain). For instance, permissioned blockchains can refer to the blockchain-based public land registries in countries such as Sweden and India where everyone in that country (e.g., citizens and auditors) is able to access the information and highlight anomalies.³⁰⁴ Entities outside of these countries will need to seek permission from pre-determined stakeholders. Enhancing the robustness of the blockchain, each block contains transaction data and details such as a timestamp, digital signatures, and the results of the encryption methods such as proof-of-works to ensure accountability and transparency.

The blockchain is an emerging technology with significant potential to disrupt many industries, ranging from financial services to government, even in the short-term. This is because the traits of blockchain (for example,

302 A public key is a long and randomly-generated string of numbers which represents the user's address on the blockchain. A private key is the password of an individual that gives him or her access to the digital assets. Coursera (2017), "Cryptography 1". Available at: <https://www.coursera.org/learn/crypto> and Synopsys (2017), "What is Cryptography?". Available at: <https://www.synopsys.com/software-integrity/resources/knowledge-database/cryptography.html>

303 WU Global Tax Policy Center (2017). Blockchain 101 for Governments". Available at: http://www.un.org/esa/ffd/wp-content/uploads/2017/10/15STM_Blockchain-101.pdf

304 The Economist (2017), "Governments may be big backers of the blockchain". Available at: <https://www.economist.com/news/business/21722869-anti-establishment-technology-faces-ironic-turn-fortune-governments-may-be-big-backers>, Deloitte (2017). "Will blockchain transform the public sector?". Available at: <https://dupress.deloitte.com/dup-us-en/industry/public-sector/understanding-basics-of-blockchain-in-government.html>, Coindesk (2017), "What is the Difference Between Public and Permissioned Blockchains?". Available at: <https://www.coindesk.com/information/what-is-the-difference-between-open-and-permissioned-blockchains/>, and IMF (2017). Digital Revolutions in Public Finance. Available at: http://www.elibrary.imf.org/view/IMF071/24304-9781484315224/24304-9781484315224/Other_formats/Source_PDF/24304-9781484316719.pdf

a blockchain network is designed to be incorruptible and decentralized) are highly valued in sectors where data security and transparency are critical. Sectors which are more advanced in blockchain acceptance include financial services (including investment banks, insurance and accounting firms) and supply chain management industries. For instance, there has been heavy investment in innovation in the financial services and about 80 percent of executives in financial institutions believe that their companies will begin using blockchain before 2020.³⁰⁵ Blockchain could save between US\$15 to US\$20 billion annually in the financial services industry by 2022.³⁰⁶ Another example is the tracing of luxury items such as diamonds; Everledger has registered more than 1.6 million diamonds on a blockchain.³⁰⁷

Impact studies of the use of blockchain in government operations remain scant as governments are only beginning to recognize the potential of blockchain and implementing isolated pilot experiments to obtain data. However, several predictive government modeling studies reveal that low-income countries (Kenya, South Africa, and Nigeria) can benefit significantly if they adopt blockchains.³⁰⁸ Governments worldwide are also beginning to invest heavily in proof-of-concept trials. As of March 2017, there were more than 115 blockchain experiments in the public sector, including some in developing countries.³⁰⁹ For instance, there are 7 planned pilots in South Africa. There are three broad areas of potential benefits of blockchain technology for enhancing institutional accountability:

- **Enhanced transparency.** Blockchain transactions can be read by all nodes in the network, which increases oversight of the public financial records. For instance, NGOs, foreign donors and charitable organizations are considering blockchain to track foreign direct investments and donations in low-income countries.³¹⁰ The government of Ukraine has also collaborated with BitFury, a blockchain provider, to address issues of distrust in the government.³¹¹ Furthermore, all information and assets can be digitized to provide stakeholders with greater clarity. For instance, not only spreadsheets can be stored on the blockchain ledger, paper-based records can be scanned, photographs can be uploaded, and assets can be tokenized.³¹²

305 Bain (2017). "Blockchain in Financial Markets: How to Gain an Edge". Available at: <http://www.bain.com/publications/articles/blockchain-in-financial-markets-how-to-gain-an-edge.aspx>

306 Deloitte (2017). "Will blockchain transform the public sector?". Available at: <https://dupress.deloitte.com/dup-us-en/industry/public-sector/understanding-basics-of-blockchain-in-government.html>

307 Fortune (2017). "The Diamond Industry Is Obsessed with the Blockchain". Available at: <http://fortune.com/2017/09/12/diamond-blockchain-everledger/>

308 The hypothetical predictive study considers the possibility of blockchain to reduce the administrative processes and costs in global trade. Benefits include increases in GDP and reductions in government deficits. IMF (2017), Digital Revolutions in Public Finance.

309 Deloitte (2017). "Will blockchain transform the public sector?". Available at: <https://dupress.deloitte.com/dup-us-en/industry/public-sector/understanding-basics-of-blockchain-in-government.html>

310 OECD (2017). Does Technology Against Corruption Always Lead to Benefit? The Potential Risks and Challenges of the Blockchain Technology. Available at: <https://www.oecd.org/cleangovbiz/Integrity-Forum-2017-Kim-Kang-blockchain-technology.pdf>

311 The Economist (2017), "Governments may be big backers of the blockchain". Available at: <https://www.economist.com/news/business/21722869-anti-establishment-technology-faces-ironic-turn-fortune-governments-may-be-big-backers>

312 WU Global Tax Policy Center (2017). Blockchain 101 for Governments". Available at: http://www.un.org/esa/ffd/wp-content/uploads/2017/10/15STM_Blockchain-101.pdf

Blockchain technologies

- **Increased oversight.** As the records on the blockchain are irreversible and verified (given security features such as consensus protocol and cryptography), this could create greater oversight and limit corrupt practices. Government officials cannot change transactions retroactively and every new record will need to be verified (participants address every transaction's authenticity by confirming the parties involved, the time and date of transaction as well as the contents) before it can be added to the blockchain. If a transaction contains fraudulent information due to corruption or forgery, it is not validated due to the consensus protocol, and therefore, the transaction cannot take place. As a result, many governments are experimenting with blockchain to enhance voting systems and real-estate management.³¹³
- **Improved operational efficiencies.** A pain point for monitoring of public financial accounts is that consolidation efforts might be tedious, time-consuming, and ineffective due to the inconsistencies and inaccuracies of information. Blockchain helps to increase the confidence and speed of producing these financial reports as all transactions can be checked and updated in near real-time (i.e., these transactions are typically verified in minutes versus days needed in some existing cases).³¹⁴ Furthermore, blockchain effectively eliminates the need for intermediary institutions (or middlemen) as all participants in the blockchain can have access to the same ledger.³¹⁵ These could include internal auditors and central consolidating ministries. Hence, blockchain could effectively lower the cost of monitoring and auditing.³¹⁶ In addition, blockchain can produce savings from reducing time required to manage paper documents. For instance, Dubai announced in 2016 that it will be adopting the "Dubai Blockchain Strategy" to move all government transactions onto a blockchain by 2021 and go paperless.³¹⁷ This initiative has the potential to eliminate almost 100 million paper transactions per year and save 25 million work hours required to manage these paper documents.³¹⁸ Through these reductions, the city is expected to save about US\$1.5 billion annually in document processing.³¹⁹

Although it is beyond the scope of this case study, it is instructive to note that blockchain could also be used to tackle other PFM concerns such as reducing corruption in public procurement, optimizing public spending and service delivery, and preventing tax fraud and evasion. Regarding corruption in public procurement, smart contracts could be used to ensure that every transaction is validated, every dollar funding is accounted for, and pre-defined objectives are achieved before transfers are authorized (though current energy and storage technologies might pose significant concerns).³²⁰ Blockchain could also be used to create a secured distributed

313 OECD (2017), Does Technology Against Corruption Always Lead to Benefit? The Potential Risks and Challenges of the Blockchain Technology. Available at: <https://www.oecd.org/cleangovbiz/Integrity-Forum-2017-Kim-Kang-blockchain-technology.pdf>

314 Deloitte (2017). "Will blockchain transform the public sector?". Available at: <https://dupress.deloitte.com/dup-us-en/industry/public-sector/understanding-basics-of-blockchain-in-government.html>

315 In the Black (2017). "Blockchain: how does it work?". Available at: <https://www.intheblack.com/articles/2017/11/09/blockchain-how-does-it-work>

316 Christian Catalini and Joshua S. Gans (2016). "Some Simple Economics of Blockchain". NBER Working Paper Series. Available at: <http://www.nber.org/papers/w22952.pdf>

317 Harvard Business Review (2017). "How Blockchain Could Help Emerging Markets Leap Ahead". Available at: <https://hbr.org/2017/05/how-blockchain-could-help-emerging-markets-leap-ahead>, Smart Dubai (2016), "Dubai Blockchain Strategy". Available at: http://www.smartdubai.ae/dubai_blockchain.php, and Gulf News (2017), "Dubai unveils plan to go paperless by 2021". Available at: <http://gulfnews.com/news/uae/government/dubai-unveils-plan-to-go-paperless-by-2021-1.2012405>

318 Gulf News (2016). "Dubai launches Blockchain strategy to become paperless by 2020". Available at: <http://gulfnews.com/news/uae/government/dubai-launches-blockchain-strategy-to-become-paperless-by-2020-1.1907790>

319 Smart Dubai (2016). "Dubai Blockchain Strategy". Available at: http://www.smartdubai.ae/dubai_blockchain.php

320 Smart contracts refer to scripts of computer code which automatically execute an action under pre-determined conditions. For instance, these contracts can disburse cash transfers to welfare recipients under certain means testing conditions. See: Center for Global Development (2017). "Blockchain and Economic Development: Hype vs. Reality". Available at: https://www.cgdev.org/sites/default/files/blockchain-and-economic-development-hype-vs-reality_0.pdf

ledger for more efficient public service delivery; for instance, in the United Kingdom, the Department for Work and Pension has started a trial where claimants use a mobile app to manage their benefit payments and their spending patterns are tracked on a blockchain so that relevant financial management advice could be given.³²¹ Blockchain could also be used to build trust in the governments. It has been found that some of the reasons people living in poverty do not access the formal economy voluntarily in many low-income countries are because they do not trust the record-keeping systems and do not want information about themselves to be known to their own governments.³²² Blockchain, eliminating the need for trust, could bridge this gap and allow better welfare services and working opportunities for these people.

What are the states of readiness to adopt the technology?

There are three broad states of readiness for blockchain adoption: pre-readiness, basic readiness, and advanced readiness (Exhibit 10). Countries in the state of pre-readiness do not have most of the key enabling conditions to start using blockchain, and may need to focus more on encouraging the uptake of existing digital tools and improving the use of traditional methods to improve reporting, tracking and monitoring functions; countries under basic state of readiness have the most of the conditions to start exploring selected pilots of blockchain technologies in public agencies; and finally, countries in the advanced state of readiness have the opportunity to potentially integrate the use of blockchain technologies across the entire government.

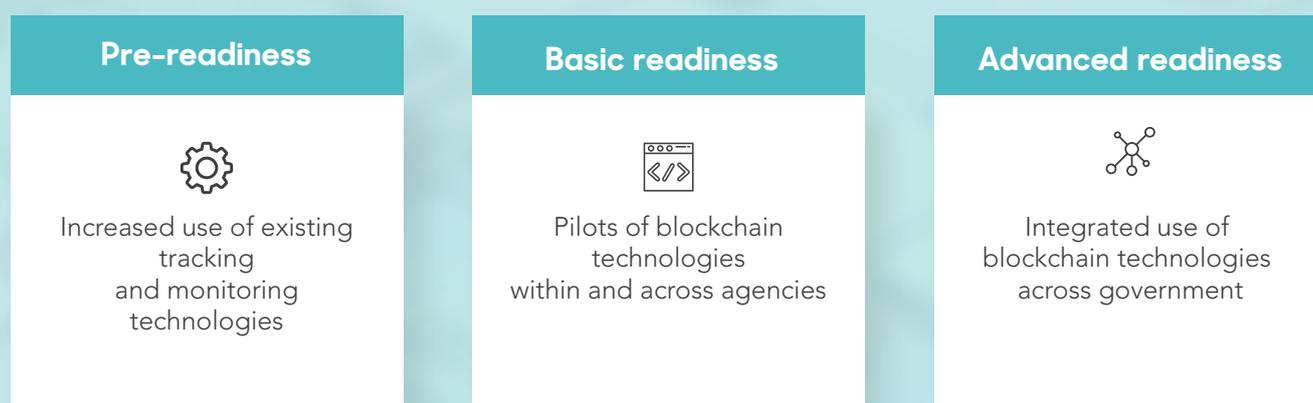
Countries must fulfill a set of key enabling conditions in each state of readiness in order to achieve positive impact. These enabling conditions are additive – in other words, a country in the advanced state of readiness may reap the full potential of blockchain only when it satisfies the key requirements in all three states. The higher the degree of fulfilling these conditions, the higher the likelihood of positive impact under each respective state. Below are further details on the stages of blockchain adoption and the key enabling conditions for each state.

321 Computer Weekly (2016). "DWP trials blockchain technology for benefit payments". Available at: <http://www.computerweekly.com/news/450300034/DWP-trials-blockchain-technology-for-benefit-payments>

322 Harvard Business Review (2017). "How Blockchain Could Help Emerging Markets Leap Ahead". Available at: <https://hbr.org/2017/05/how-blockchain-could-help-emerging-markets-leap-ahead>

Exhibit 10

There are three states of readiness in blockchain adoption to enhance the reporting and monitoring of public financial accounts



Key requirements

- Clear and comprehensive legislation for compliance
- Consistent data classification systems
- Strong independent auditor
- Basic ICT infrastructure for government
- Basic accounting and financial reporting skills
- Robust legal, data governance, and privacy frameworks for blockchain operations
- Strong prioritization and resourcing of pilot projects
- Local capacity building
- Alignment of key stakeholders
- Practical verification mechanisms
- Political support at highest level
- Highly developed internet infrastructure
- Interoperability across government departments and IT systems
- Resilient and secure networks
- Adoption of supporting technologies

Country examples

 Philippines

 Haiti

 Pakistan

 U.A.E

 Kenya

 South Africa

 Rwanda

 India

 Estonia

 Singapore

 Sweden

Blockchain technologies

Pre-readiness describes the state of readiness where countries do not have the prerequisites to attempt blockchain adoption and should concentrate most of their efforts to improve existing tracking and monitoring processes by putting in place some fundamental reforms, in order to enhance the transparency and accountability of public financial records. These processes include improving the recording and tracking of data; digitizing paper-based processes; and ensuring consistent data classification standards (which can enable easier analysis). This could also extend to beginning the process of integrating public records across different levels of government. For example, Kenya released the “IFMIS Re-engineering Strategic Plan 2011 - 2013” in 2011 with the objective of connecting 47 country offices to its IFMIS.³²³ Part of this new plan was to connect the 47 County Government offices to the IFMIS.³²⁴ Rwanda and South Africa also regularly evaluate its accounting systems.³²⁵ This is a critical first step as the benefits of blockchain technology depend crucially on the integrity of the underlying data (i.e., how data is tracked, recorded, and verified in the first place).

The key enabling conditions in the pre-readiness state include:

- **Clear and comprehensive legislation for compliance.** It is important to set the foundation for effective tracking and monitoring practices in the form of legislation and statutes. For instance, Singapore and Nigeria have their Audit Acts enacted in 1966 and 1956 respectively.³²⁶ This includes establishing penalties for lapses in the accounting chain, accounting and auditing time frames, and incentives for compliance (such as pegging tracking transactions to an officer’s annual KPIs). This will help to reduce the incentives for corruption, and ensure that government officers understand the importance of ensuring transparency and accountability of the public financial accounts.
- **Consistent data classification systems.** Common data recording and classification approaches need to be adopted across different government departments and levels of government. The Government of Pakistan and the World Bank embarked on program called the Project to Improve Financial Reporting and Auditing (PIFRA) to overhaul the public financial management system from 1996 to 2014.³²⁷ Achievements include establishing a nationwide integrated audit management system to facilitate the standardization of work and information management.³²⁸

323 National Treasury (2014). IFMIS Re-engineering Strategic Plan (2013 – 2018). Available at: <http://www.ifmis.go.ke/wp-content/uploads/2014/02/Strategic-Plan-2013-2018-R.pdf> and National Treasury (2017), “Integrated Financial Management Information System”. Available at: <http://www.ifmis.go.ke/>

324 National Treasury (2017). “FAQs”. Available at: http://www.ifmis.go.ke/?page_id=2490

325 ECORYS (2012), Rwanda: Independent Evaluation of the Implementation of the PFM Reform Strategy 2008-2012. Available at: https://www.oecd.org/derec/unitedkingdom/11_EvaluationSupportPublicFinanceManagement%20ReformRwanda.pdf and ECP RYS (2008), Republic of South Africa Public Expenditure and Financial Accountability. Available at: <http://www.treasury.gov.za/publications/other/Final%20PEFA%20Report%20-%2029%20Sept%202008.pdf>

326 AGC (2017). “Audit Act”. Available at: <http://statutes.agc.gov.sg/aol/search/display/view.w3p;page=0;query=DocId%3A%226478a6ad-dde0-4fe0-b791-b244a28a8bc4%22%20Status%3Apublished%20Depth%3A0;rec=0> and Adetunji Oto Ogunyemi (2014), “Auditing and Corruption in Nigeria: A Review of the Legal Weight of the Audit Act of 1956” Historical Research Letter Volume 15. Available at: <https://www.google.com.sg/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKewj6hu2qg4HYAhUKQl8KHyeO-AKqQFggqMAE&url=http%3A%2F%2Fwww.iiste.org%2FJournals%2FIndex.php%2FHRL%2Farticle%2Fdownload%2F18209%2F18584&usq=AOvWaw1kG06wbESMZ8IzGaRCPWP2>

327 FABS (2017). “Financial Accounting and Budgeting System”. Available at: <http://www.fabs.gov.pk/>

328 The Association of Chartered Certified Accountants (2010), Improving public sector financial management in developing countries and emerging economies. Available at: <http://www.accaglobal.com/content/dam/acca/global/PDF-technical/public-sector/tech-afb-ipsfm.pdf>

Blockchain technologies

- **Strong independent auditor.** An independent auditing body that has the powers to enforce legislation and hand out penalties when needed is crucial to reinforcing compliance legislation. For instance, the Ghana Audit Service, which is only bounded by the constitution and the law, is granted powers to conduct independent audits of public financial records.³²⁹
- **Basic ICT infrastructure for government.** Without a basic level of ICT infrastructures such as computers, smartphones, and internet access, it is impossible for countries to digitize the financial reporting process. Common challenges such as weak and intermittent network connections, frequent outages, and outdated infrastructure (both hardware and software) in developing countries will likely require heavy capital investments initially to ensure successful outcomes.³³⁰
- **Basic accounting and financial reporting skills.** In many low-income countries, officials supervising the accounting processes are often not trained in the critical skills.³³¹ This includes a lack of practical, hands-on training of officials.

Basic readiness describes the set of conditions that countries should acquire before they begin pilots of blockchain technologies in selected public agencies. According to a survey of over 200 government leaders in 16 countries, almost all public organizations say they plan to invest in blockchain to help manage financial transactions and regulatory compliance in 2018.³³² However, it is uncertain if these countries have all the required enabling conditions that would increase the success rates of their pilot programs. The main idea behind this stage is to develop possible business cases for the adoption of blockchain in the public sector (for instance, for additional security and accountability), given that impact studies in this area is still scarce. One way to pursue this phase is a “test and accelerate” approach. Pilots could be first trialed within “siloes” agencies with small databases and low transaction volumes. These trials could be extended to include more entities to study the coordination and interoperability issues between agencies.³³³ For instance, if the Ministry of Land Transport were to transfer its automobile records onto a blockchain, it needs to ensure that the police department can read and access these records. Two Indian states (Andhra Pradesh and Telangana) are exploring the use of blockchain to store government data and integrate different departments.³³⁴ Rwanda is also exploring these pilots.³³⁵ Finally, pilots could be accelerated to include larger agencies and more entities. These pilots serve as proof-of-concepts (for instance, what type of blockchain and encryption means to

329 Ghana Audit Service (2017). “Mandates”. Available at: <http://intosaiitaudit.org/mandates/writeups/ghana.htm>

330 Studies have shown that IT infrastructure affects digital adoption in government positively. See: Ngo Tan Vu Khanh (2014), “The critical factors affecting E-Government adoption”. ARXIV. Available at: <https://arxiv.org/ftp/arxiv/papers/1401/1401.4876.pdf>

331 OECD (2017). “Government accounting and the use of the accruals basis”.

332 The Economist (2017). “Governments may be big backers of the blockchain”. Available at: <https://www.economist.com/news/business/21722869-anti-establishment-technology-faces-ironic-turn-fortune-governments-may-be-big-backers>, IBM Institute for Business Value (2017), Building trust in governments. Available at: <http://www.the-blockchain.com/docs/IBM%20Report%20-%20Blockchain%20-%20Building%20Trust%20in%20Government.pdf> and IBM (2017), “Four Ways Blockchain Could Aid Governments”. Available at: <https://www.ibm.com/blogs/think/2017/01/four-ways-for-blockchain/>

333 Interoperability refers to the ability of different organizations’ database to be free and securely exchanged.

334 Open Gov (2017). “Two Indian states exploring the use of Blockchain technology for storing government data”. Available at: <https://www.opengovasia.com/articles/7891-two-indian-states-exploring-the-use-of-blockchain-technology-for-storing-government-data>

335 Nasdaq (2017). “WISeKey and Microsoft collaborate to support Rwandan Government make secure transactions using Blockchain Technology”. Available at: <https://globenewswire.com/news-release/2017/10/11/1144094/0/en/WISeKey-and-Microsoft-collaborate-to-support-Rwandan-Government-make-secure-transactions-using-Blockchain-Technology.html> and Rwanda Updates (2017), “WISeKey to set up Blockchain/loT Center of Excellence in Rwanda”. Available at: <http://rwandaupdates.com/wisekey-to-set-up-blockchainiot-center-of-excellence-in-rwanda/>

implement) to gather data as well as to identify loopholes and concerns that need to be addressed. A potential concern uncovered might be the lack of local capacity to maintain and update the blockchains; following which, governments can invest resources in training and equipping.

The key enabling conditions in the basic readiness state include:

- **Robust legal, data governance, and privacy frameworks for blockchain operations.** As blockchain is a new technology that will fundamentally decentralize information, there are significant grey areas regarding regulations and the use of such data. For instance, is the information on the blockchain legally binding? Who governs the blockchain networks? What information should be accessible and by whom? Hence, it is important for these frameworks to be in place to avoid disputes and confusion. To ensure that blockchains are compliant with corporate laws, the State of Delaware established the Delaware Blockchain Initiative which resulted in amendments to the Delaware General Corporation Law in 2017.³³⁶ In the developing world, a South African blockchain firm announced that it is working with the South African Reserve Bank to consider the drafting of local cryptocurrency regulations.³³⁷
- **Strong prioritization and resourcing of pilot projects.** Pilot efforts for blockchain efforts should be chosen carefully, and based on factors such as funding requirements, difficulty of implementation, and potential upside opportunity. Existing blockchain pilot initiatives can cost several millions of dollars.³³⁸ For instance, Australia has announced in 2017 that it will be running a blockchain-powered smart utility pilot project which costs around US\$6 million.³³⁹ Nevertheless, as with many other technologies, implementation costs can vary widely depending on the scope of the pilots and the state of existing infrastructure and expertise (which will determine cost of servers, capacity of storage, network range, power generation, cost of hiring developers and computer scientists etc.).
- **Local capacity building.** Although blockchain has been around for about a decade, many people are still unaware of it or still have the wrong conception of this technology.³⁴⁰ This is also prevalent in the public sector. While there are increasingly more individuals and companies been trained in the blockchain, many of them are from developed countries. It is crucial to build up local technical expertise as blockchain networks in government often deal with sensitive information (e.g., health records, public financial accounts). These skills include knowledge on how to verify transactions, how to spot anomalies, how to troubleshoot errors, and how to input information on the blockchain.

336 Forbes (2017). "Why the Delaware Blockchain Initiative Matters to All Dealmakers". Available at: <https://www.forbes.com/sites/grouptthink/2017/09/20/why-the-delaware-block-chain-initiative-matters-to-all-dealmakers/#4e3f58e87550>

337 Bitcoinhub (2017). "Exclusive Interview: Lorien Gamaroff of Bankymoon". Available at: <https://bitcoinhub.co.za/exclusive-interview-lorien-gamaroff-bankymoon/>

338 IMF (2017). Digital Revolutions in Public Finance. Available at: http://www.elibrary.imf.org/view/IMF071/24304-9781484315224/24304-9781484315224/Other_formats/Source_PDF/24304-9781484316719.pdf

339 Coin Desk (2017). "Australian Government Grants \$8 Million for Blockchain Energy Pilot". Available at: <https://www.coindesk.com/australian-government-grants-8-million-for-block-chain-energy-pilot/>

340 Georgia's National Agency of Public Registry has recently moved its land registry onto the blockchain. Some 160,000 registrations have already been processed. The main barrier to introduction, officials say, has not been technical, but educational. See: The Economist (2017). "Governments may be big backers of the blockchain". Available at: <https://www.economist.com/news/business/21722869-anti-establishment-technology-faces-ironic-turn-fortune-governments-may-be-big-backers>

Blockchain technologies

- **Alignment of key stakeholders.** Given the potential impact of blockchain to disintermediate certain stakeholders and to threaten the ill-gotten gains of corrupt officials, the implementation of this technology is likely to face significant opposition. Given the complex nature of the technology, citizens may also question the benefits and the need for the implementation of blockchain solutions. To counter this, it is important that there is an active communication campaign to support pilot projects and explain the benefits of blockchain in clear terms to different stakeholders.
- **Practical verification mechanisms.** Governments need to establish suitable cryptography approaches and verification mechanisms to use for its blockchain networks. Though proof-of-work (which refers to a form of cryptography method) via mining has worked largely as a consensus protocol for public blockchains such as cryptocurrencies networks, there are still fundamental flaws such as the risk of centralization of power among mining pools.³⁴¹ This will defeat the promise of a decentralized network. For instance, if a public blockchain is used in a government setting, officers of different nodes might team up to attempt to gain majority consensus (meaning more than 50 percent of the nodes verifying and approving a transaction) and push for a certain agenda (e.g., to assign a tender to a certain contractor). Hence, ICT teams in the governments might need to find other methods, apart from financial incentives from mining, to compel members of the network (e.g., accounting officers, auditing officers) to participate in and verify blockchain networks.³⁴² Similarly, for the public to participate, viable verification mechanisms must be devised to encourage participation and effectiveness.

Advanced readiness describes the set of enabling conditions that countries must have for advanced blockchain adoption to enhance institutional accountability in public finance management. Advanced blockchain adoption describes the situation where there is the integrated blockchain networks for the tracking and monitoring of public financial accounts across the entire government. One way that this could pan out is as follows: each individual public agency has its own blockchain (be it private or permissioned) accessible by all its staff; and linking the entire government is a permissioned blockchain which can be verified by everyone in that country and others who are granted access (e.g., international aid donors who want to track their funding³⁴³). If data privacy issues could be resolved, governments might even consider linking the entire public sector with a public blockchain, reaping the full benefits of a decentralized network. In this advanced stage of blockchain adoption, the business case for blockchain in government has already been established and all public financial records are transparent and accountable. This is an ideal scenario – and no country, even if they have the necessary conditions (technologically advanced countries like Singapore, Sweden and Estonia arguably have the required readiness), are at this stage of adoption yet. The time horizon for reaching this phase is also unclear and depend not only on the evolution of the technology, but also governments finding ways to mitigate security concerns such as privacy and verification methods.

341 LinkedIn (2017). "The high fees and the hell of Bitcoin mining, explained". Available at: <https://www.linkedin.com/pulse/high-fees-hell-bitcoin-mining-explained-roberto-capodiec/>

342 For civil servants, they might be compelled to participate as this verification process is part of their jobs. For the public, it could be due to altruistic reasons or to ensure transparency in public financial records.

343 BBC (2016). "Afghanistan aid: Donors promise \$15.2bn in Brussels". Available at: <http://www.bbc.com/news/world-asia-37560704>

Blockchain technologies

Some of the key enabling conditions required to reach an advanced state of readiness include:

- Political support at the highest level. High-level political backing is a key condition, especially as the level of resistance is expected to be very high as implementation on such a large scale will involve many stakeholders, many of whom may have vested interests.³⁴⁴ Furthermore, the decision to adopt blockchain for the tracking and monitoring of public financial records will lead to the decentralization of information and increased oversight.
- Highly developed internet infrastructure. Internet infrastructure that can process high volumes of data in a fast and reliable manner are crucial to support widespread adoption of blockchain technologies. For instance, one common concern of blockchain technologies is the amount of storage constantly required to maintain updated copies of the ledger; the Ethereum network has accumulated more than 200 GB of data in the blockchain within three years of active use.³⁴⁵ Associated with this is the energy-intensive nature of the data mining process. For example, the data mining associated with Bitcoin technology could potentially grow 20-fold by 2020, using as much electricity as Denmark.³⁴⁶ More energy and data efficient processing approaches will be needed before governments can use blockchain to track and monitor all their public financial records.
- Interoperability across government departments and IT system. Interoperability of systems and standards, particularly in data formats, is another key requirement. If this is not achieved, there will be inefficiencies in converting the data formats which might increase operating costs (e.g., prolong the time for audits) and compromise the integrity of the data.³⁴⁷ Some countries have already been discussing new international standards for blockchain networks to pre-empt future adoption.³⁴⁸
- Resilient and secure networks. The blockchain networks need to be properly maintained and resilient to hacking and other technical threats to ensure transparency and accountability. The type of blockchain chosen for the public sector will also be an important decision – for instance, public blockchain networks are more secure, due to the mass of nodes, than private or permissioned ones.
- Adoption of supporting technologies. Blockchain technologies hold most promise when combined with other technologies, such as Artificial Intelligence (AI). For example, blockchain technology with AI could be used for robust comprehensive, real-time, automated auditing processes, without the need for armies of auditors.

344 OECD (2017). Does Technology Against Corruption Always Lead to Benefit? The Potential Risks and Challenges of the Blockchain Technology. Available at: <https://www.oecd.org/cleangovbiz/Integrity-Forum-2017-Kim-Kang-blockchain-technology.pdf>

345 Kaspersky (2017). "Six myths about blockchain and Bitcoin: Debunking the effectiveness of the technology". Available at: <https://www.kaspersky.com/blog/bitcoin-blockchain-issues/18019/>

346 IEEE Spectrum (2017). "The Ridiculous Amount of Energy It Takes to Run Bitcoin". Available at: <https://spectrum.ieee.org/energy/policy/the-ridiculous-amount-of-energy-it-takes-to-run-bitcoin> and Bloomberg (2017), "An Expert's Guide to Navigating the World of Bitcoin". Available at: <https://www.bloomberg.com/view/articles/2017-12-10/an-expert-s-guide-to-navigating-the-world-of-bitcoin>

347 If the data in the blockchain requires extraction and modification due to formatting issues between systems, this might expose the data to corrupt officers.

348 Open Gov (2017). "Blockchain and the public sector - What happened in 2016". Available at: <https://www.opengovasia.com/articles/7274-blockchain-and-the-public-sector-developments-in-2016>

What does this mean for low-income countries?

Most governments now use some form of digital tools (e.g., reporting modules in IFMIS) to track and monitor public financial records, albeit with varying degrees of sophistication. Given the existing conditions in low-income countries and uncertainties about the technology, many low-income countries are still considered to be in the state of pre-readiness when it comes to blockchain adoption.

For these countries, while the focus should be on getting the basics right, it makes sense for them to work in parallel to build some of the latter stage conditions, and to keep an open mind about the potential of blockchain technology in public finance management. For example, investing to upgrade the overall ICT architecture and the digital education of stakeholders (such as rank-and-file government officials and citizens) should be an ongoing effort for all developing countries – partly because of the high cost and time required.

There are several lessons that have emerged from country experiences that are applicable to developing countries that have already started pilot blockchain programs:

- **Clear objectives and scoping.** Faced with financial and technical constraints, it is essential to have clear and realistic goals, and to scope efforts accordingly. For example, which spending entities should adopt blockchain first? What types of data and frequency of updates are required? What kind of blockchain networks to implement – public, private, permissioned or a combination? Should every citizen be able to access the public financial records? Are there ways to reduce the computing burdens of blockchains? How should the governments deal with potential job cuts?³⁴⁹ Compared to the existing technology tools (e.g., MySQL and Oracle), is blockchain a better solution to the given challenges? Answering such questions are crucial for funding decisions, network design, training requirements, and the communication to stakeholders.
- **Build the necessary skills (and the mindset shift) in staff.** It is important to raise the general knowledge and awareness of blockchain networks of government officials through hands-on training sessions and workshops. Other approaches include evaluating and updating non-effective, outdated skills training, collaborating with the private sector as well as incorporating the relevant skills into the school curriculum.³⁵⁰
- **Adopt a phased rollout.** Given the very nascent stage of blockchain and the immediate need to support the uptake of existing digital technologies, governments should implement changes in a staged fashion.

³⁴⁹ As blockchain networks can eliminate the middlemen, conduct smart contracts, and decentralize information, certain jobs such as auditors and data entry officers might be made redundant. This has been fears that automation and technologies are threatening traditional jobs. However, while this might be true, research has shown that technologies also create new higher-value occupations. Hence, all these components must be thoroughly thought through. See: Gov Tech (2017), "Blockchain: Is it a Transformative Tech for Government?". Available at: <http://www.govtech.com/fs/data/Blockchain-Is-it-a-Transformative-Tech-for-Government.html> and AlphaBeta (2017), The Automation Advantage. Available at: <http://www.alphabeta.com/wp-content/uploads/2017/08/The-Automation-Advantage.pdf>

³⁵⁰ The Guardian (2014). "The challenge of filling the skills gap in emerging economies". Available at: <https://www.theguardian.com/sustainable-business/2014/oct/07/the-challenge-of-filling-the-skills-gap-in-emerging-economies>

This approach allows time for stakeholders to receive feedback and to troubleshoot kinks in the system, and helps to demonstrate the positive impact of blockchain through pilots – all of which may reduce the level of future resistance.

- **Ensure incentives to encourage participation.** Governments should ensure that the blockchain networks within and beyond the public sector are user-friendly and simple. This will lower the barriers to entry and increase the participation rates, resulting in critical mass for verification of public financial records. Furthermore, the cryptography mechanisms should be well-thought through for the different stakeholders such as government officials and citizens to motivate participation. Governments will need to motivate civil servants to participate and verify the transactions. These could come in the forms of regulations, penalties, or incentives (e.g., integrating verification checks as part of an accounting officer's KPIs for the year). For citizens, governments could have some financial incentive programs to encourage participation. For instance, vouchers could be issued if someone verifies a certain number of transactions per week.
- **Learn, learn, learn.** Given the nascent stage of the technology and high risk of poor decision-making, it is important that governments are actively incorporating insights from pilot initiatives, and also seeking to learn from the experience of other countries. Dedicated public agencies should devote resources to conduct reviews and evaluation; one such country example is CSIRO in Australia.³⁵¹ Governments could also engage in partnership with the private sector to leverage their expertise. For example, the South Korean government has recently signed blockchain projects with Samsung to leverage their technical expertise.³⁵² In the Australian blockchain energy pilot, the government is working with blockchain providers such as Power Ledger, as well as Murdoch University and Cisco.³⁵³

351 Open Gov (2017). "Blockchain and the public sector - What happened in 2016". Available at: <https://www.opengovasia.com/articles/7274-blockchain-and-the-public-sector-developments-in-2016>

352 The Coin Telegraph (2017). "Samsung Wins Public Sector Blockchain Contract for Korean Gov't". Available at: <https://cointelegraph.com/news/samsung-wins-public-sector-blockchain-contract-for-korean-govt>

353 Coin Desk (2017). "Australian Government Grants \$8 Million for Blockchain Energy Pilot". Available at: <https://www.coindesk.com/australian-government-grants-8-million-for-blockchain-energy-pilot/>

Concluding thoughts



Concluding thoughts

This research demonstrates the tremendous potential for technology to transform PFM processes in low-income countries, which could lead to more positive outcomes. There are several key messages that have emerged from the case studies:

Lesson 1: Know your starting point

Technology adoption must always take into account a country's specific context, its needs and state of readiness to implement different types of PFM technology. This means not all countries will be able to adopt every available PFM technology. There are scenarios, including for technologies not covered in these case studies, where countries will not meet the minimum conditions required to adopt a more advanced technology. They should instead choose more practical options, including pushing for basic reforms first. Before implementing a technology, public sector officials should develop a good understanding of the benefits and costs of technologies with varying degrees of sophistication, and the overall enabling conditions required to reach different levels of technological adoption. Subsequently, countries need to have an honest assessment of their own capabilities and have realistic expectations of what technology can achieve.

Lesson 2: Be clear on the objectives

It is essential to have clear and realistic objectives for what is to be achieved with the technologies. This can significantly reduce both the time and cost of implementation and produce the greatest impact in the shortest period of time. A major challenge facing increased digitization is that of too much data – governments and societies must learn to make better and more selective of that information, rather than being drowned in too much of it. For example, it is important to distinguish core data from data that is less crucial when adopting GIS for tax purposes, particularly because data creation and collection costs can be prohibitive in low-income countries where geospatial data is not as developed and readily available. Another example is in India and Indonesia, where tax authorities used data analytics to target the “big fish” – the largest taxpayers and institutions expected to yield the highest tax penalties.

Lesson 3: Adopt a phased rollout

The need to consider existing conditions relative to the requirements of a range of implementation options (from basic to advanced use) implies that leapfrogging of stages within a technology is usually unfeasible. Implementation in stages, starting with stakeholders that are best equipped to do so, can help to reduce costs, allows time to receive feedback and to troubleshoot kinks in the system, reduces expectations and helps to demonstrate positive impact – all of which may reduce the level of resistance on a broader level. Moreover, low-income countries should resist the temptation and political pressure to quickly expand the scope and reach of successful pilot projects, otherwise service quality may suddenly drop without the right conditions in place. For example, the public procurement authority of Turkey made much effort to smooth the transition of e-procurement implementation, allowing almost 7 months to allow contracting authorities and suppliers to register on the electronic platform and learn how to use it, before launching a pilot tender.

While leapfrogging within a technology is typically unfeasible, current low-income countries may be in the position to benefit from many of these technologies much quicker than developed countries - both in terms of the implementation process and the opportunity to leapfrog outdated technology or operation models, because they are not constrained by legacy systems (and assuming that enabling conditions are met). For instance, the digitization of paper-based records can be done faster in many low-income countries once the required infrastructure is installed because of the much smaller and less complex base of records. Another example that is already happening is the adoption of mobile payments outside financial institutions. Estimates show that around 55 percent of adults had a bank or financial services account in emerging economies in 2014, but nearly 80 percent owned a mobile phone.³⁵⁴ In low-income countries where traditional financial intermediaries are still often inefficient, users are already “skipping” these channels directly to mobile banking as mobile phone penetration continues to deepen, and users are not constrained by the mindset that payments outside traditional financial institutions are unsafe. The famous example is M-Pesa in Kenya which leveraged powerful network effects to dramatically grow the adoption rate of its mobile wallet offerings at much quicker rate than traditional financial services accounts which grow at roughly the pace of national income.³⁵⁵ This kind of “shortcutting” was something developed countries did not have the luxury of having in the past.

354 The New Dawn (2016). “The Promise of Digital Finance”. Available at: <http://www.thenewdawnliberia.com/commentary/6095-the-promise-of-digital-finance>

355 The New Dawn (2016). “The Promise of Digital Finance”. Available at: <http://www.thenewdawnliberia.com/commentary/6095-the-promise-of-digital-finance>

Lesson 4: Champion digitization in the public sector

Technological reforms in PFM often encounter strong opposition from influential groups, who are deeply vested in the status quo, and inertia among government officials. Furthermore, as demonstrated in the case studies, the advanced use of many technologies requires the broad economy to be digitized to a fairly large extent. For example, the advanced use of e-procurement systems is characterized by high overall transaction coverage, which requires private firms and individuals to be accepting and comfortable with digital platforms in order to access and use the official e-procurement site effectively. In digital G2P payments, the most advanced use is where governments digitize all its transfer programs, and this requires all recipients to not only have access but the trust, confidence and capabilities to use digital payments platforms. These suggest that PFM technology and reform programs will often have to be part of an overall drive towards digital (and to some extent financial) inclusion work at the country-level. Global best practice shows that high-level political support can be crucial to achieve results. A success story is Mexico, where the synergies between digitization and PFM really came together after 2013 (indicative estimates show that digitization helped the government to save around 3.3 percent of its combined spend on wages, pensions and social transfers annually), when the president championed its National Digital Strategy that included a commitment to “encourage the innovation of digital services through the democratization of public spending”.³⁵⁶ The 2013 strategy reflected over 15 years of consistent senior-level sponsorship that was necessary for the complex coordination efforts required across government agencies.³⁵⁷

Lesson 5: Focus on shifting mindsets (and not just on skills)

While building skills to support implementation is important, it is also important to focus on creating a digital mindset among government employees. Transforming into a data-driven culture requires a fundamental change in mindset for managers and staff. Government leaders can help by rewarding the development of statistical and computing skills. One expert revealed that South Africa is a leader in incentivizing a data-driven approach, linking performance rewards to the use of data in decision-making.

³⁵⁶ Cangiano M, Gelb A and Goodwin-Groen R (2017). “Integration of Digitalization and Public Financial Management – Initial Evidence.” Chapter 12 of Gupta S, Keen M, Shah A and Verdier G (eds), *Digital Revolutions in Public Finance*. International Monetary Fund.

³⁵⁷ Cangiano M, Gelb A and Goodwin-Groen R (2017). “Integration of Digitalization and Public Financial Management – Initial Evidence.” Chapter 12 of Gupta S, Keen M, Shah A and Verdier G (eds), *Digital Revolutions in Public Finance*. International Monetary Fund.

Lesson 6: Communicate, communicate, communicate!

Constant communication with users is another important element of change management, particularly when successful implementation may require a large behavioral change. Two-way communication can play a key role to increase trust and overall buy-in of digital technologies. Easy access to information channels can also help to reduce resistance and mistrust in new technologies. For example, in Kenya, a hotline was established for recipients who were part of the program for digitizing food assistance payments, where they could ask questions, express concerns, and report grievances without fear of reprisal. A good understanding of cultural norms and sensitivities can smooth the communication process. A relevant example is the involvement of local chiefs in Sierra Leone to communicate the rationale of using GIS technology to better track and enforce property tax, in order to gain the acceptance of the people more effectively.³⁵⁸

Topics for future research

During the expert interviews and analysis for this research, a number of outstanding questions were identified which could inform future research efforts. These include:

- **Identifying and minimizing risks:** There are a number of common risks associated with the adoption of technology in PFM. For example, the purchase of IT systems can have a “lock-in” effect for technology that may become quickly outdated. Further research is needed to assess the plausibility of open-source and flexible systems to avoid such lock-ins, and to understand for which types of technology these systems may be most useful. As expounded throughout the paper, using technology that is not context-specific is a major risk and often presents governments with two options: to custom build a solution or to purchase commercial, off-the-shelf solutions. The most sensible choice will depend heavily on the technology in question, its main purpose, and available government resources.
- **Centralized or decentralized implementation:** Should technological adoption be centralized in a dedicated unit led by central fiscal institutions (Ministry of Finance, Central Bank, Treasury) or left to more decentralized efforts? What are the pros and cons of each approach? While the case studies presented in this paper do not immediately provide answers to these questions, governments will need to make a decision depending on the specific technology, the objective, and the resources and capacity of decentralized units to implement change. For example, it may make sense to decentralize the adoption of GIS for tracking property taxes to local agencies, since property taxes are typically raised locally. Decentralization also makes sense where the creation of localized datasets would require a substantial

358 Fish P (2015). “Practical aspects of mobilising property tax: experience in Sierra Leone and Malawi.” *Commonwealth Journal of Local Governance*. Available at: <http://eprss.lib.uts.edu.au/journals/index.php/cjlg/article/view/4591/4920>

Concluding thoughts

effort. More analysis is required on a case-by-case basis to arrive at the appropriate answer for every implementation effort.

- **Better appreciation of the counterfactuals:** The IMF's recent publication on the digital revolution in public finance, and this research, emphasize the immense potential benefits of digital (and more generally, technological) PFM when pursued hand-in-hand with broader digital inclusion goals.³⁵⁹ However, further research is needed to understand the implications of the counterfactual situation – not integrating PFM with the broader government digitalization agenda and not digitally connecting the increasingly complex relations between government and citizens.³⁶⁰ Can digitizing PFM functions succeed without a concerted effort to deepen digital inclusion in the economy?
- **Legislation sequencing:** A final area requiring further exploration relates to the appropriate sequencing of legislation. Does legislation need to be in place before a technology can take hold, or is it better to adopt a “wait and see” approach given the uncertainties in how a regulation could unfold?

³⁵⁹ Gupta S, Keen M, Shah A, Verdier G (2017). *Digital Revolutions in Public Finance*. International Monetary Fund, Washington DC.

³⁶⁰ Cangiano M, Gelb A and Goodwin-Groen R (2017). “Integration of Digitalization and Public Financial Management – Initial Evidence.” Chapter 12 of Gupta S, Keen M, Shah A and Verdier G (eds), *Digital Revolutions in Public Finance*. International Monetary Fund.

Appendix: Long-list of technological applications



The tables below summarize the technological applications to address each of the five areas of PFM concern discussed in this report. Note that the tables are based on the specific use of technology, rather than just the technology itself. Therefore, a technology may appear as a potential solution across more than one PFM concern areas (e.g., big data analytics could be applicable to multiple PFM concerns).

Table A1: i) Aligning budgets with policy priorities

Technological family	Application	Comments
Integrated IT hardware and software	IFMIS – budget preparation module	<p>The budget preparation module enables multiple-step budget preparation, facilitates planning and strategizing across line ministries and other spending agencies, and supports multiple scenarios testing. Each budget version can be approved individually or integrated into a single or multiple budget version groups for approval. The final version of the approved budget is used to establish the allocation and control.³⁶¹</p> <p>Budget preparation modules can play an integral role during the legislative debate stage, even in low-income countries. For example, East Timor regularly uses budget preparation tools to run live simulations of different spending scenarios in parliament to facilitate budget policy debates.</p>
Citizen and business engagement solutions	Social media to facilitate participatory budgeting	<p>Participatory budgeting (PB) increases citizen engagement in budget matters. It is a democratic process in which community members are encouraged to give input on how to spend part of a public budget, enabling taxpayers to work with government to make the budget decisions that affect their lives.³⁶² Engagement can be conducted via social media platforms especially as society becomes increasingly digitized.</p> <p>Vallejo in the US actively uses several forms of social media to facilitate participatory budgeting. For example, videos explaining the participatory budgeting process are posted on YouTube to increase understanding, interest and participation in the process. Vallejo also operates a monthly electronic newsletter, and archives past issues on the city’s website. The city further utilizes social media applications such as Twitter, Facebook and Nextdoor to provide details, updates and instructions to the community.³⁶³</p> <p>Similarly, in Kenya, the International Budget Partnership uploads videos of budget deliberations between government departments and members of civil society onto YouTube, with the hope that these videos would stimulate further discussions among the wider public about upcoming budgets.³⁶⁴</p>

361 USAID (2008). “IFMIS: Options for budget preparation module implementation”. Available at: http://pdf.usaid.gov/pdf_docs/Pdaco825.pdf

362 Please see Participatory Budgeting Project website: <https://www.participatorybudgeting.org/what-is-pb/>

363 Please see The Engine Room website: <https://library.theengineroom.org/participatory-budgeting/#examples>

364 International Budget Partnership Kenya (2017). “Deliberating Budgets: An example from Nairobi County, Kenya”. Available at: <https://www.internationalbudget.org/publications/deliberating-budgets-nairobi-county-kenya/>

<p>Citizen and business engagement solutions</p>	<p>Digital publishing of budget proposals and spending reviews</p>	<p>Publishing budget proposals online allows external scrutiny, analysis and feedback that could lead to revisions that better takes into account the concerns of civil society and the private sector. Similarly, spending reviews which are key considerations for the following year's budget allocations, can be uploaded online. Feedback received could be used in future strategic budgeting process.</p> <p>The Ministry of Finance of Finland publishes its annual budget proposals on its website. All revisions and mistakes are documented and made public. The proposal also includes the government's economic projections and justifications for its various programs.³⁶⁵ In Germany, the Federal Ministry of Finance began conducting annual spending reviews in 2015. The reviews are uploaded online and analyze both revenue and expenditure to assess the impact of budgeted programs and helps the government reprioritize funds depending on new priorities. These reviews account for the views of external stakeholders including government auditors, experts, scientists and academics, and are published on the Finance Ministry's website for anyone to access.³⁶⁶</p>
<p>Identification and recording technologies</p>	<p>Geographic Information System (GIS) for strategic planning</p>	<p>GIS is a set of computing tools that enables users to visualize data in graphic map formats or satellite pictures.</p> <p>Given that an estimated 90 percent of government data includes a spatial component, it is unsurprising that GIS has been an integral tool for city planning and the strategic allocation of developmental funds.³⁶⁷ Interviews with GIS practitioners indicate that the technology can improve the quality of analysis and help governments, both locally and on the national level, to increase the robustness and productivity of their spending and investment proposals. Health authorities commonly use GIS to evaluate the costs and benefits of building public hospitals at different locations.</p>
<p>Data analytical applications</p>	<p>Use of high frequency fiscal data to improve economic forecasting</p>	<p>The use of high frequency fiscal data for data analytics can help produce more timely and accurate projections of the economy.³⁶⁸ Real-time or daily fiscal data can provide authorities with information that is timely, accurate and easily accessible compared to official reporting channels (e.g. quarterly fiscal updates).</p> <p>Analysis of high frequency fiscal data can help governments spot and respond to cyclical downturns quicker, for example, by introducing supplementary budgets that are ahead of the curve to buttress the economy. It also allows authorities to monitor accounts (debt and spending) in real-time and take corrective action as early as possible. This can be particularly useful in situations where the government is constrained by strict fiscal rules.</p>

365 Daily Finland (2017). "Government proposes EUR 55.4b budget for 2018". Available at: <http://www.dailyfinland.fi/business/1756/Govt-proposes-EUR-55.4b-budget-for-2018>

366 Federal Ministry of Finance (2017). Spending reviews in the federal budget. Available at: <http://www.bundesfinanzministerium.de/Content/EN/Standardartikel/Topics/Public-Finances/Articles/2017-06-14-spending-reviews-im-bundeshaushalt.html?nn=12940&view=pdf>

367 Robinson M (2008). A History of Spatial Data Coordination. Federal Geographic Data Committee.

368 Shaw N (2012). "Geographical Information Systems and Health: Current State and Future Directions." Healthcare Information Research. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3402560/>

Data analytical applications	Big data analysis for strategic budgeting and program prioritization	<p>Big data analysis allows governments to have up-to-date knowledge of economic or social developments that require attention. It facilitates scenario testing and prioritize spending to achieve more efficient outcomes.</p> <p>Big data collection and analysis across the various public entities may help government better appreciate social and economic areas that are highly complex and have interacting effects, leading to more effective budgets. An example is in the design of programs for poverty relief and crime reduction.³⁶⁹</p>
Data analytical applications	Data visualization tools to produce Citizen's Budget	<p>Software or digital applications can be used to help citizens decipher complicated government finance data through visually compelling charts. They should include functionalities that allow users to delve into specific funding categories or programs for further insights. It can strengthen civic society by raising the interest and ability of citizens to comprehend public finances.</p> <p>An example is the low-cost, open source budget visualization app "Visual Budget" which is gaining popularity over more expensive solutions in American cities and counties. With minimal technical expertise, the app can be integrated onto cities' websites and future updating of financial data is simple and straightforward vis spreadsheets.³⁷⁰</p>

Table A2: ii) Improving tax compliance

Technological family	Application	Comments
Digitization of payments	Digital (P2G, B2G) payment to prevent revenue leakage	<p>Different forms of digital payments (i.e. internet banking, mobile payments, direct debit etc.) can increase the convenience for payers and lowers the risk of late or non-payment.</p> <p>Providing means for taxpayers (both individuals and corporates) to conveniently settle their obligations using internet banking portals have led to more timely receipts. One example is in Malaysia where Citibank Berhad and Lembaga Hasil Dalam Negeri Malaysia (LHDNM) launched CitiConnectSM e-Tax - an online payment solution that allows firms to settle their tax payments to LHDNM.³⁷¹</p> <p>African cities such as Douala II in Cameroon and Kinondoni in Tanzania have reported tax revenue increases of over 50% within a few years of implementing mobile payment solutions.³⁷²</p>

369 Centre for Effective Services (2014). A primer on implementing whole of government approaches

370 Gov Tech (2016). "Low-Cost Budget Visualization Tool Gains Momentum". Available at: <http://www.govtech.com/civic/Low-Cost-Budget-Visualization-Tool-Gains-Momentum.html>

371 Citigroup (2009). "Citibank and LHDNM Launch e-Tax Payment". Available at: <http://www.citigroup.com/citi/news/2009/090529a.htm>

372 Uraia, The impact of smart technologies in the municipal budget: Increased revenue and reduced expenditure for better services. 2016

<p>Digitization of payments</p>	<p>E-invoicing (B2C, B2B) to reduce under-reporting</p>	<p>E-invoicing methods are used by trading partners, such as customers and their suppliers, to present and monitor transactional documents between one another and ensure the terms of their trading agreements are being met. E-invoicing creates a trail of digitized transaction details that can be used to track under declaration of revenues for tax purposes by businesses.</p> <p>Many countries in Latin America have compulsory e-invoicing laws. The European Commission also issued directive for the mandatory implementation of an EU-wide electronic invoicing network. In Mexico, e-invoice led to ~7 percent increase for legal entities and ~21 percent for individuals. Other impact estimates show that there is a decline in VAT dodging from 32 percent in 2011 to 19 percent in 2015.³⁷³</p> <p>Real-time VAT reporting is a specific form of e-invoicing where companies are mandated to report necessary information in each invoice to the tax authorities in digital format.</p> <p>According to software services company Tieto and Finnish Financial Services, adopting a uniform standard could increase European tax revenues by EUR160 billion annually. In Spain, it is now compulsory for large payers to file their VAT information in real time on the new online system known as Suministro Inmediato de Información (SII).³⁷⁴</p>
<p>Identification and recording technologies</p>	<p>Biometrics smart cards to enhance identification and track taxpayer behaviour</p>	<p>Data collected in biometric smartcards used to access government services can be used to identify potential taxpayers by tracking user activity.</p> <p>India has made it compulsory that taxpayers link their Aadhar card to tax accounts, improving the tax authority's ability to better track non-compliance.</p>
<p>Identification and recording technologies</p>	<p>Fiscal control units to reduce B2C under-reporting</p>	<p>Data recording technologies, referred to as fiscal control units in some countries, help to secure sales data once a transaction goes through such that sales data cannot be tampered by phantomware or zappers.</p> <p>In Hungary, fiscal control units were installed in electronic cash registers used in concerned sectors such as hospitality. Within a year, VAT revenues rose by 15 percent, an amount which already exceeded the cost of implementation. Belgium reported an 8 percent increase in reported restaurant sales after installation of the technology.³⁷⁵</p>

373 "Impact of CFDI on tax evasion". Available at: <http://cfdi.edicomgroup.com/en/cfdi-al-dia-en/impact-cfdi-tax-evasion/>

374 DLA Piper (2017). "Spain requires real-time submissions of VAT information". Available at: <https://www.dlapiper.com/en/us/insights/publications/2017/07/spain-requires-vat-information/>

375 Organisation for Economic Co-operation and Development (OECD), Technologies for better tax administration: A practical guide for revenue bodies. 2016

<p>Identification and recording technologies</p>	<p>Geographic Information System (GIS) to enhance tax mapping</p>	<p>Mapping taxpayers to taxable goods can be very challenging. GIS is a set of computing tools that enables users to visualize data in graphic map formats or satellite pictures. It can help governments to establish accurate tax maps which enables them to crack down on tax evaders (for e.g. understating business activities, land value, property size etc.)³⁷⁶</p> <p>In Cartago, Costa Rica, GIS is used to better track property and land ownership information. The program increased budget collection by 315 percent between 2006 and 2015 (an increase of almost US\$30 million), and 12 percent between 2014 and 2015. The cost of the GIS project was around US\$600,000 – implying a very positive return on investment in annual terms.³⁷⁷</p>
<p>Identification and recording technologies</p>	<p>Blockchain technologies for digital asset tracking</p>	<p>Blockchain is an emerging technology and refers to a form of peer-to-peer online distributed ledger, amongst computer nodes, which is made up of a continuously growing list of records linked and secured to each other using cryptography. As a blockchain network is designed to be incorruptible and decentralized, it is potentially very valuable in sectors where data security and transparency are critical.</p> <p>Application to tax functions is still in infancy but has huge potential impact for tracking and monitoring of taxable assets. For example, if ownership and location of digital assets are reliably captured at asset creation and updated throughout their lifetime, it would reduce opportunities for tax evasion.³⁷⁸</p>
<p>Integrated IT hardware and software</p>	<p>IFMIS – accounts receivable/ revenue management modules</p>	<p>Accounts receivable and revenue management modules produce bills and processes and records receipts, including all types of inflows received by government units, including non-tax revenues and fees.³⁷⁹</p> <p>This is core IFMIS component where data generated can be utilized in a variety of ways to detect possible tax non-compliance.</p>
<p>Integrated IT hardware and software</p>	<p>“Natural systems” integration with digital tax services in large corporates</p>	<p>This refers to integration of tax services with a range of third-party services (e.g., accounting software, point-of-sale systems) that can help improve the efficiency of tax assessment and collection for corporates.³⁸⁰</p> <p>One of the cornerstones of the Australian Tax Office’s (ATO) Digital Strategy is “integration with natural systems.” By embedding services within these systems, taxpayers use day-to-day (e.g. accounting software, point-of-sale systems) the ATO can facilitate seamless transactions between government and businesses. This integration with natural systems relies on delivery via third parties, which the ATO can enable through development of rich Application Programming Interfaces (APIs). Integration will enable taxpayer reporting and payment obligations to be met easily, quickly and automatically in “real-time”, as a by-product of their day to day activities. This in turn will significantly reduce red tape for the community whilst enhancing compliance.³⁸¹</p>

376 Uraia, The impact of smart technologies in the municipal budget: Increased revenue and reduced expenditure for better services. 2016

377 Uraia, The impact of smart technologies in the municipal budget: Increased revenue and reduced expenditure for better services. 2016

378 IBM (2016). “Blockchain: Tackling Tax Evasion”.

379 USAID (2008). Integrated Financial Management Information Systems. A Practical Guide. Available at: http://pdf.usaid.gov/pdf_docs/Pnack595.pdf

380 Organisation for Economic Co-operation and Development (2016), Technologies for better tax administration: A practical guide for revenue bodies.

381 Organisation for Economic Co-operation and Development (2016), Technologies for better tax administration: A practical guide for revenue bodies.

<p>Integrated IT hardware and software</p>	<p>E-customs to standardize and increase declarations</p>	<p>IT systems used at customs to accurately track the flow of goods, monitor illegal activities and enable duties payments.</p> <p>The ASYCUDA (Automated System for Custom Data) is a computerized management system which generates trade data to be used for statistical analysis and currently implemented in over 90 countries, territories and regions. The system aims to secure custom revenues for many countries and to improve the efficiency and effectiveness of custom operations.³⁸² However, actual success has been mixed. For example, Afghanistan reported an initial increase in transparency and efficiency gains, but companies started using various means to circumvent the system soon after. It is reported that Dubai had considerably more success with its similar system called the E-Clearance.³⁸³</p>
<p>Integrated IT hardware and software</p>	<p>Cloud computing decreases tax collection costs</p>	<p>The elasticity of cloud computing services allows tax authorities to process exponentially higher volumes of data, which can help reduce tax evasion and collection efforts.</p> <p>Combining data collection with advanced data analytics can help tax authorities spot illegal activities more accurately. The delivery of better services also increases the trust between the taxpayer and the authorities which could encourage voluntary filing of taxes. In the Tax Authority of Mexico's (SAT) case, improvement of its online portal resulted in an estimated increase in revenue collection of 10% in 2015 from the previous year.³⁸⁴</p>
<p>Citizen and business engagement solutions</p>	<p>Integrated tax portals increase convenience for taxpayers</p>	<p>Well-designed tax portals can allow taxpayers to file their return, track their refunds, make online payments, obtain a copy of their prior year's return or income details to access other services, and to be able to do all this through one single access account. Increasing the convenience to taxpayers through integrated services can help to improve tax compliance.³⁸⁵</p> <p>In Singapore, User Experience Design (UXD) methodology has been adopted in re-designing the "myTax Portal" for use on desktop and mobile. Interviews reveal that well-functioning tax portals may have positive impact on tax morale.</p>
<p>Citizen and business engagement solutions</p>	<p>Short Message Service (SMS) to improve tax communication</p>	<p>SMS is a text messaging service component of most telephone, World Wide Web, and mobile telephony systems. It uses standardized communication protocols to enable mobile phone devices to exchange short text messages.³⁸⁶ Use of SMS for tax reminders may lower the risk of late or non-payment.</p> <p>In Singapore, IRAS uses SMS to communicate policy changes to taxpayers and also to send reminders for filing and payment. A total of 6 million messages were sent in 2015 and more than 96 percent of those surveyed agreed that the SMS service was timely and helpful. Inland Revenue Department in New Zealand started sending text reminders in 2016. The simple practice is also becoming more common in developing regions such as Kampala in Uganda, which has reportedly led to increased compliance.³⁸⁷</p>

382 Information retrieved from: <https://www.asycuda.org/aboutas.asp>

383 Forbes (2017). "Government technology reduces corruption". Available at: <https://www.forbes.com/sites/alexandrawrage/2017/04/13/government-technology-reduces-corruption/#42f0f0b2f94d>

384 Microsoft (2015). "Tax authority improves interaction with taxpayers through cloud computing services". Available at: <https://enterprise.microsoft.com/en-us/customer-story/industries/government/tax-authority-of-mexico/>

385 Organisation for Economic Co-operation and Development (2016), Technologies for better tax administration: A practical guide for revenue bodies.

386 Information retrieved from: <http://www.kashamtech.com/sms.html>

387 Uraia (2016), The impact of smart technologies in the municipal budget: Increased revenue and reduced expenditure for better services.

<p>Citizen and business engagement solutions</p>	<p>Social media to improve tax communication and awareness</p>	<p>Use of social media outlets such as Twitter and Facebook to communicate policy changes and deadline reminders.</p> <p>The UK's Her Majesty Revenue & Customs (HMRC) has set up a social media customer support team which uses a range of social media including Twitter, Facebook, Instagram, YouTube and LinkedIn to disseminate news and updates, and provide guidance and answer questions from the public. The engagement is intended to complement formal communication channels by the HMRC.³⁸⁸</p>
<p>Data analytical applications</p>	<p>Big data to detect tax fraud and evasion</p>	<p>Use of data techniques to retrieve insights from mass amounts of unstructured data. Data can be analyzed and mapped to declared income by taxpayers to identify potential discrepancies. Analytical software (tax intelligence software) can help reduce leakage by identifying high risk cases such that audit resources could be used more efficiently. It can also help to maximize tax collection by identifying the most profitable collection strategy.</p> <p>The UK uses a product called COSAIN which automates the collation and filtering of social media and websites.³⁸⁹ India's Project Insight relies on social media postings to match residents' spending patterns with their declared income.</p> <p>Austria uses internet monitoring and scraping tools to supplement their compliance measures which has led to extra VAT collection of EUR10 million and 44 voluntary declarations.</p> <p>The Birmingham City Council in the UK started deploying internal data matching across multiple systems to detect tax frauds. It has proven very successful and helped recover GBP25 million over 5 years.³⁹⁰</p> <p>Italy uses a tool called the Redditometro – a data analytical tool which examines a taxpayer's expenditure patterns against where he lives and the type of household he is in. Cases flagged for inconsistencies would warrant closer examination of the taxpayer's tax returns.³⁹¹</p> <p>The UK recovered GBP2.6 billion in additional tax revenue after implementing strategic risk tool.³⁹²</p>
<p>Data analytical applications</p>	<p>Automated filing service reduces non-compliance</p>	<p>Pre-populated tax returns could reduce leakage by reducing the risk of non-compliance and contact between taxpayer and revenue authority, reducing scope for corruption and other leakages.</p> <p>According to interviewees, several developed countries such as Singapore and Estonia have very efficient auto filing tax systems, drawing from a broad range of data from different ministries to reduce filing requirements of taxpayers.</p>

388 For more information, please refer to: <https://www.gov.uk/government/organisations/hm-revenue-customs/about/social-media-use#why-hmrc-engages-in-social-media>

389 Organisation for Economic Co-operation and Development (OECD), Technologies for better tax administration: A practical guide for revenue bodies. 2016

390 Fighting Fraud Locally (2011). The Local Government Fraud Strategy. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/118508/strategy-document.pdf

391 The New York Times (2013). "Italians have a new tool to unearth tax cheats". Available at: <http://www.nytimes.com/2013/01/28/world/europe/italys-new-tool-for-tax-cheats-the-red-ditometro.html>

392 IT World Canada (2017). "Predictive Analytics could narrow 'tax gap': Conference Board Canada." Available at: <https://www.itworldcanada.com/article/predictive-analytics-could-help-narrow-tax-gap-conference-board-of-canada/390684>

Data analytical applications	Computer Assisted Audit Tools and Techniques (CAATs) for internal audit	<p>CAATs are commercially available E-audit tools to identify data gaps in business records and tax return forms. Tests can then be conducted to assess the probability of fraud.</p> <p>The Revenue Commissioners of Ireland has used E-audit to identify many cases of sales suppression to avoid VAT payments.</p>
Data analytical applications	Artificial intelligence to detect tax evasion	<p>Artificial intelligence (the simulation of human intelligence processes by machines) can automate and enhance audit processes by cutting out human errors, leading to improved tax compliance.</p> <p>This is a nascent area with large potential impact. Researchers from M.I.T and Mitre Corporation demonstrated in a paper how an algorithm could be used to detect a specific kind of tax shelter used by partnerships. They estimated around US\$90 billion in underreported income between 2005 and 2015 using this structure.³⁹³</p>

Table A3: iii) Allocating public spending more efficiently and deliver services more effectively

Technological family	Application	Comments
Digitization of payments	Electronic charge cards for public expenses	<p>Issue public workers with charge cards to control and monitor spend. Cards may include credit and debit cards, stored-value cards, single-use cards and declining balance cards.</p> <p>The General Services Administration (GSA) SmartPay programme in the US helps government agencies implement card payment programmes that have led to significant savings. For example, the Department of State saved almost US\$13 million in paper invoice transactions since introducing payment cards for recurring expenditure. According to Visa, the GSA estimates US\$1.7 billion in annual savings when purchase cards are used in place of written purchase orders and US\$3.6 billion in annual savings from airfare discounts.³⁹⁴ Vietnam and Indonesia rolling out government-issued credit cards initiatives to control spend.³⁹⁵</p>

393 The New York Times (2015). "Computer Scientists Wield Artificial Intelligence to Battle Tax Evasion". Available at: <https://www.nytimes.com/2015/10/10/business/computer-scientists-wield-artificial-intelligence-to-battle-tax-evasion.html>

394 Visa Government Solutions (2012). Partnering with governments to transform payments.

395 Farooq K and April L (2017). "Digital Money is Spearheading the Next Wave of Public Financial Management (PFM) Reforms in EAP". Available at: <http://blog-pfm.imf.org/pfm-blog/2017/08/digital-money-is-spearheading-the-next-wave-of-public-financial-management-pfm-reforms-in-eap.html>

<p>Digitization of payments</p>	<p>Digital payments for government salary payments (G2G)</p>	<p>Payment of government salaries using digital means such as internet banking, digital wallets, mobile payments etc. It increases convenience for recipients and lowers risk of late or non-payment.</p> <p>At the height of the Ebola crisis, Sierra Leone turned to mobile wallets to make fast, accurate, and secure payments to Response Workers. Before digitization, cash payments were slow, inaccurate, and open to graft and theft. Digitization cut payment times from over one month to around one week, putting an end to payment-related strikes. In doing so, digital payments strengthened Sierra Leone’s capacity to contain the Ebola disease, treat those infected, and ultimately save lives. In the process, digitizing payments also delivered cost savings of more than US\$10 million by eliminating double-payment, reducing fraud, removing the costs of physical cash transportation and security, and cutting travel costs for Response Workers.³⁹⁶</p>
<p>Digitization of payments</p>	<p>Digitization of existing and potential G2P payments (e.g. welfare, subsidies, carbon credits)</p>	<p>The use of electronic or mobile wallets to facilitate transfer payments such as welfare and subsidies. Useful for people in remote regions, allowing them to cut down prohibitive traveling costs to the nearest financial institution. These include preloaded debit cards or stored-value cards to deliver transfers to recipients who do not have access to accounts in financial institutions. Removing the human element in G2P payments reduces the opportunities for rent-seeking and fraud.</p> <p>Pakistan issued prepaid cards loaded with aid payments to victims displaced by armed conflicts in 2009 and again to flood victims in 2010. National Identity Agency of Pakistan, United Bank Limited and Visa teamed up to distribute the cards and install terminals in local businesses to accept payment cards and connect them to the global payments network. Not only were aid delivered efficiently, 270,000 bank accounts were created in the process, strengthening financial inclusion.³⁹⁷</p> <p>In India, the distribution of India’s cooking gas subsidies by electronic transfer through the Direct Benefit Transfer for Liquefied Petroleum Gas scheme led to savings of 0.4 percent of total government expenditure (for fiscal years 2014-2015 and 2015-2016) as fake recipients were eliminated.³⁹⁸ J-PAL found that in Andhra Pradesh, sub-districts which introduced electronic payments has NGREGS leakage of around 19% - down from 31% in “control” districts without electronic payments. The World Bank also estimated that by digitizing subsidy flows in India, the government could save 1% of its annual GDP, equivalent to over US\$20 billion.³⁹⁹</p> <p>Another example are stored-value cards which could be designed to restrict spending to particular items and services, ensuring that transfer payments are targeted and reduce abuse of funds.</p>

396 Better Than Cash Alliance (2016). Saving Money, Saving Lives: A Case Study on the Benefits of Digitizing Payments to Ebola Response Workers in Sierra Leone. Available at: https://bt-ca-prod.s3.amazonaws.com/documents/186/english_attachments/BTCA-Ebola-Case-Study.pdf?1502739794

397 For more information, refer to: <http://www.visa.com/blogarchives/us/category/prepaid-2/index.html>

398 Roy R and Rai S (2017). “Fiscal Policy Consequences of Digitalization and Demonetization in India.” Chapter 11 of Gupta S, Keen M, Shah A and Verdier G (eds), Digital Revolutions in Public Finance. International Monetary Fund

399 Consultative Group to Assist the Poor (CGAP), From cash to digital transfers in India: The story so far. 2015

<p>Digitization of payments</p>	<p>Digitization of non-tax P2G payments (eg. Utilities payments, public transport)</p>	<p>Direct debit increases ease of payment and consumer satisfaction for users of government services.</p> <p>An example is the GIRO system in Singapore where consumers can set up a direct debit arrangement with their banks and creditors to make automatic payments on pre-agreed dates.</p> <p>Another example is the direct carrier billing model which is a viable channel for micropayments collection. In Helsinki (Finland), passengers can use their mobile phones to pay for public transport. Potential use to deliver public services that require some form of co-payment (e.g. public health and crop insurance) more efficiently.</p>
<p>Identification and recording technologies</p>	<p>Biometrics technology to increase accuracy of G2P payments</p>	<p>Biometrics can improve identification and when combined with digital payment methods, help to improve subsidy outcomes. Biometrics smart cards help to identify subsidy recipients so that transfer payments are efficient and eliminates “ghost recipients” who were wrongfully included.</p> <p>India state of Andhra Pradesh introduced biometric IDs and e-payments for subsidies in 2010. Beneficiaries of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) received 24% more in benefits with no additional cost to the government. There were also time efficiencies as the new system reduced lag between working on an MGNREGS project and being paid by 10 days (29% reduction from 34 days).</p> <p>⁴⁰⁰With the Aadhaar payment system in India, researchers find that there is a \$32.8 million reduction in annual leakage on the NREGA programme. ⁴⁰¹</p> <p>In Botswana which transferred its pension and social grants registration to biometric enrolment, leading to registration decline of 25% as duplicates, ghosts and the deceased were eliminated.⁴⁰²</p>
<p>Identification and recording technologies</p>	<p>Biometrics to improve public services (e.g. teacher absenteeism)</p>	<p>Biometrics can improve identification and have applications in reducing absenteeism and “ghost workers” in the public sector. This could improve the quality of public services for citizens.</p> <p>In India, an Aadhaar-enabled biometric attendance system (AEBAS) was introduced in response to high absenteeism rates in public sector. Official sources note that the average gain per central government employee is 20 minutes a day.⁴⁰³</p>

⁴⁰⁰ Livemint (2016). “The economics of MGNREGS”. Available at: <http://www.livemint.com/Sundayapp/ueWD2KvNelmsOGEupZND6K/The-economics-of-the-MGNREGS.html>

⁴⁰¹ Karthik Muralidharan, Paul Niehaus and Sandip Sukhtankar (2014), Building state capacity: evidence from biometric smartcards in India.

⁴⁰² Alab Gelb and Julia Clark (2013). Identification for development: The biometric revolution. Center for Global Development.

⁴⁰³ India Today (2015). “Modimetrics raise efficiency of Central government employees.” Available at: <http://indiatoday.intoday.in/story/narendra-modi-biometric-system-central-government-employees/1/411283.html>

<p>Identification and recording technologies</p>	<p>Treasury Single Account (TSA) to derive monetary savings</p>	<p>IMF defined TSA as a “unified structure of government bank accounts that gives a consolidated view of government cash resources. Based on this principle and the unity of treasury, a TSA is a bank account or a set of linked accounts through which the government transacts all its receipts and payments” .⁴⁰⁴ Implementing the TSA strengthens cash management by reducing unnecessary commercial banking fees and government borrowing by eliminating “float”. Consolidating financial accounts can also enhance reconciliation of revenue collection and payment.⁴⁰⁵</p> <p>Savings derived from reduced borrowing, lower banking fees and leakage can be spent on more public services. In Uganda, within 3 months of introducing the TSA, 165 dormant bank accounts were shut down and UGX15 billion was transferred into a consolidated fund. The TSA aims to ultimately eliminate the need for cash rationing, which affects service delivery, and help solve the persistent problem of low absorption of public funds. ⁴⁰⁶</p> <p>In Nigeria, more than 20,000 government bank accounts were closed, enabling the Nigerian government to save EUR1.3 million on average a month on banking fees; total savings of around EUR7 billion since TSA was implemented⁴⁰⁷</p>
<p>Identification and recording technologies</p>	<p>Blockchain for data security and more efficient service delivery</p>	<p>Blockchain technology have applications in secure and efficient data management which in turn leads to more effective delivery of public services.</p> <p>The Department for Work and Pension in the UK has started a trial where claimants use a mobile app to receive and spend their benefit payments. Their spending patterns are tracked and recoded on a distributed ledger so that they could receive financial management advice.⁴⁰⁸</p> <p>Estonia has started using blockchain to secure the health records of over a million citizens. Transparent, updated and easily accessible data should prevent medical fraud and lead to more efficient health services at lower costs.⁴⁰⁹</p>
<p>Identification and recording technologies</p>	<p>GIS may help governments allocate funds for public services more efficiently</p>	<p>The Indian government used data from a multi-layered GIS platform to investigate fraud around welfare payments.⁴¹⁰</p> <p>Likewise, GIS analysis in Italy helped to curb the amount of subsidies paid to farmers who deliberately overdeclared their land holdings in order to receive more money.⁴¹¹ Authorities in Latvia also successfully used GIS to improve the mapping of more than 300,000 land parcels and their subsidy needs.</p>

404 International Monetary Fund, Treasury Single Account: Concept, design and implementation issues. 2010

405 Adeolu, I. A. (2015), Understanding the treasury single account (TSA) system –things you should know. Business & Economy, Market Development. Abuja: Office of the Accountant General of the Federation

406 Economic Policy Research Centre. A Review of Uganda’s Public Finance Management Reforms (2012 to 2014).2015

407 Daily Trust (2016). “TSA: 20,000 bank accounts closed, accruals hit N5.244trn”. Available at: <https://www.dailytrust.com.ng/news/business/tsa-20-000-bank-accounts-closed-accruals-hit-n5-244trn/185236.html>

408 Computerweekly.com (2016). “DWP trials blockchain technology for benefit payments”. Available at: <http://www.computerweekly.com/news/450300034/DWP-trials-blockchain-technology-for-benefit-payments>

409 Coindesk (2016). “Blockchain Startup to Secure 1 Million e-Health Records in Estonia”. Available at: <https://www.coindesk.com/blockchain-startup-aims-to-secure-1-million-estonian-health-records/>

410 The DBT programme was launched in India in 2013. It aims to transfer various government subsidies directly into the bank accounts of recipients to reduce leakages and delays. More information: <https://www.geospatialworld.net/blogs/for-financial-inclusion-india-strikes-up-direct-benefit-transfer-through-gis/>

411 The difference between the area declared for subsidies and the actual landholdings declined from 9 percent to just 2 percent in a few years since GIS was introduced to clamp down on fraud. See: Longley P, et al. (2001). Geographic Information Systems and Science. John Wiley & Sons

<p>Integrated IT hardware and software</p>	<p>IFMIS – account payable, commitment & payment modules</p>	<p>IFMIS integrates information systems with key financial IFMIS refers more specifically to the computerization of PFM processes, from budget preparation and execution to accounting and reporting, with the help of an integrated system for financial management of line ministries, spending agencies and other public sector operations.⁴¹²</p> <p>Commitment control modules – ensures that before a purchase is committed to, there is sufficient cash allocated for the expense and the allocation matches the appropriated budget. Accounts payable modules – Processes and generates payments, with built-in checks to ensure invoices match approved commitments.⁴¹³</p>
<p>Integrated IT hardware and software</p>	<p>Integrated payroll and human resource systems or portals</p>	<p>Payment of public sector salary using digital means, such as through an integrated payroll system, could lead to payments that are more accurate and timely. An integrated payroll system allows both human resources and payroll staff to access the same information without duplicate paperwork or files, creating efficiencies that save time and money.⁴¹⁴</p> <p>Cambodia has collaborated with a local institution to roll out a pilot mobile banking services to facilitate payroll payments to civil servants. In addition, this initiative has enabled more timely and easy payment by citizens for services including electricity, service charges for businesses, vehicle registration and inspection.⁴¹⁵</p> <p>The Integrated Personnel and Payroll Information System (IPPI) is used in Nigeria after the government spent 75% of its resources to pay “ghost workers”. The system included a biometric component which ensures that all salary payments are associated with the unique and correct individual. The system weeded out 60,000 ghost workers and cost savings of US\$3 million in the first month of operation in 2007 and over US\$1 billion to date.⁴¹⁶</p>
<p>Integrated IT hardware and software</p>	<p>Cloud infrastructure to improve cost efficiencies and facilitate better taxpayer services</p>	<p>The elasticity of cloud computing services allows tax authorities to process exponentially higher volumes of data when required, leading to better provision of services to taxpayers.</p> <p>The Tax Authority of Mexico (SAT) collected more data on taxpayers in the two years since migrating its systems onto the cloud than the prior 15 years. The ability to collect and process more data allows SAT to create more quality services for taxpayers. For example, the SAT now pays their tax refunds within five days, a process that previously took up to two months.⁴¹⁷</p>

412 USAID (2008). Integrated Financial Management Information Systems. A Practical Guide. Available at: http://pdf.usaid.gov/pdf_docs/Pnack595.pdf

413 USAID (2008). Integrated Financial Management Information Systems. A Practical Guide. Available at: http://pdf.usaid.gov/pdf_docs/Pnack595.pdf

414 Payday Workforce Solutions (2015). “Benefits of an integrated payroll system”. Available at: <http://www.paydayonesource.com/benefits-of-an-integrated-payroll-system/>

415 Farooq K and April L (2017). “Digital Money is Spearheading the Next Wave of Public Financial Management (PFM) Reforms in EAP”. Available at: <http://blog-pfm.imf.org/pfmblog/2017/08/digital-money-is-spearheading-the-next-wave-of-public-financial-management-pfm-reforms-in-eap.html>

416 Effective Institutions Platform (2015). A study of peer learning in public sector reforms. 2015. Available at: https://www.effectiveinstitutions.org/media/Peer_learning_study_final_p5v0700.pdf

417 Available at: <https://enterprise.microsoft.com/en-us/customer-story/industries/government/tax-authority-of-mexico/>

<p>Integrated IT hardware and software</p>	<p>Project management tool</p>	<p>An IT tool that helps teams manage projects from start to finish by facilitating time management, goal setting, cost and resource management, oversight and communication. Such a tool can be useful in various phases of PFM, but particularly in the management of public infrastructure investment projects (e.g. construction of a public hospital).</p> <p>Gwinnett County Public Schools (GCPS), one of the largest school district in the US, uses project management solutions by Microsoft to gain centralized visibility into all work underway, to better allocate limited resources, and to identify risks. The results were very positive and allowed staff to work more efficiently and handle more work requests. ⁴¹⁸</p>
<p>Citizen and business engagement solutions</p>	<p>Mobile applications to get citizen feedback on public services</p>	<p>The OneService feedback app was launched by the Municipal Services Office (MSO) in Singapore in 2015, following rigorous testing with 1,700 users comprising 1,400 public officers and 300 grassroots volunteers. The purpose of the app is to provide a simple and efficient mechanism for citizens to provide feedback on municipal issues, via one common platform that routes feedback to relevant agencies. Categories available for feedback include "Animals", "Cleanliness", "Roads and Footpaths" and so on. Participating government agencies include the Housing and Development Board, (HDB) the Land Transport Authority (LTA) and the Police. As of 2017, over 94,000 local users lodged over 111,000 cases through the service. ⁴¹⁹</p>
<p>Citizen and business engagement solutions</p>	<p>Whole-of-government digital services</p>	<p>An integrated approach across government agencies and ministries to provide products and services such as information portals, payment systems, authentication and services platforms to citizens.</p> <p>WoG service delivery methods in Estonia and Singapore, for example, have helped maintained their governments' effectiveness and led to efficiencies in government programs. Analytics across government websites and digital services are used to understand user behaviour to further optimize service delivery. WoG approach to service delivery can also cut services and operational duplication⁴²⁰ and create feedback mechanisms that strengthen fiscal discipline.</p>
<p>Data analytical applications</p>	<p>Big data analysis to improve G2P and G2G payments (service delivery)</p>	<p>The use of big data analytics helps governments generate valuable insights that enable more targeted and timely interventions, leading to more desired outcomes for citizens.</p> <p>Transport for London (TfL) uses data collected from Oyster prepaid travel cards to produce maps that give city planners an accurate picture of traffic flows and individual journeys in order to improve public transport services. ⁴²¹</p>

⁴¹⁸ Microsoft (2014). "Georgia school district runs more smoothly with better project management." Available at: <https://customers.microsoft.com/en-us/story/georgia-school-district-runs-more-smoothly-with-better>

⁴¹⁹ Straits Times (2017). "Giving feedback now easier on OneService app and portal." Available at: <http://www.straitstimes.com/singapore/housing/giving-feedback-easier-now-on-oneservice-app-and-portal>

⁴²⁰ Centre for Effective Services (2014), A primer on implementing whole of government approaches.

⁴²¹ Forbes (2017). "How big data and the internet of things improve public transport in London". Available at: <https://www.forbes.com/sites/bernardmarr/2015/05/27/how-big-data-and-the-internet-of-things-improve-public-transport-in-london/#120bc64e1be6>

Table A4: iv) Reducing corruption in public procurement

Technological family	Application	Comments
Digitization of payments	Digital payments for public spend	<p>Digital payments eliminate direct contact between payers and payees, reducing scope for rent seeking. They can also generate a trail of transaction history which may help government auditors monitor purchases and analyze spending trends for overall efficient budget management.</p> <p>In Brazil, public servants have been convicted for corruption using evidence from their card transactions. One example is the forced resignation of Matilde Ribeiro, formerly the Minister of Promotion of Racial Equality, following an examination of her government credit card expenses.⁴²²</p> <p>In Nigeria, all Ministries and Development Agencies (MDAs) began using various electronic payment channels for financial transactions including payment to contractors, service providers and intra government agencies. Less delays in payment and reduced susceptibility for corruption.</p>
Digitization of payments	E-invoicing increases control over government payments (B2G, G2B)	<p>The exchange of the invoice document between a supplier and a buyer in an integrated electronic format.⁴²³ It generates a digital database of transaction history that can be used for auditing to reduce corruption in public spending.</p> <p>E-invoicing is already mandatory for Business-to-Government (B2G) transactions in the US, Singapore, Sweden, Finland, Denmark and Italy. According to Billentis, the public sector is responsible for 15-18% of all purchases made in a country⁴²⁴ – scope for corruption is large.</p>

⁴²² Apolitical (2017). "Brazil is fighting corruption by making government spending public". Available at: https://apolitical.co/solution_article/brazil-fighting-corruption-making-government-spending-public/

⁴²³ Information retrieved from: <https://www.einvoicingbasics.co.uk/what-is-e-invoicing/>

⁴²⁴ Presentation by Bruno Koch, "The impact of B2G E-Invoicing to the whole economy", 13. Konferencija eBiz 2014 Zagreb, Croatia. Available at: http://www.billentis.com/eBiz2014_elektronickog_fakturiranja.pdf

<p>Citizen and business engagement solutions</p>	<p>E-procurement systems that integrate all parts of the procurement process</p>	<p>One-stop platform where all government tenders and transactions take place. It can facilitate access to public tender information, conduct transparent bidding processes, reduce direct interaction between procurement officials and suppliers and allow for easier detection of irregularities and corruption.⁴²⁵</p> <p>Korea launched a E-procurement system called KONEPS in 2002 where all public organizations are mandated to publish tenders through the system. Since its launch in 2002, KONEPS has evolved to include biometric recognition and a mobile application to strengthen security and improved ease of usage. The system has led to increased participation in public tenders, improved transparency and eliminate illegal practices such as collusion. According to the integrity assessment conducted by Korea Anti-Corruption and Civil Rights Commission, Integrity perception index of the Public Procurement Service (PPS) has improved from 6.8 to 8.52 out of 10 since the launch of KONEPS.⁴²⁶</p> <p>E-procurement systems can also improve operational efficiencies. An online procurement system is used in Texas by state and local agencies for all purchases. The portal's performance in terms of user experience and security increased significantly. Features such as search filters and product comparison made the site more intuitive and helped purchasers quickly find and purchase the items they needed.⁴²⁷</p>
<p>Citizen and business engagement solutions</p>	<p>Fiscal transparency portal to digitally publish all fiscal data to public</p>	<p>A digital platform which publishes data on government revenue and expenditure can help to promote transparency and accountability in public procurement.</p> <p>An example is the federal Transparency Portal in Brazil which has an average of 900,000 unique visitors each month. The portal includes a National Debarment list which highlights contractors who have been sanctioned for corruption and fraud. Spending on huge projects like the 2014 World Cup and 2016 Olympic Games were also published. Feedback and whistleblowing mechanisms also available on the site.</p>
<p>Citizen and business engagement solutions</p>	<p>Mobile applications to engage citizens and encourage whistleblowing</p>	<p>Mobile technology and applications are being utilized to harness data and gain quicker and deeper insights from citizens. In developing countries, this technology is being used to empower citizens in remote areas, making information more accessible and there is no reason why the success of this technology could not be used in the fight against corruption.⁴²⁸</p> <p>Examples of this include the creation of applications and websites to detect and deter corruption such as 'I paid a bribe'.⁴²⁹The World Bank has also used various mobile applications to encourage citizens to share information on Bank-financed projects, such as information on possible corruption and fraud. Through the "Integrity App", users can send information (such as a half-built school or hospital) to relevant stakeholders.⁴³⁰</p>

425 Organisation for Economic Co-operation and Development (OECD), Preventing corruption in public procurement. 2016

426 Organisation for Economic Co-operation and Development (OECD), Preventing corruption in public procurement. 2016

427 Deloitte Digital. How are digital trends reshaping government financial organizations? Finds from Deloitte NASACT 2015 digital government transformation survey. 2015

428 Silveria L (2016). "4 technologies helping us fight corruption." World Economic Forum. Available at: <https://www.weforum.org/agenda/2016/04/4-technologies-helping-us-to-fight-corruption/>

429 Silveria L (2016). "4 technologies helping us fight corruption." World Economic Forum. Available at: <https://www.weforum.org/agenda/2016/04/4-technologies-helping-us-to-fight-corruption/>

430 Silveria L (2016). "4 technologies helping us fight corruption." World Economic Forum. Available at: <https://www.weforum.org/agenda/2016/04/4-technologies-helping-us-to-fight-corruption/>

<p>Integrated IT hardware and software</p>	<p>IFMIS – account payable and reporting modules</p>	<p>IFMIS integrates information systems with key financial IFMIS refers more specifically to the computerization of PFM processes, from budget preparation and execution to accounting and reporting, with the help of an integrated system for financial management of line ministries, spending agencies and other public-sector operations.⁴³¹</p> <p>Accounts payable modules: processes and generates payments, with built-in checks to ensure invoices match approved commitments.⁴³² Timely and accurate reports generated by reporting components of IFMIS could enhance audit functions to unearth potential irregularities in payments.</p>
<p>Integrated IT hardware and software</p>	<p>Project management tool can raise accountability by increasing visibility and oversight of public fund flows</p>	<p>An IT tool that helps teams manage projects from start to finish by facilitating time management, goal setting, cost and resource management, oversight and communication. Such a tool can be useful in various phases of PFM, but particularly in the management of public infrastructure investment projects (e.g. construction of a public hospital).</p> <p>Gwinnett County Public Schools (GCPS), one of the largest school district in the US, uses project management solutions by Microsoft to gain centralized visibility into all work underway, to better allocate limited resources, and to identify risks. The results were very positive and allowed staff to work more efficiently and handle more work requests.⁴³³</p>
<p>Identification and recording technologies</p>	<p>Blockchain: Smart contracts for transparency in public transactions</p>	<p>Blockchain technology stores information in a securely so that it is unalterable, traceable, and robust. It has wide-reaching applications in the public sector, especially because government agencies can use this technology to replace existing processes and systems which are inefficient because they are currently lacking trust and a clear source of truth.⁴³⁴</p> <p>Smart contracts permit trusted transactions and agreements to be carried out among disparate, anonymous parties without the need for a central authority, legal system, or external enforcement mechanism. They render transactions traceable, transparent, and irreversible.⁴³⁵</p> <p>In the public sector, transparency is paramount. Blockchain technology combined with the use of smart contracts could tremendously improve the tendering process. Here are some potential advantages: i) identity of bidders and the bidding entity is proven, ii) ensure all participants have same information, iii) automate the process and iv) auditing, review and communication of decisions.⁴³⁶</p>

431 USAID (2008). Integrated Financial Management Information Systems. A Practical Guide. Available at: http://pdf.usaid.gov/pdf_docs/Pnadm595.pdf

432 USAID (2008). Integrated Financial Management Information Systems. A Practical Guide. Available at: http://pdf.usaid.gov/pdf_docs/Pnadm595.pdf

433 Microsoft (2014). "Georgia school district runs more smoothly with better project management." Available at: <https://customers.microsoft.com/en-us/story/georgia-school-district-runs-more-smoothly-with-better>

434 Maltaverne B (2017). "What can Blockchain do for public procurement?" Public Spend Forum. Available at: <https://www.publicspendforum.net/blogs/bertrand-maltaverne/2017/08/28/blockchain-technology-public-procurement>

435 Definition retrieved from: <http://www.investopedia.com/terms/s/smart-contracts.asp>

436 Maltaverne B (2017). "What can Blockchain do for public procurement?" Public Spend Forum. Available at: <https://www.publicspendforum.net/blogs/bertrand-maltaverne/2017/08/28/blockchain-technology-public-procurement>

Table A5: v) Enhancing institutional accountability

Technological family	Application	Comments
Digitization of payments	Digitization of paper-based transactions	<p>Using technology to digitize paper-based transactions, thereby enhancing real time reporting and improving the quality of reports, while also providing audit trails for government payments.</p> <p>In Nigeria, all Ministries and Development Agencies (MDAs) began using various electronic payment channels for financial transactions including payment to contractors, service providers and intra government agencies.</p> <p>Card usage generates a trail of digital transaction history which helps government agencies account for small purchases, analyze spending trends for overall efficient budget management. All government card transactions in Brazil are tracked and furnished for public access.</p>
Integrated IT hardware and software	IFMIS – reporting modules	<p>In Kenya, the IFMIS reporting module has been configured to generate more than 1000 statutory and management reports real time. A user can generate the reports at the click of a button, although the accuracy of generated reports still depends on the data entered by the user. Reports that can be generated include: Appropriation report, Statement of Assets and liabilities, Invoice register report, Account analysis report, Unaccounted transactions report, amongst others.⁴³⁷</p>
Integrated IT hardware and software	Integrated payroll and human resource systems to account for public payroll	<p>An integrated payroll system allows both human resources and payroll staff to access the same information without duplicate paperwork or files, creating efficiencies that save time and money.</p> <p>Integrated Personnel and Payroll Information System (IPPIS) in Nigeria lets the government have greater clarity on its workforce and wage liabilities, leading to better overall control of its financial accounts.</p>
Integrated IT hardware and software	Software for accounting: classification and standardization	<p>Software that standardizes accounting rules and formats is useful when used across ministries, departments and governments, in order to produce numbers and reports that are comparable.</p> <p>International Public-Sector Accounting Standards (IPSAS)-compliant software has been used to facilitate shift to accrual accounting to standardize accounts across government levels, improving financial management and monitoring functions.</p>

⁴³⁷ Information taken from the Republic of Kenya National Treasury's Integrated Financial Management Information System (IFMIS) website. Please see: http://www.ifmis.go.ke/?page_id=2490

<p>Integrated IT hardware and software</p>	<p>E-customs for better customs data management</p>	<p>This includes systems such as the ASYCUDA (Automated System for Custom Data) - a computerized management system which generates trade data to be used for statistical analysis and currently implemented in over 90 countries, territories and regions.</p> <p>Using the ASYCUDA can increased capabilities for accounting, post-clearance audit, statistics and information management. Easier aggregation of data at regional and international levels. Better and faster economic decision-making (UNCTAD).</p>
<p>Identification and recording technologies</p>	<p>Treasury Single Account (TSA) to centralize control over public funds</p>	<p>The Nigerian government sees the TSA as a tool to centralize control over its revenue through a more effective process of cash management. The TSA increases the government's visibility over its financial position on a daily basis, reducing the risks of financial leakages.</p>
<p>Citizen and business engagement solutions</p>	<p>Fiscal transparency portal as a commitment device</p>	<p>Digital platform that publishes information of government spending for public scrutiny, creating incentives for governments to strengthen fiscal discipline. Making fiscal information public also allows independent groups and civil society to scrutinize government spending. It can support the official audit process as well as exert pressure on Supreme Audit Institutions to conduct fair, in-depth and timely audits.</p> <p>Canada has an online government database that consolidates data on government spending and allows users to build customized reports that meet their specific needs. A report by consumer advocacy group US PIRG finds that in the US, a transparency portal could be launched for less than US\$300,000 but leads to substantial cost savings.⁴³⁸</p> <p>Mexico's fiscal transparency portal raised the level of transparency in the budget process by encouraging public debate on policies and increased ability of public to conduct research using budget information. Interviewees are of opinion that Mexico's portal is a "best-in-class" example.</p>
<p>Data analytical applications</p>	<p>Computer Assisted Audit Tools and Techniques (CAATTs) for audit</p>	<p>Commercially available electric audit tools help to identify data gaps in sales documents and government financial accounts. Further analysis can then be conducted to ascertain if fraudulent or duplicate disbursements were made.</p> <p>The Internal Auditor at Washoe County in the US used CAATTs software to flag many payments issues each month, leading to thousands of dollars of recovered payments.⁴³⁹</p>

438 Wood C (2015). "How does your state rank for financial data transparency?" Government Technology. Available at: <http://www.govtech.com/data/How-Does-Your-State-Rank-for-Financial-Data-Transparency.html>

439 CaseWare Analytics. "CaseWare Monitor helps county government identify duplicate payments, tighten controls and take a proactive stance against fraud." Available at: <https://www.casewareanalytics.com/success-stories/washoe-county>

Data analytical applications	Artificial intelligence (AI) to enhance audits and automate financial reporting	AI can increase the quality of data mining and analysis through iterative learning processes, reduce human error and lead to a clearer picture of government accounts for more efficient policy decisions. For example, bots could be used to collect and analyse data 24/7 and over time, learn the right and best questions to ask.
Data analytical applications	High frequency fiscal data for more timely reporting	Use of high-frequency fiscal data should allow financial updates to be reported more frequently. Instead of semi-annual or annual updates, it is technically possible to produce monthly reports. Daily fiscal data is now easily available, timely and more accurate than official reporting channels. This allows authorities to monitor accounts in real-time and could increase the ability to spot signs of fiscal stress and thus increase the overall resilience of the fiscal system. ⁴⁴⁰
Data analytical applications	Big data techniques to increase auditing efficiencies and effectiveness	Auditors can take advantage of software to analyse large volume of data stored in government's IFMIS, which has grown exponentially in recent years. This can enhance the audit outcomes. In 2016, The Comptroller and Auditor General of India (CAG) set up the Centre for Data Management and Analytics (CDMA) which is equipped with the latest technological tools and infrastructure to increase the capacity and efficiency of public auditors in all audit offices of CAG across the country. ⁴⁴¹ South Africa's (State Audit Institution) uses data mining in fraud investigation; Oman's SAI has incorporated digital forensics in audits aimed at fighting corruption; Canada's Office of the Auditor General has accomplished a tremendous amount of work using population-based approaches and text analytics; and SAI Brazil has connected technical experts with line auditors in its audit efforts. ⁴⁴²
Identification and recording technologies	Blockchain to increase accounting and audit transparency	Blockchain technology has significant potential for accounting functions as it allows all transactions to be recorded, viewed and monitored in real time while leaving a trail if anyone attempts to alter the data. Blockchain technology can be applied to ensure that audit process is not tampered and is conducted fairly and in a transparent manner.

440 Misch F, Olden B and Poplawski-Riberio M (2017). "Opportunities for fiscal policy making in the digital era". Available at: <http://blog-pfm.imf.org/pfmblog/2017/05/opportunities-for-fiscal-policy-making-in-the-digital-era.html>

441 The Hindu Business Line (2018). "CAG gears up for Big Data, to revamp auditing process" Available at: <http://www.thehindubusinessline.com/news/cag-gears-up-for-big-data-to-revamp-auditing-process/article9076794.ece>

442 INTOSAI Journal (2017). "Symposium highlights big data and sustainability." Available at: <https://intosajournal.com/2017/07/31/symposium-highlights-big-data-and-sustainability/>



αlphaβeta
strategy x economics

www.alphabeta.com

Singapore

1 Upper Circular Road, #04-01, Singapore, 058400

Sydney

Level 7, 4 Martin Place, Sydney NSW 2000