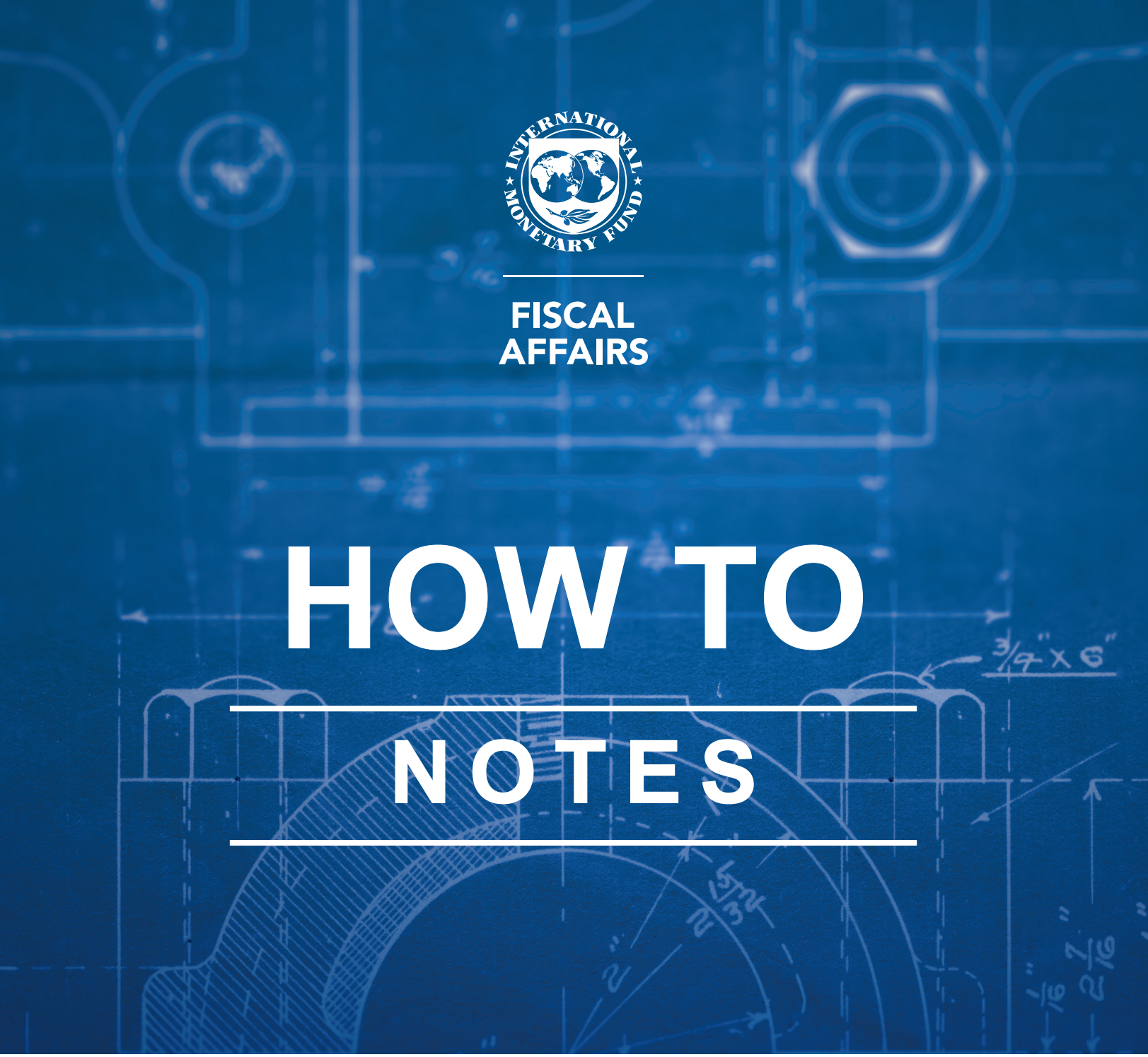

FISCAL AFFAIRS

HOW TO NOTES

How to Design a Financial Management Information System

A Modular Approach

NOTE 19/02

Fiscal Affairs Department

How to Design a Financial Management Information System

A Modular Approach

Prepared by Gerardo Uña, Richard Allen, and Nicolas Botton

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Fiscal Affairs Department
How to Design a Financial Management Information System—A Modular Approach
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Abstract
A well-functioning financial management information system (FMIS) provides timely, reliable, and comprehensive reports that support implementation of the government's fiscal policies and fiscal rules, and the formulating, controlling, monitoring, and executing of the budget. The architecture of FMISs has undergone a transformation since these systems were first developed in the 1980s. Rather than attempting to cover all or most public financial management (PFM) functions, many FMISs now focus on a few core functions such as accounting and reporting, budget execution, and cash management. Yet a survey of 46 countries shows that many face severe challenges in transforming their FMIS into an effective tool of fiscal governance. These challenges relate to weaknesses in the system's core functions, its institutional coverage, the information technology platforms it uses, and the ease of sharing data with other IT systems. This How to Note discusses how to address these challenges. Replacing an FMIS with an entirely new system may not be an optimal strategy. By utilizing the latest technology, a better approach may be to update or replace one or more core modules of the system: the so-called modular approach. Implementation of an effective FMIS, however, depends on two critical preconditions: strong political motivation and commitment, and the system's ability to meet ongoing and anticipated PFM needs.

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HOW TO DESIGN A FINANCIAL MANAGEMENT INFORMATION SYSTEM: A MODULAR APPROACH

Introduction

Many advanced economies, as well as developing countries, emerging markets, and even fragile states (IMF, 2017), often with the support of donors, have invested substantially in financial management information system (FMIS) infrastructure and software since the late 1980s.[1] Financial management information systems (FMISs) can be defined as "a set of automated solutions that enable governments to plan, execute and monitor the budget, by assisting in the prioritization, execution and reporting of expenditures, as well as the custodianship and reporting of revenues" (Dener, Watkins, and Dorotinsky 2011). At their core, these systems provide a complete record of a government's financial events and transactions. The broad objective of an FMIS, as a key fiscal management tool, is to generate timely, relevant, and reliable financial data and reports that support financial decision making and improvements in fiscal discipline, expenditure control, and fiscal transparency.

Modern FMISs play a key role in ensuring that countries meet their key macroeconomic and fiscal goals and objectives, and reduce their governance vulnerabilities, including corruption (IMF 2018c), while keeping pace with technological advances in digitalization, data management, and cybersecurity.

However, several studies, as well as capacity development reports prepared by the IMF's Fiscal Affairs Department, suggest that the performance of these systems has been mixed, especially in developing countries and some emerging markets (Dener, Watkins, and Dorotinsky 2011; Fritz, Verhoeven, and Avenia 2017; Hashim and Piatti-Fünfkirchen 2018). Governments and donors have also almost invariably underestimated the institutional challenges of implementing FMIS projects, which has led to a misalignment of incentives, delays, underbudgeting, and low levels of efficiency and effectiveness (Fritz, Verhoeven, and Avenia 2017). Vendors tend to promote solutions that are comprehensive in coverage and include expensive long-term maintenance contracts but are not always tailored to the beneficiary country's needs. Similar inefficiencies can arise in the private sector. According to a study by McKinsey (2012), 45 percent of large information technology (IT) projects—defined as projects with a budget of at least US$15 million—run over budget, and 17 percent of these projects fail to such an extent that they impede the key activities of the company.

When an FMIS is not in place, each line ministry and agency typically utilizes its own information system, resulting in loss of control and coordination by the ministry of finance, and unreliable financial reports. In general, the literature has focused on how to design and implement an FMIS when no such system previously existed (Hashim 2014; USAID 2008). There is much literature on planning, designing, and implementing an FMIS project. Currently, however, most developing countries and emerging markets are not looking at first-time automation of their financial management functions. These countries already have some form of FMIS in place, which may operate at varying levels of efficiency, effectiveness, and institutional coverage. Many countries are looking to improve and modernize their FMIS, and to link these systems with subnational FMIS platforms and related public financial management (PFM) systems, such as planning, public procurement, and debt management.

Having invested a substantial amount of resources (financial and human) in their FMIS, countries nevertheless often find that the system is not performing well. The reasons for underperformance are many, including absence of a well-prepared conceptual design, lack of ownership, weak project management, and/or inadequate leveraging of available new functionalities and technology. In countries where the FMIS's performance is inadequate, a key question to consider is how to improve the system by revamping its functionalities and adopting modern technology, where feasible, rather than replacing it with an entirely new one. In

[1]For example, loans disbursed by the World Bank to finance FMIS projects amounted to some US$2.2 billion during the 25-year period to 2011 (Dener, Watkins, and Dorotinsky 2011), and the amount has subsequently increased to more than US$4.9 billion (C. Dener, World Bank's FMIS web page, http://www.worldbank.org/en/topic/governance/brief/financial-management-information-systems-fmis, July 2018).

the case of commercial-off-the-shelf (COTS) software solutions, for example, better and more efficient functionalities can often be achieved through improved parameterization of existing FMIS modules.

Digitalization is no longer simply a tool to reduce costs and enhance business processes, but also to automate controls, reduce workload, and achieve more transparency in the public sector. Governments face the need to upgrade their FMISs in the context of the rapid digitalization of finance functions across government as well as the private sector. A prime objective of digitalization is making the most of the digital data already available (World Bank 2016c; Gupta and others 2017; McKinsey 2017; IMF 2018a). Technological innovations in recent years have made it possible to collect, organize, share, and interpret data on a much greater scale than previously, often providing the real-time availability of information. Agencies can access "big data" from multiple sources, both from inside the government as well as from external platforms that include social media (Chenok and others 2017).

Looking ahead 10 or 20 years, digitalization is likely to radically change the nature of FMIS from a fully integrated set of functions and processes into a virtual system in which a central agency, such as the finance ministry or national treasury, collects financial data from a wide variety of sources, and transforms this information into the required formats and reports (Mitsch and others 2017). However, such virtual systems could face challenges in synchronizing and normalizing data from multiple sources to generate consistent and harmonized financial reports. These challenges include exchanging financial information among various levels of government (central, local, and municipal) where cloud-based solutions can be considered.

The purpose of this note is to: (1) review recent trends in FMIS design across a range of emerging markets and developing countries; (2) summarize the main characteristics of the various approaches to FMIS design that have been adopted in recent years; (3) highlight the key FMIS challenges faced by countries that have implemented an FMIS; (4) consider how to address these challenges and improve the performance of FMISs; (5) discuss how and under what conditions increased flexibility can be built into the design of FMIS solutions through a modular approach; and (6) provide a roadmap of key steps and decision points in the process of modernizing an FMIS.

Box 1 provides a glossary of key technical terms and concepts used in the note.

Main Characteristics of FMISs

The scope and design features of FMISs have undergone a transformation in the past 30 years reflecting the extensive developments in PFM and IT systems. Modern FMIS platforms are able to include different components to support PFM functions, help governments comply with financial regulations and reporting standards, and support decentralized budget operations through web-based IT solutions (Dener and Min 2013).

The literature makes an important distinction between the essential, or core, components of an FMIS and auxiliary PFM functions. A core FMIS is defined in this note as an information system that supports budget execution, accounting, and treasury and cash management functions, and generates financial reports in a timely manner (Box 2). Under this definition, budget formulation, which is typically a self-contained module, is not considered as a part of the core, although closely linked to it. A core FMIS thus defined should cover all the entities that constitute the budgetary central government,[2] include the management of all the government's own resources and externally funded programs and projects, and be based on a sound IT platform. In many countries, the coverage of FMISs extends beyond these core elements to auxiliary PFM functions such as debt management, public service payroll and human resource management, and public procurement systems (Bartel 1996; Dener, Watkins, and Dorotinsky 2011; Dorotinsky and Watkins 2013; Hashim 2014).

Additionally, the literature differentiates between the concept of an FMIS and an integrated financial management information system (IFMIS), in which a wide range of PFM systems (for example, payroll, public investment management, or procurement) share the same central database as the core functions (Dener and Min 2013).

[2]Namely, the entities and units for which funds are appropriated through the national budget. Many public sector entities are typically excluded from the national budget; for example, social security funds and other extrabudgetary funds and accounts, statutory bodies and public corporations, and subnational governments and their related extrabudgetary entities, statutory bodies, and commercial enterprises (IMF 2018b).

Box 1. Definition of Key Terms and Concepts Related to FMIS

Applications programming interface (API): A programming interface enabling one system to be plugged into another system to send and request information.

Conceptual design (CD): Specification of the objectives, scope, and coverage of an FMIS, along with an overview of the user requirements and key business processes that the system is required to support.

Commercial-off-the-shelf (COTS): An IT product or package that is designed to meet generic market needs rather than the needs of a country's FMIS.

Data warehouse: A database designed to collect, integrate, and store information from several sources for the use of various clients in analytical work and decision making.

Enterprise resource planning (ERP): A type of business management software—typically a suite of integrated applications—that an organization can use to collect, store, and manage data from various sources and business activities.

Enterprise service bus (ESB): A software tool that enables several IT applications to communicate and exchange information with each other.

Extract, transform, load (ETL): A data integration tool that enables data from one system to be used by another system's data warehouse or database.

Functionalities: The software routines that are designed to deliver the required functions of an FMIS, such as accounting, reporting, budget execution, and treasury management.

Interoperability: The ability of one information system to exchange information with other systems without any restrictions.

Locally developed software (LDSW): A customized information system developed by local or regional software providers who generally supply services for the government to maintain the system.

Middleware: A computer software that connects various components or applications; it is used most often to support complex, distributed applications that make up a complete information system.

Parameterization: In an information system, the process of introducing specific data and parameters (for example, the chart of accounts, the number and denomination of ministries and agencies) to satisfy the system's business and operational needs.

eXtensible markup language (XML): Software language used to exchange and manage data, especially useful for web-based systems.

Evolution in the Coverage and Design of FMIS

Historically, the development of FMISs started in the 1980s with in-house systems developed by ministries of finance or treasury departments to support their activities. In these early days, separate systems were typically developed to support functions such as accounting, budget execution, financial reporting, or cash management, with limited interfaces between the systems. Gradually, interfaces were developed to allow for better exchange of data. Following these initial attempts, there have been two main approaches to developing a model for the design of an FMIS that is able to manage data more systematically across the government.

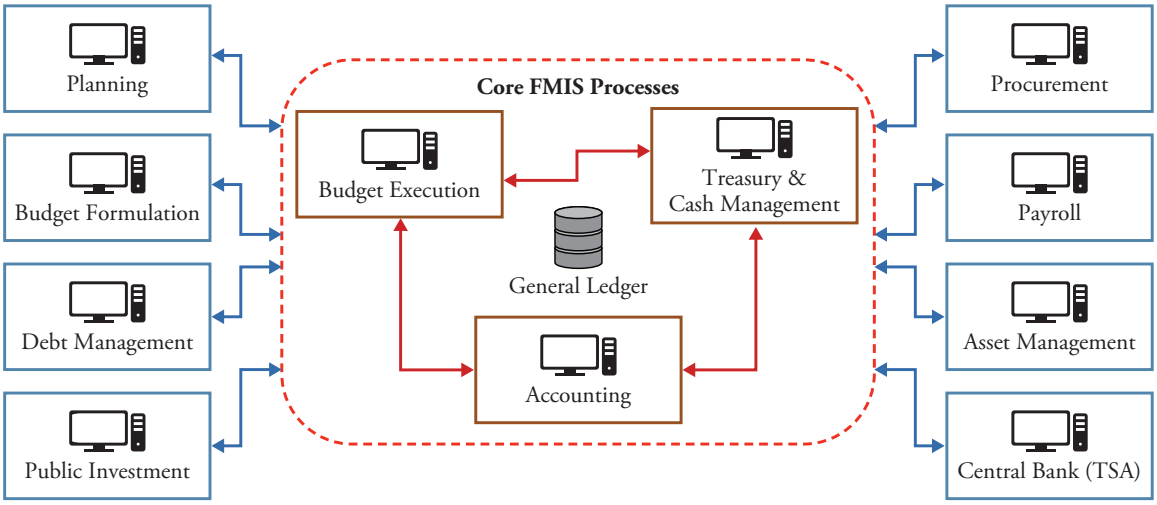
Box 2. Different Types of Financial Management Information Systems

Financial management information system (FMIS): An information system that includes components supporting several PFM functions (for example, accounting, budget preparation and execution, treasury operations, debt management, payroll, procurement, public investment) and generates reports through web-based IT solutions.

Core financial management information system: An information system with a narrower coverage, focused on supporting budget execution, accounting, and treasury and cash management functions, and that generates timely reports.

Integrated financial management information system (IFMIS): An information system that pursues the same broad objectives as an FMIS but whose components share the same database and IT platform.

Figure 1. FMIS Core and Auxiliary PFM Functions



Source: Authors, based on Dener, Watkins, and Dorotinsky 2011.

Enterprise Resource Planning–Based Comprehensive Approach

The first approach, which was prevalent in Latin America from the mid-1980s until the late 1990s, was to implement a monolithic IT system that used the same technological platform, sometimes called an integrated FMIS (IFMIS—see Box 2), that supported both core PFM business processes—including budget execution (usually called the budgeting module of an FMIS), accounting (the general ledger), and treasury and cash management (the treasury module)—as well as other important finance functions of government such as development planning, budget formulation, debt management, procurement, payroll, and asset management (Figure 1). The core functionalities of the FMIS, as defined, are shown by the dashed area in Figure 1. This approach broadly replicated the vision of the so-called enterprise resource planning (ERP) systems that were widely used in the private sector to support companies' resource management business processes. Such systems required strong technical capacity in the government, complex change management processes, and lengthy implementation periods. As a result, they experienced varying levels of success (Fritz, Verhoeven, and Avenia 2017). In French-speaking sub-Saharan Africa, information systems based on the French CHORUS model, now fully deployed in many of these countries, is a good example of an ERP-type solution.

The level of risk and often mixed success of the many FMIS projects that were initiated during this period partly explain a major shift in the design of FMISs that took place—especially in some Latin American, Asian, and African countries—in the late 1990s and early 2000s. Another factor was the explosive growth of internet services.

Core FMIS plus Auxiliary Functions Approach

In this second approach, the idea of using a central tool to cover a comprehensive range of PFM processes was largely abandoned, and the scope of FMIS design was refocused on the core PFM processes (budget execution, treasury and cash management, and accounting) using a single IT platform. Other key PFM business processes, such as debt management, national development planning, public investment management, public service payroll, asset management, and procurement—mainly using procurement web portals—were supported by separate IT systems, which in some cases exchanged information to produce timely, relevant, and reliable financial data. In the case of initiatives supported by the World Bank, such projects generally achieved a "satisfactory" or "moderately satisfactory" performance.[3]

[3]The World Bank's *Implementation Completion Reports* (ICRs) for the period up to 2011 indicate that the majority of 55 completed FMIS projects achieved a "satisfactory" rating or above on most dimensions of their performance (67 percent on outcomes, 87 percent on sustainability, 56 percent on development impact,

Table 1. Advantages and Disadvantages of Alternative IT Solutions

#	IT Solutions	Main Advantages	Main Disadvantages
1	**In-house IT solutions**	• Government retains ownership of the software source code • Possibility of introducing changes to the system quickly • Reduced maintenance cost in the short term • Development is under government's full control and responsibility	• Usually involves hiring new staff and the creation of large ICT units to develop and maintain the system • The government assumes all the costs and risks of the project
2	**Locally developed software solutions**	• The government retains ownership of the software source code • Risks and costs are shared between the government and the vendor • There is less of a need to increase the staff or create large ICT units	• Often requires the contracting of maintenance services • Tends to create dependency on the vendor
3	**Commercial-off-the-shelf solutions**	• Facilitates the implementation of good practice business processes • Risks and costs are shared between the government and the supplier • Implementation times could be shorter	• Government does not own the software source code • Requires a greater willingness of the government to adapt business processes to the IT solutions • Costs related to licenses, support, and maintenance fall on the government

Source: Uña and Pimenta 2015.
Note: IT = information technology; ICT = information and communication technology.

The two approaches—the ERP-based comprehensive approach and the core FMIS plus auxiliary functions approach (both of which are still being implemented in many countries)—generally operate at the level of the central government, but an increasing number of countries are also including regional, municipal, or local governments within the coverage of their FMISs.

The use of FMISs has arguably provided an opportunity for supporting broader PFM reform initiatives where windows of opportunity arise (Fritz, Verhoeven, and Avenia 2018) and for packaging substantial amounts of funding, equivalent to many millions of US dollars, into loan or grant agreements.

As discussed later, however, large FMIS and IFMIS applications have been shown to be less efficient in many environments than systems that focus on a few core PFM modules, adopt a sequenced approach to implementation, and incorporate agile and iterative software solutions. Yet, countries and development partners have continued to promote comprehensive applications in countries such as Cambodia, Ukraine, and Zambia (Hashim and Piatti-Fünfkirchen 2018).

IT Architecture for an FMIS

The architecture of FMISs has evolved from the client-server, mainframe and often monolithic systems of the 1980s and 1990s, into the multilayered web-based systems of the 2000s and 2010s. In general, FMISs operating in Latin America employ a single central database, which is centrally administered by the finance ministry, but with decentralized operations in the line ministries and other spending entities. In sub-Saharan Africa, information systems can be found with software architecture that either uses separate databases for each entity, or solutions that maintain a single central database. In Latin America, FMISs were typically developed in-house, whereas in sub-Saharan Africa substantial use was made of commercial-off-the-shelf (COTS) software. In the Caribbean, central and south Asia, the Pacific Islands, and southeast Europe, both types of solution—sometimes a mixture of COTS and locally developed software (LDSW)—can be found.[4] Table 1 summarizes the advantages and disadvantages of these various approaches.

61 percent on performance from the Bank's perspective, and 59 percent on performance from the borrower's perspective). When these projects were reviewed by the Bank's Independent Evaluation Group, however, the rating of nearly two-thirds of these projects was downgraded from "satisfactory" to "moderately satisfactory" (Dener, Watkins, and Dorotinsky 2011).

[4]In the case of in-house IT solutions, the development is typically the direct responsibility of the government, supported by a team of experts hired directly by the ministry of finance. LDSW solutions, on the other hand, are developed by local providers who generally supply services for the government to maintain the systems. Finally, COTS solutions are IT products or packages that are designed to meet generic market needs rather than the needs of a financial management system in a specific country (Uña and Pimenta 2015).

However, the new breed of FMIS—based on multilayered, web-based systems—has also suffered from many challenges. Analysis of a sample of 22 countries discussed in Hashim and Piatti-Fünfkirchen (2018) highlights these issues, including insufficient institutional coverage of the FMIS (examples are Ghana, Liberia, Malawi, Philippines, and Sierra Leone), the absence of an integrated system of government bank accounts (for example in Liberia and Zambia), and insufficient attention given to a sound conceptual design[5] that is fundamental to a successful FMIS. These issues and challenges are discussed in the next section.

After three decades of FMIS implementation across different regions, many countries have initiated a process of modernization to improve the functionalities, institutional coverage, and integration of their systems. However, the results have not been uniformly successful. In some countries, the FMIS has delivered broadly the intended results (examples include Brazil, Chile, India, and Turkey), whereas, in other countries, substantial challenges and unanticipated costs have arisen, leading to underperformance of the systems in many cases.

Issues Reducing the Effectiveness of FMISs

Despite their substantial investment of financial and human resources in FMISs, many developing countries still face severe challenges in implementing even the basic features of these systems. Experience has shown that successful implementation of an FMIS requires a complex mix of sustained commitment and leadership by the national government, especially the finance ministry, strong internal technical capacities, sound conceptual design, good project management capabilities, and sufficient resources (human and financial) to implement the systems. All phases of planning, designing, procuring, and executing a typical FMIS project take on average 6–7 years to complete (Dener, Watkins, and Dorotinsky 2011), but this period has been much longer in some countries. Other important preconditions include an effective change management strategy, as well as institutional arrangements to coordinate activities among the numerous stakeholders involved in operating the system and using its outputs (Dorotinsky and Watkins 2013; Uña and Pimenta 2015; Joshi and van Nguyen 2016; Hashim and Piatti-Fünfkirchen 2018). Implementation challenges can be complex and severe, leading to cost overruns and disappointing results.

Most critically, implementation of an FMIS will not be effective if a country's underlying PFM weaknesses are not addressed, or if the institutional conditions are adverse. For example, if many government activities are conducted through extrabudgetary entities or off-budget accounts, financial reports generated by the FMIS may present a seriously incomplete picture of the government's fiscal operations. Liberia is an example of such a case: donor financing accounts for 80 percent of capital spending and is entirely executed off-budget, without being captured in the FMIS (IMF 2016). Lack of well-designed and enforced internal control mechanisms, efficient cash management procedures, or a treasury single account provide further examples of PFM weaknesses that may seriously undermine an FMIS. Reforms of PFM should be undertaken before or in parallel with the introduction of an FMIS. Correct motivation and strong political commitment are other essential preconditions. Unless there is a commitment to improving fiscal management and fiscal transparency, FMIS implementation alone will achieve little.

Other factors such as poorly performing connectivity infrastructure, hardware obsolescence, and lack of vendor support and maintenance of the systems after software licenses have expired can also have adverse impacts on FMIS performance. Connectivity issues have implications for the design of an FMIS. In countries where internet connectivity is particularly poor, a web-based solution may not be an appropriate choice.

An FMIS's failure to deliver its full functionalities often arises because project managers do not make full use of the existing configuration, do not amend the parameters to meet the system's new functional requirements—such as the chart of accounts and definitions of different users' roles—or seek to work around these parameters. In many countries, project managers give priority to ensuring that the FMIS is up and running as soon as possible and may take short cuts that can have damaging consequences for efficient fiscal reporting. For example, countries may choose to automate many existing business processes—processes that were originally designed to operate a manual system—without redesigning them in line with

[5]A conceptual design is defined as "a specification of the objectives, scope, and coverage of an FMIS along with an overview of the PFM framework, user requirements, and key business processes that the system is required to support." See Kahn and Pessoa (2010).

good international practices or making basic changes to a country's chart of accounts or its accounting regulations and manuals (Khan and Pessoa 2010). Furthermore, because of budgetary constraints, some developing countries may choose to subscribe to fewer than the required number of COTS final user licenses, thus undermining the integrity and control of data managed by the system.

In such circumstances, the FMIS is often set up as the scapegoat for any subsequent deficiencies in the reliability or timeliness of financial reports, but the true faults lie elsewhere. Examples in this regard include Papua New Guinea, Malawi, Zambia, and the first FMIS project developed by Cambodia (on Malawi and Zambia, see World Bank 2016a, 2016b).

Cross-Country Survey of FMIS Challenges

Table 2 summarizes the challenges in implementing the functionalities of a core FMIS faced by a sample of 46 developing countries and emerging markets in Africa, central and south Asia, Latin America and the Caribbean, the Pacific Islands, and southeast Europe.[6] These data have been derived from FMIS assessments included in technical assistance reports prepared by the Fiscal Affairs Department, mainly from the period 2015–18, and from other reports and sources of information.

The challenges experienced by countries in implementing an effective FMIS, shown in Table 2, fall into four broad categories: (1) issues related to the functionalities of the FMIS; (2) the institutional coverage of the system; (3) technological issues—related to hardware, software, and connectivity; and (4) interoperability issues—related to the capacity for sharing data between the FMIS and other information systems.

Functionality-related Challenges

These mainly relate to four functional areas:

- *Accounting and fiscal reporting.* In several of the countries reviewed, the FMIS presents problems in generating reliable and timely cash basis financial statements,[7] and/or in recording all expenditures, revenues, borrowing, loans, grants, and other financial transactions made by government entities. Many FMISs are not based on a consistent chart of accounts or budget classification aligned with international standards. Several of the FMISs reviewed also failed to generate accurate and timely budget reports (on a monthly, quarterly, mid-year, or end-year basis). These challenges have been evident, for example, in Cambodia, Colombia, Grenada, Jamaica, Mali, Moldova, Peru, Senegal, and the Solomon Islands. In several countries, the FMIS has insufficient financial reporting capabilities, undermining its usefulness as a tool to support PFM processes and transparent dissemination of fiscal information. The absence of a data warehouse or the capacity to drill down to detailed information, for example, may restrict the production of reports that are tailored to the specific needs of users. Countries such as the Maldives, Nigeria, and Uruguay have faced these problems.
- *Tracking of cash flows, use of electronic payments, and bank reconciliation.* Some countries face challenges ensuring that there is a consistent flow of information on payments between the FMIS accounting registers and the government's bank accounts, and timely registration of financial transactions in the accounting system. The adoption of reliable cash flow plans requires systems to keep track of these operations and reconcile them. The FMIS should be able to identify any transactions that create a discrepancy between the public accounts and the corresponding bank statements. Yet, in some countries, this task requires manual checks by accounting staff. Examples include Equatorial Guinea, Malawi, Moldova, Mozambique, Panama, Papua New Guinea, and Timor-Leste.
- *Budget execution and internal controls.* Several of the FMISs reviewed have difficulty capturing all relevant

[6]The 46 countries included in the sample are: Albania, Antigua and Barbuda, Azerbaijan, Bahamas, Bosnia and Herzegovina, British Virgin Islands, Burkina-Faso, Cambodia, Cabo Verde, Colombia, Republic of Congo, Dominican Republic, Equatorial Guinea, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Honduras, Jamaica, Kosovo, Lesotho, Liberia, FYR Macedonia, Malawi, Malaysia, Maldives, Mali, Moldova, Mongolia, Montenegro, Mozambique, Niger, Nigeria, Panama, Papua New Guinea, Philippines, Peru, São Tomé and Príncipe, Senegal, Solomon Islands, Tanzania, Timor-Leste, Togo, Uruguay, and Zambia.

[7]According to the cash basis International Public Sector Accounting Standards (IPSAS), the components of the mandatory financial statement include: a statement of cash receipt and payments, accounting policies and explanatory notes, and a statement of comparison of the original and actual budget. In the case of the accrual basis IPSAS, the main five financial statements include: financial position, financial performance, changes in net assets/equity, cash flow, and a comparison of the approved budget and actual spending.

Table 2. Main Challenges in Implementing a Core FMIS in Developing Countries and Emerging Markets

Topic		Main Challenges	Country Examples
1. Functionality related issue	***1.1. Accounting and fiscal reporting***	***Problems in the generation of accurate and timely fiscal reports:*** • Generate cash basis financial statements: a statement of cash receipt and payments, accounting policies and explanatory notes, and a comparison of original and actual budgets. • Issue the annual financial statements within six months of the end of the fiscal year. • Issue in-year (for example, monthly, quarterly, mid-year) and end-year budget reports on time, according to criteria established in international standards. • Support the accuracy and automation of accounting entries. • Ensure that all accounting and budget data have an appropriate and consistent classification by administrative units, economic categories, functions, and so on, aligned to international standards.	Bahamas, Cambodia, Colombia, Dominican Republic, Ghana, Honduras, Jamaica, Malaysia, Mali, Moldova, Panama, Peru, Senegal, Solomon Islands, Togo, and Zambia
		Failures to integrate the chart of accounts and the budget classification: • Ensure timely and reliable accounting and budget registration of financial transactions.	British Virgin Islands, Burkina-Faso, Grenada, Honduras, Kosovo, Mali, and Moldova
		Absence of a data warehouse or the capacity to drill down to detailed accounting and budgetary information: • Support the production of reports that are tailored to the specific needs of users.	Maldives, Nigeria, and Uruguay
	1.2. Tracking of cash flows and bank reconciliation	***Deficiencies related to electronic payments and bank reconciliations:*** • Ensure the integrity and consistency of data on payments and revenues between the FMIS and government bank accounts.	Azerbaijan, Bahamas, Equatorial Guinea, FYR Macedonia, Malawi, Moldova, Mozambique, Panama, Papua New Guinea, and Timor-Leste
	1.3. Budget execution and internal control	***Insufficient support for the management and control of the budget:*** • Manage all expenditures, borrowing, debt, loans, and grants through the FMIS. • Capture all relevant data to ensure the control of expenditure by tracking all payments against commitments, budget appropriations, and budget releases. • Track multiannual spending on individual public investment projects, identifying delays in implementation and cost overruns.	Antigua and Barbuda, Cambodia, Republic of Congo, Equatorial Guinea, Guatemala, Liberia, Maldives, Mali, Mongolia, Solomon Islands, and Tanzania
	1.4 Treasury and cash management	***Insufficient support for government banking functions:*** • Support the efficient functioning of the TSA, under a single bank account or a unified structure of bank accounts. • Provide an electronic payment mechanism that avoids manual payments for central government, extrabudgetary entities and accounts, and social security funds.	Albania, Azerbaijan, Guatemala, Lesotho, FYR Macedonia, Montenegro, Mozambique, Niger, and Philippines
		Unreliable and untimely information for cash management: • Record cash flow on the days the payments are made, and the receipts received. • Record accurate and timely information related to the recognition date of the accounts payable. • Monitor that payments are made by the due date. • Provide timely information on the stock of arrears and the creation of new arrears.	Antigua and Barbuda, Bosnia and Herzegovina, Cambodia, Dominican Republic, Jamaica, Mongolia, and São Tomé and Príncipe
2. Institutional Coverage		***Incomplete coverage of central government entities:*** • Ensure that the FMIS covers the budgetary central government, extrabudgetary entities and accounts, and social security funds.	Cambodia, Guinea-Bissau, Jamaica, Philippines, and São Tomé and Príncipe
3. Connectivity and IT Platforms		***Software, hardware, and connectivity problems:*** • Ensure that software licenses have not expired, thus leaving the government without vendor support and with outdated hardware. • Establish good connectivity for FMIS users in regional or remote locations. • Minimize performance problems due to software design weaknesses, limited hardware capacity, and/or inadequate database maintenance. • Prepare a recovery and business continuity plan.	Antigua and Barbuda, Bahamas, Republic of Congo, Dominican Republic, Guinea-Bissau, Honduras, Malawi, Nigeria, Philippines, São Tomé and Príncipe, and Solomon Islands
4. Information and Data Sharing Capabilities		• Ensure shared information with other PFM systems, such as debt management, revenue collection, public procurement, payroll management, or public investment management.	Cabo Verde, Mali, and Peru

Source: Authors.

Note: FMIS = financial management information system; PFM = public financial management; TSA = treasury single account.

data for controlling payments against commitments and budget appropriations (including warrants or commitment ceilings) for many categories of expenditure. Additionally, several FMISs recorded information for a single fiscal year only and were unable to track multiyear commitments and spending—for example, on public investment projects financed by multiannual contracts. Examples include Antigua and Barbuda, the Republic of Congo, Guatemala, Liberia, Mongolia, and Tanzania.

- *Treasury and cash management.* An FMIS should provide support for making cash forecasts, the operation of government bank accounts through a treasury single account, and electronic payments, but it is not uncommon to see shortcomings in these areas. These include weaknesses in tracking and providing cash flow information, the absence of an electronic payment and receipts mechanism, and failure to generate information on the stock and accumulation of arrears because of weaknesses in capturing accurate and timely information on the accounts payable. Examples include Azerbaijan, Bosnia and Herzegovina, Dominican Republic, Lesotho, Montenegro, Mozambique, Niger, and Philippines.

Inadequate Institutional Coverage

Many FMISs do not cover all budgetary central government entities. Constraints on rolling out the system across the government may be technical, operational, or reflect delays in the implementation of the FMIS. Examples include Cambodia, Guinea-Bissau, Philippines, and São Tomé and Príncipe.

Connectivity and IT Platform Related Issues

Problems with internet connections or networking infrastructure may preclude the utilization of an FMIS by users located outside the main cities or the centers of government. Other countries have experienced problems with the performance of their IT platforms that have generated operational risks. For example, FMIS software licenses may have expired (so that the government cannot obtain vendors' support), or hardware may be outdated. Inadequate database maintenance, especially to ensure the timely recording of transactions during high-load periods, may also cause performance problems. Besides, not all countries ensure that there is adequate support (both financial and personnel) for routine maintenance of the FMIS or have put in place a suitable recovery and business continuity plan. Countries such as Bahamas, Republic of Congo, Guinea-Bissau, Honduras, and São Tomé and Príncipe have faced challenges in these areas.

Information Sharing Capabilities (Interoperability)

Many FMISs lack facilities for sharing and exchanging data with other PFM systems—such as debt management, revenue collection, public procurement, public investment, or payroll management systems—which may be under the responsibility of separate government agencies and different IT platforms. Examples include Cabo Verde, Mali, and Peru.

Information Sharing in Practice

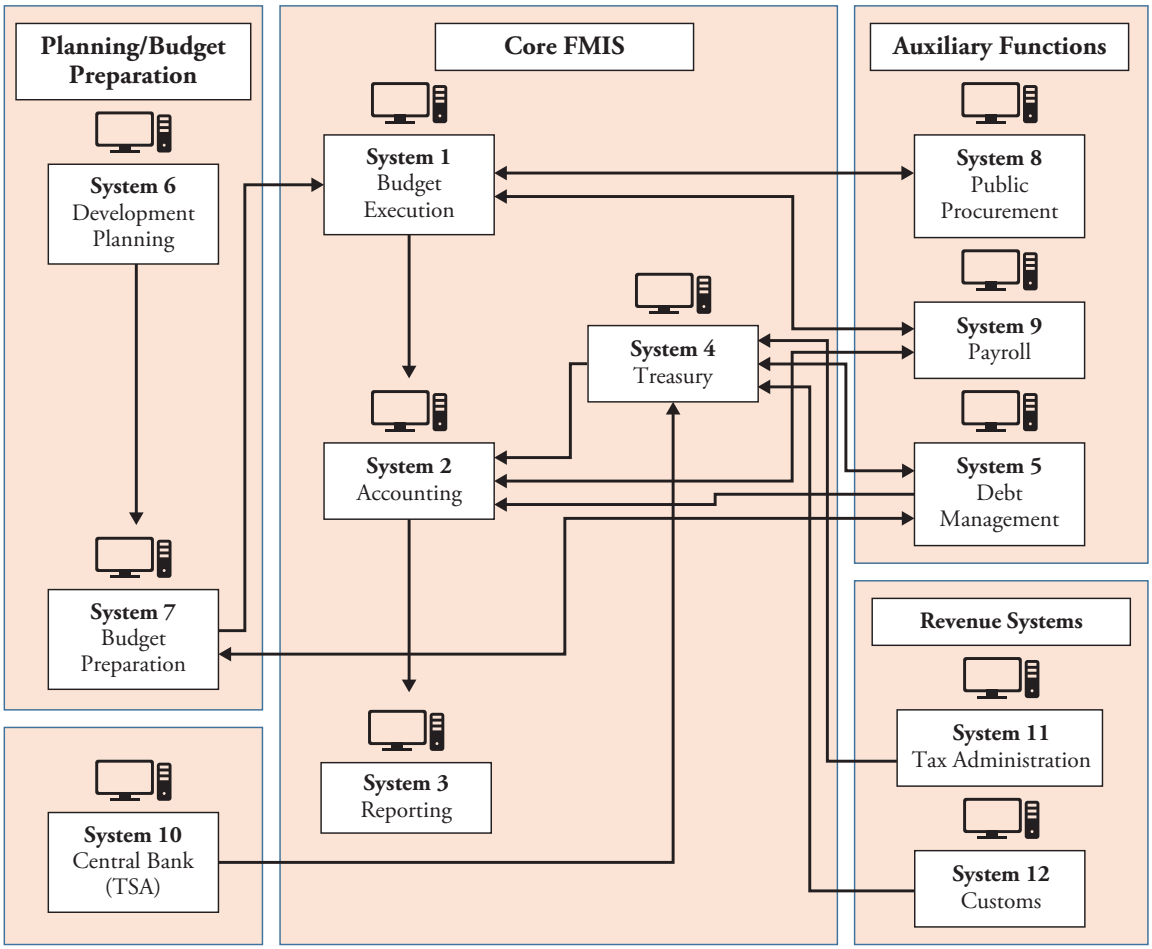
Figure 2 provides an illustrative example from sub-Saharan African countries of the relationship between the core FMIS (systems 1 to 4) and other PFM systems (systems 5 to 12). System 6 represents the national and sectoral planning processes where data need to be reentered into the FMIS, and their links to the budget preparation process (system 7). Systems 8 to 12 represent functions relating to revenue collection, customs, procurement, debt management, and government accounts held in the central bank. In principle, it should be possible to share data from these auxiliary systems with the FMIS, but in practice such data interfaces have rarely been established or are ineffective. Besides, in sub-Saharan African countries, there is usually no single IT department responsible for PFM systems, so it becomes even more challenging to harmonize these systems and to share relevant data. This situation is compounded when each information system is under the responsibility of a unit for which sharing data with other government agencies is not a priority.

IT and Digitalization Issues

In principle, coordinating FMIS design features across countries, especially those that are part of an economic and monetary union, and even using a common technological platform, could generate economies and other benefits, but in practice such sharing of technology has not been effective so far. A recent study of the possibility of coordinating FMIS solutions across the France's zone franc[8] concluded that

[8]These countries comprise the West Africa Economic and Monetary Union (WAEMU), the Economic Community of Central African States (CEMAC), Comoros, and France.

Figure 2. Core and Non-Core Systems of the FMIS in Sub-Saharan Africa



Source: Authors.

the sharing of good practices, comparing experiences, and testing scenarios among countries and experts may reduce significantly the risk of failure without sharing the same technology (Assistance au Développement des Échanges en Technologies Économiques et Financières 2014). The situation could be different in federal countries, such as Brazil, where some states successfully share an FMIS platform (Grupo de Gestores das Finanças Estaduais 2017).

In addition to the challenges mentioned, the design of an FMIS faces emerging issues related to digitalization and opportunities for improving PFM. These challenges and opportunities fall under five broad areas—namely artificial intelligence and machine learning, cybersecurity, privacy concerns, digital inclusion and open data, and e-government initiatives—which are summarized in Box 3. A detailed discussion of digitalization issues, however, is outside the scope of the present study.

How to Improve the Performance of an FMIS

A phased and layered approach should be considered for improving the coverage and functionality of an FMIS in which the core functions (such as accounting or budget execution) constitute the basic layer and other layers (for example, budget preparation) are built on top. Joshi and van Nguyen (2016) provide examples of the application of this approach in Mongolia, Timor-Leste, and Vietnam.

Figure 3 shows the typical structure of a modern FMIS that many developing countries and emerging markets are currently trying to put in place. The core FMIS functions defined earlier form an integrated

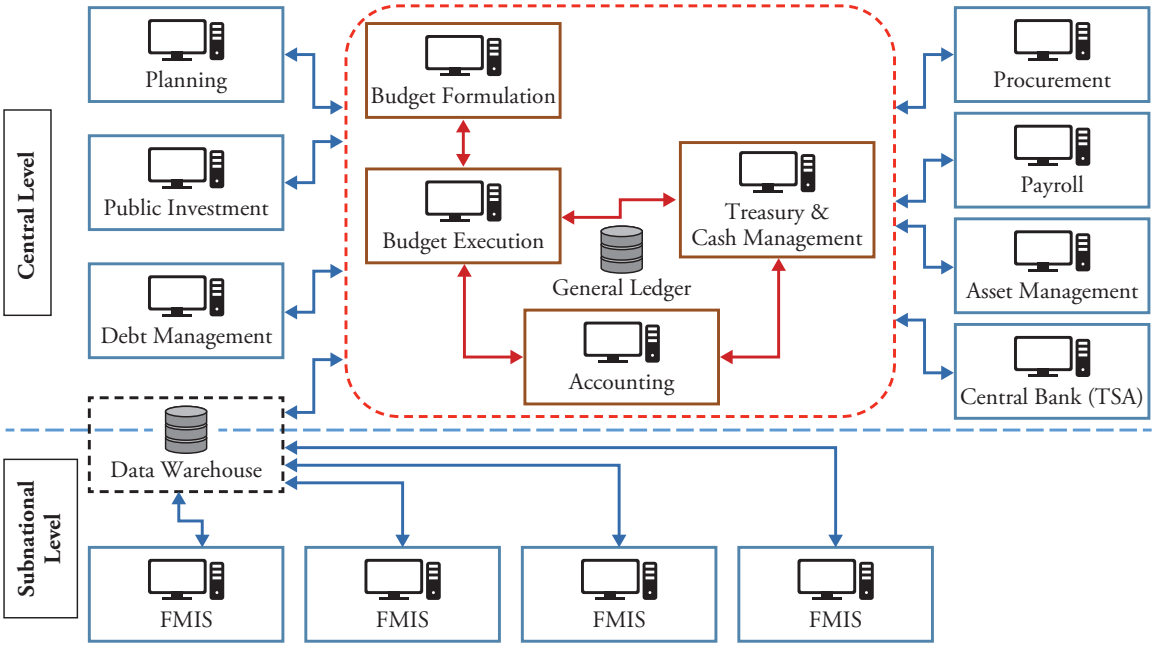
Box 3. Digitalization Challenges and Opportunities Related to the FMIS

- ***Artificial intelligence and machine learning.*** FMISs generate enormous quantities of financial data, many thousands of transactions per month. The Brazilian Treasury is adopting machine learning to reduce the burden of performing routine tasks by piloting the use of blockchain technology for issuing Treasury bills. Initiatives by some countries to tackle corruption by better creating secure digitalized records in the public sector using blockchain technology are also encouraging. This technology could be used to monitor the construction and financing of infrastructure projects and ensure the integrity of financial transactions between the government, donors, and private partners (Wiest 2019).
- ***Cybersecurity.*** Digital systems are highly vulnerable to various kinds of IT security threats, including cyberattacks. The availability of data, their integrity, and the protection of their confidentiality are key to the credibility of government. National authorities should be proactive in preparing for and preventing cyberattacks to protect their financial operations, avoid fraud, and safeguard the information provided to citizens (Dawson 2018). The private sector has produced guidelines related to cybersecurity; for example, ISO/IEC 27001:2013 covers security techniques related to IT systems and information security management issues. These cybersecurity practices, however, are sometimes treated as an afterthought when implementing an FMIS. In considering FMIS solutions based on cloud computing, cybersecurity issues have become increasingly relevant.
- ***Privacy concerns.*** The real-time recording of digital information about individual citizens, and the use of such data by organizations across the public and private sector, raises concerns about the management and use of personal information. Some countries are now moving to adopt a single-platform approach, connecting information on citizens held by several government ministries, and centralizing the storage of such information in a single data center using cloud technology (for example, Estonia and India). In recent years, there have been many examples of intrusions of privacy through hacking, leaks, and ransom attacks at major government institutions, highlighting the vulnerability of government systems to cyberattacks (Gupta and others 2017; IMF 2018a). An FMIS is exposed to similar risks related to the privacy of the data contained in the system. Although many of the reports generated by an FMIS are of primary interest for an internal audience, there are some reports (for example, data of vendors' bank accounts, or tax registers) that may raise privacy concerns.
- ***Digital inclusion and open data.*** Governments should ensure that the public is able to access relevant information from the FMIS using digital technology. The time and cost of providing wider access can be reduced through budget transparency portals (Dener and Min 2013; Gupta and others 2017; IMF 2018a). FMISs generate a large amount of data that can be used by many nongovernmental users. In most countries, there is much room for improvement, not only in deciding what information governments should publish under freedom of information legislation and its fiscal transparency policies, but also how to provide easy access to such data using digital technology.
- ***e-Government initiatives.*** Digitalization of non-core FMIS processes—such as payroll, procurement, e-invoicing, e-collection of revenue, and so on—streamlines operations and may change the relationship between the public sector and citizens. They are likely to have an impact on FMIS operations by increasing demand for the exchange of information or the utilization of big data tools.

package that is shown in the red box. It should be noted that, under this approach, a budget formulation module is sometimes included as part of the core system, although it often functions on a standalone basis. In addition, the outputs of various systems could usefully be channeled through a data warehouse that serves as a repository of comprehensive and timely financial information.[9] Some countries have also included information from subnational levels of government in their data warehouses. The systems described in Figure 3 typically focus on the interoper-

[9]Some countries have developed methods of capturing expenditures linked to specific government projects or programs using online transactional processing techniques supported by the FMIS.

Figure 3. Schematic Representation of a Comprehensive FMIS in Developing Countries



Source: Authors.

ability and automation of data exchanges, using recent technological innovations such as application programming interfaces (APIs) and/or by introducing interoperability layers among different information systems.

It is commonly observed that, for reasons discussed earlier and illustrated in Table 2, many of the stakeholders involved in the development of the systems illustrated in Figure 3—including government officials, development partners, international experts, and some vendors—recommend implementing an entirely new set of core FMIS modules from scratch whenever this core is not delivering its key outputs. A comprehensive database of all FMIS projects prepared by the World Bank[10] provides relevant examples. Out of a total of 102 projects that were approved and executed between 1991 and 2011, 92 projects implemented some type of FMIS solution. Out of these 92 projects, 57 percent represented completely new FMIS systems, the remainder representing an extension of existing systems. For the 28 projects approved after 2011 that are still under execution, 75 percent represented new systems. In cases in which the FMIS is experiencing severe structural or maintenance problems, the replacement of an entire system might be justified, but in other cases, more efficient and cost-effective solutions are available that make better use of a country's IT infrastructure and its human capacities.

Successful modernization of the FMIS, as illustrated in Figure 3, depends critically on the assumption that the current core FMIS is delivering its expected functionalities, has a broad institutional coverage, and is operating under a sound IT platform. Nevertheless, as shown in Table 2, many developing countries and emerging markets continue to face challenges in implementing the basic functionalities of their FMIS, and a fresh approach to the design and implementation of the core FMIS modules should be considered.

Undertaking a Diagnostic Assessment

In considering the options for modernizing its FMIS, a country should first undertake an in-depth diagnostic assessment of the functional and technological challenges that need to be resolved. Such an assessment would be carried by government officials responsible for managing the existing FMIS and could be supported technically and financially by the

[10]See https://datacatalog.worldbank.org/dataset/financial-management-information-systems-database.

development partners.[11] The assessment should review the main business rules and definitions included in the conceptual design of the FMIS, updating these rules as required in the system's software applications. In some cases, it might be necessary to update the conceptual design itself.

The design of FMISs should be sufficiently flexible to allow new standards, principles, and policies of accounting and reporting to be adopted as circumstances require. The application of international standards such as International Public Sector Accounting Standards (IPSAS) and IMF's *Government Finance Statistics Manual* (GFSM) by developing countries and emerging markets, for example, has been growing in recent years. In many cases, the adoption of the cash basis IPSAS standard is a stepping stone to potential future implementation of accrual basis accounting and financial reporting. In addition, these standards have been incorporated into the directives that determine the financial reporting requirements of the members of regional economic and monetary unions, the number of which has been increasing.[12] Compliance with good practices of fiscal transparency and PFM in general—for example, with the help of an IMF fiscal transparency evaluation or a public expenditure and financial accountability assessment (PEFA)—also creates an incentive for countries to bring their fiscal reporting arrangements into line with international standards, but progress in this area has been mixed (Dener and Min 2013).

The FMIS's capability to address planned PFM reforms—for example, to expand the coverage and comprehensiveness of fiscal reports—should also be considered at this stage, as should the production of reports on cross-cutting issues such as gender budgeting, climate change, and the digital economy. A key risk is that government simply replicates existing business processes in the new FMIS rather than seeking to make them more efficient and effective.

The main challenges discussed in Table 2 could be used as a guide to conduct this diagnostic assessment. In each of the areas reviewed—namely accounting and fiscal reporting, tracking of cash flows and bank reconciliation, budget execution and internal control, treasury and cash management, institutional coverage, connectivity and IT platform, and interoperability and data sharing—a thorough assessment should be carried out. For example, it may be necessary to evaluate the FMIS's capabilities to produce timely and reliable annual financial statements as well as monthly or quarterly budget execution reports, benchmarked against international standards. In the case of budget execution, it will be important to assess how well the FMIS tracks all payments against commitments, budget appropriations, and budget releases. Another key issue is whether the FMIS provides timely and accurate reconciliation of financial accounting data and day-to-day movements in government bank accounts. The institutional coverage of the FMIS should be assessed, such as the extent to which it covers budgetary central government entities, extrabudgetary entities, and social security funds. The FMIS may also face a range of hardware, software, and connectivity challenges, as well as issues of fragmentation and interoperability that need to be addressed.

When to Adopt a Modular Approach

Once the diagnostic assessment has been carried out, decisions will need to be made about whether to replace the whole FMIS or to adopt a modular approach. Based on the diagnostic assessment, it should be possible to categorize the challenges facing an FMIS according to how well the system performs against various functional and technological requirements or standards. Figure 4 illustrates potential options for modernizing the FMIS based on the severity of the challenges faced.

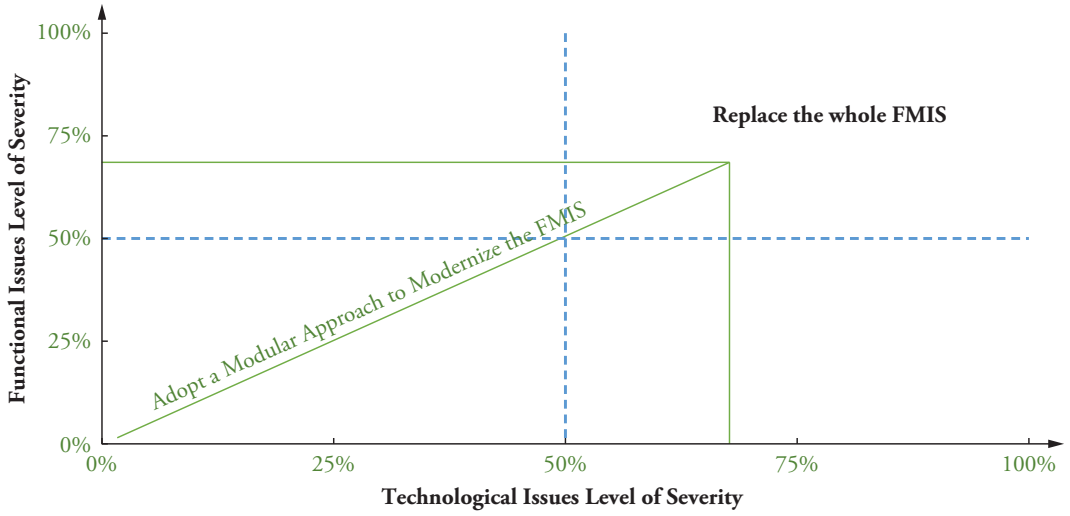
When the diagnostic assessment shows that the FMIS presents severe weaknesses or failures covering more than 75 percent of its core functionalities and main technological dimensions—the upper right quadrant in Figure 4—initiating a process to replace the core FMIS by a COTS, LDSW, or in-house development solution could be the optimal decision.[13] When the assessment shows relatively few functional and

[11]Often, the Treasury Directorate or the Budget Directorate of the finance ministry oversees the operation of the FMIS. Some countries (for example, Cambodia and Chile) have established an Information Technology Directorate within the finance ministry to undertake this function.

[12]Examples from developing countries include the East African Community (ECA), the Central African Economic and Monetary Community (CEMAC), and the West African Economic and Monetary Union (WAEMU).

[13]It is a general practice in software development to apply the 80/20 rule, or Pareto principle, which states that, in many situations, roughly 80 percent of the effects come from 20 percent of the causes. Considering that on average FMIS core functionalities represent about 20 percent of all functionalities of the system, it should be possible to assess whether the severity of technological issues and

Figure 4. Illustrative Options for Modernizing the FMIS



technological challenges, workable solutions fall in the other three quadrants of the diagram.

In such circumstances, especially those outcomes that are indicated by the green zone in Figure 4, a good solution may be a modular approach, rather than replacing all core FMIS modules simultaneously. For example, if the accounting module is not performing adequately, it would be possible to upgrade or replace this module while retaining the modules relating to the budget execution, treasury, and cash management functions. The solution should also include a data warehouse that collects, integrates, and stores information from various sources. The suitability of a modular approach will depend on, among other things, an analysis of the costs and benefits of alternative solutions and the level of coupling and cohesion in the FMIS.[14] In cases in which the level of the system's coupling is low and the level of cohesion is high, for example, applying a modular approach could be the preferred option.

Figure 5 presents the modular approach, which focuses on the core functionalities depicted by the red box in Figure 3, rather than a wider set of modules. Under this approach, one module of the FMIS core would be upgraded, reengineered, or replaced at a time by making use of APIs and/or interoperability layers between different information systems, as well as more agile software development approaches. All other modules of the FMIS would remain in operation, without a need to replace the full information system. Box 4 provides some examples of countries that have implemented a modular approach.

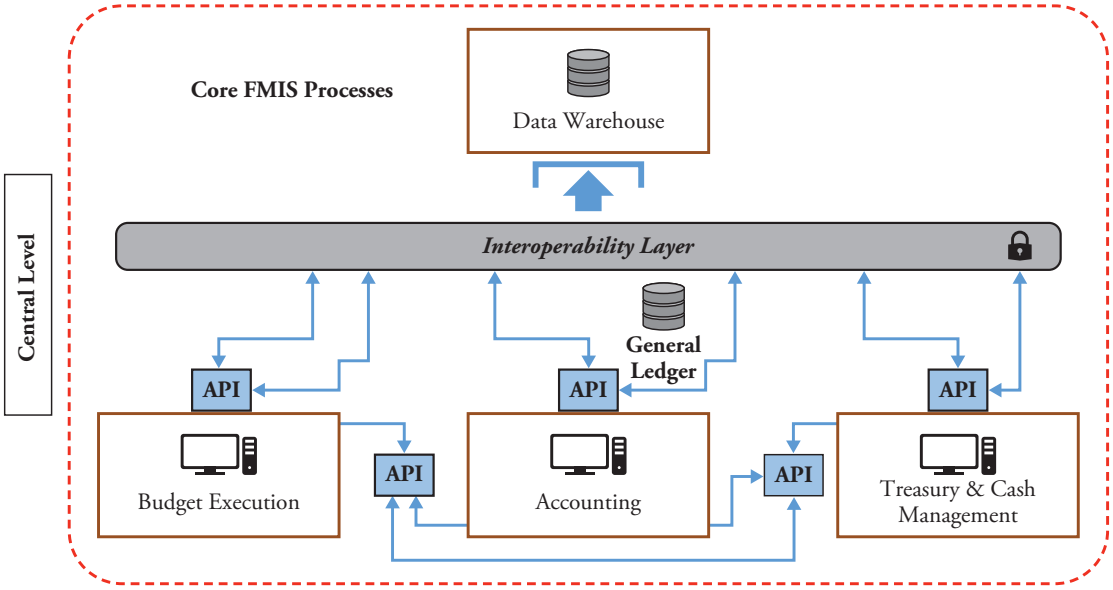
By utilizing the latest technological advances, implementation of a modular approach has become more feasible. In the early days of FMIS development, software applications and the hardware available to support the exchange of financial information—and the interoperability between different information systems, or different modules of the same system—were not widely available either in private sector systems or in the public sector. However, since around the year 2005, information systems have been increasingly developed on web-based platforms under a service-oriented design, which increased a system's capacity for interoperability and the ease of upgrading or maintenance.

In a web-based platform, all the software is located at the central server, and the clients connect to the FMIS over a wide area network or a virtual private network using internet (web-browser) technology. Therefore, when the central servers are updated, all clients are provided with instant access to the updated system. Additionally, under a service-oriented design, the

functional challenges relates to more than 80 percent of all FMIS functionalities.

[14]In software engineering, the term *coupling* represents the degree of interdependence between software modules—a measure of how closely they are connected. Modules are highly coupled when a change to module A forces a change to module B, if the system is to remain functional. The term *cohesion* describes how closely related are the functions within a single module. Low cohesion implies that different modules perform tasks that are not closely related to each other and therefore can create functional or performance problems.

Figure 5. Schematic Representation of the Modular Approach



Source: Authors.

Box 4. Country Examples of a Modular Approach

Examples of using a modular approach can be found in many advanced economies. In the case of the United States, for example, budget execution and payment processes are decentralized to government agencies, which are responsible for setting up their own financial management systems, subject to a common set of standards and requirements. These requirements are validated by business rules engines at the US Treasury Department and the Office of Management and Budget (OMB) respectively, which exercise a central oversight role of FMISs at the federal level. Data are exchanged between other government departments and agencies, and the Treasury Department and OMB systems through direct input into the APIs or through batch exchanges using an XML format.

In the cases of the United Kingdom and the Netherlands, the information systems for aggregate spending control are relatively simple (Hadley, Miller, and Welham 2019). In the United Kingdom, for example, under the budget monitoring system used by the finance ministry, data are only entered at fixed points of the year by the spending agencies. The Netherlands operates a similar approach with its IBOS system. Financial systems that run the detailed day-to-day management of budgets, forecasts, transactions, approvals, payments, accounts, and financial reports have been almost entirely delegated to the spending ministries and agencies. In all three countries, financial information systems have established a common set of standards for the various information fields, a key feature of the modular approach.

A modular approach has also been adopted in some emerging markets. In the case of São Paulo state in Brazil, for example, a web-based version of the FMIS (called SIAFEM.net) was developed together with a middleware layer that connected a series of web-based applications to enhance the overall system's interoperability and its interfaces with public procurement and the public sector cost system.

In Mali, a previously fragmented FMIS was upgraded to conform with the harmonized framework of PFM that is required by the region's economic and monetary union, of which Mali is a member. The system's interoperability was increased by utilizing an extract-transform-load tool. In the case of Cabo Verde, Guyana, and Mali, business intelligence tools were implemented on top of an existing FMIS solution to improve the system's reporting capabilities.

system's capacity to exchange and share information is increased. A range of additional software solutions is available today that facilitate the timely exchange of data among different information systems. These software developments include, for example, the utilization of API web services, or the incorporation of a middleware layer that enhances the capacity of an information system to manage data from several sources. The use of flexible data warehouse solutions has also been increasing. The utilization of such technological innovations opens new perspectives to modernize the FMIS.

To summarize, a modular approach offers the following potential benefits which should:

- Support the implementation and monitoring of core fiscal objectives, fiscal rules, and financial regulations, by giving priority to strengthening the FMIS's accounting, budget, treasury, and reporting functions.
- Facilitate the exchange of information between the core and noncore modules of the FMIS, and between the information systems operated by individual ministries and agencies.
- Allow countries to make the best use of their existing systems, utilizing investments in IT and human resource capabilities that are already available, and avoiding the need to replace all or most of their existing FMIS.
- Increase the flexibility to incorporate advanced technologies within the FMIS, including web-based or multilayered systems.
- Provide for more agile solutions in rapidly evolving environments (for example, where several PFM reforms are taking place simultaneously).
- Permit countries to implement different IT solutions from several vendors instead of being tied to a single vendor.
- Enable issues of poor connectivity to be better managed (for example, some modules may continue to operate while others are out of operation).

There are also some potential disadvantages and costs associated with a modular approach. Since each module of the FMIS could function under a different technological platform, the modular approach requires the establishment of a common set of standards for the various information fields—for example, on the organizational structure of government, the budget classification and chart of accounts, and a country's regions and local government units. These standards should be adopted by each module to ensure that the data are used consistently. In an ERP system or traditional comprehensive FMIS, by contrast, such standards are not an issue because there is only one system based on a single platform.

To validate that each module produces and manages the information according to these standards, a central business rules engine should be established, preferably in the general ledger. Efficient interfaces between the various components of the FMIS can then be developed. Enterprise service buses (ESBs) and other integration tools (for example, extract, transform, load tools) can make such reconciliation easier. Nevertheless, the requirements for uniform information standards are still nontrivial and may add to the technological complexities and maintenance costs of the system once it is operational.

Another potential limitation of an approach that requires only one or two modules to be replaced is that ERP-based or COTS solutions are less flexible than in-house or LDSW solutions. Nevertheless, ERP solutions are increasingly incorporating greater flexibility in their design—for example, through more capacity to exchange information among several information systems via APIs—thus allowing the application of a modular approach to these solutions. However, by exchanging information in this way, the system may become more vulnerable to security risks. As a result, governments will need to strengthen their cybersecurity policies.

Developing and Implementing a Roadmap for Modernizing the FMIS

Once the government has decided to modernize the FMIS, the next step should be to define and implement a detailed roadmap. Where a modular approach to reform is both feasible and supported by the government, the following solutions could be considered:

- ***Reengineering a specific core FMIS module*** to resolve its functional weaknesses and deliver improved performance and interoperability. This approach could include some necessary modifications to the structure of the database and/or developing a middleware layer. Another option could be to replace a specific core module with alternative software available from the same or a different vendor or developing an FMIS module tailored to a country's specific requirements. More agile software development approaches driven by automation are making such a strategy faster to implement and

more cost-effective than in the past. This option is more appropriate when the FMIS has a low level of coupling; low or medium functional problems in the core areas of accounting and fiscal reporting, budget execution, or treasury and cash management; and no severe technological problems.

- ***Developing a data sharing layer on top of the existing core FMIS modules*** to produce a simpler transaction processing function. This approach would maintain the existing applications and applied API interfaces, using software systems called ESBs. It could be more appropriate in an FMIS that has been developed in-house and with a medium level of coupling; low or medium problems in the core functional areas; and no severe technological problems.
- ***Replatforming or migrating the core FMIS systems to the cloud,*** from high-cost hardware or outdated platforms to cloud-ready platforms using specifically designed technology.[15] Under this approach, the benefits are mostly related to simplifying the IT environment and divesting organizations of much of the responsibility associated with managing applications, increasing at the same time the flexibility of running the information systems on a reliable hardware and software platform. The level of development of cloud computing providers in each country, especially in developing countries, should be assessed to guarantee the security and business continuity of the FMIS.[16] This option may be preferred when the FMIS presents relatively minor functional problems that can be addressed easily; medium or high technological challenges related to software licenses, database problems; or hardware and connectivity weaknesses.

Decisions will also be required on whether the agreed changes should be implemented all at once or in stages. There is extensive literature on the steps that governments should follow in implementing an FMIS (Hashim and Allan 2001; Diamond and Khemani 2005; Dener, Watkins, and Dorotinsky 2011; Hashim 2014; Uña and Pimenta 2015; Fritz, Verhoeven, and Avenia 2017). The change impacts on a very large number of public agencies and users, and requires significant time and attention to communications, raising the awareness and readiness of users, and providing them with training. In brief, the required steps include the following:

- Defining a strategy and action plan, with appropriate targets and milestones, taking account of the budget cycle.[17]
- Securing the necessary human and financial resources, through domestic or external resources, to undertake the project.
- Establishing a project implementation unit and a steering committee chaired by a senior government official or minister.
- Developing a change management, communication and capacity building strategy, as well as a mechanism to obtain regular feedback from end users of financial information.

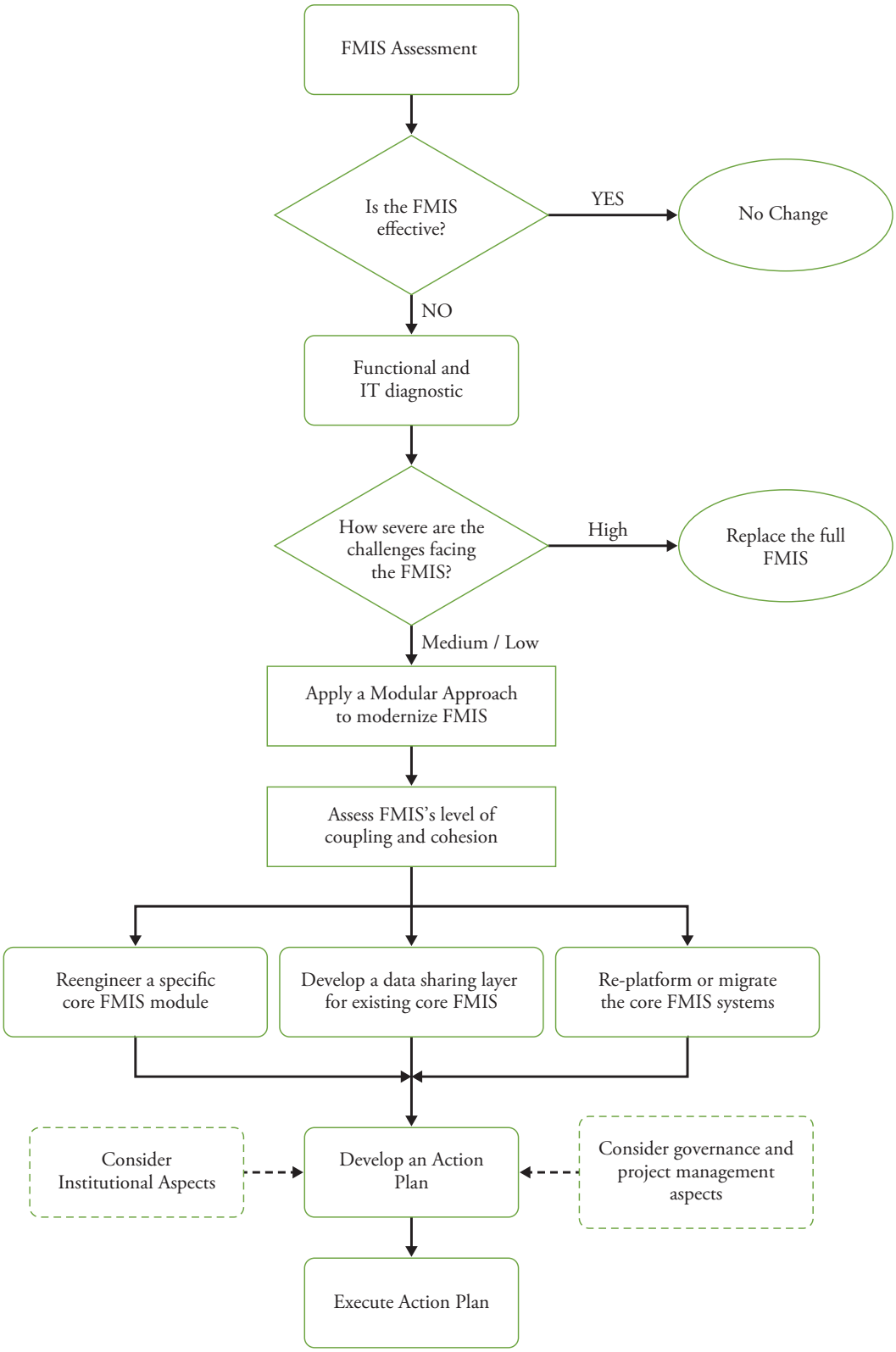
The conceptual design of the FMIS may also need to be revisited, and business processes reengineered (Khan and Pessoa 2010). Generally, these business processes are related to commitment authorizations, virement procedures, the payment process, and accounting. Under a modular approach, the business process review should be narrowly focused on a few core characteristics that require modification. Figure 6 is a flow chart that summarizes the main steps and decision points in the process of modernizing an FMIS.

[15]This option is also known in the software industry as lifting and shifting the software applications. (McClure, 2018)

[16]Additionally, any legal restrictions on the utilization of cloud computing solutions should be assessed.

[17]Countries might want to consider introducing the FMIS at the mid-year point, preparing the budget initially on both the new system and the legacy system, and formulating backup plans and procedures in case of underperformance or failure of the system.

Figure 6. Modernization of an FMIS: Key Steps and Decision Points



Source: Authors.

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