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Study on Public Debt Management Systems and Results of a Survey on Solutions Used by Debt Management Offices

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Abstract

A debt management system is the backbone of any sovereign debt management office. A robust, well-functioning and user-friendly system allows governments to strengthen their debt management environment. This study aims to contribute to the literature on (i) the essential requirements of a debt management system, (ii) the selection criteria for software that fits the system modernization and integration needs of a debt management office, and (iii) how the solutions currently used by governments meet those requirements. It also contains the results of a survey that shows the current landscape of solutions used by a sample of debt management offices from 31 countries. The target audience is emerging and developing countries that seek to strengthen the information technology platform they use for debt management. The study concludes that it is fundamental for a debt management system to meet the debt management office's evolving needs, while at the same time differentiating among functions and coverage that are mandatory, relevant, and desirable. This differentiation provides a helpful guide for debt managers deciding between building a tailored debt management system from scratch or purchasing an off-the-shelf system. The survey results suggest that current systems can handle the critical functions and instruments of debt management offices. However, if the nature of respondents' debt portfolios evolves over time, system limitations may present challenges. One clear takeaway is that debt managers should consider the ability of their debt management system to interact with external (for example, financial management information system) information technology platforms as an essential characteristic of their information ecosystem.

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Study on Public Debt Management Systems and Results of a Survey on Solutions Used by Debt Management Offices

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Abbreviations

CS-DRMS	Commonwealth Secretariat Debt Recording and Management System
DMFAS	Debt Management and Financial Analysis System
DMS	Debt Management System
DMO	Debt Management Office
FMIS	Financial Management Information System
IT	Information Technology
LIC	Low-Income Country
LMIC	Lower Middle-Income Country
PFM	Public Financial Management
STP	Straight-Through Processing
UNCTAD	United Nations Conference on Trade and Development
WB	World Bank

I. Introduction

A Debt Management System (DMS) is the backbone of any sovereign Debt Management Office (DMO). A robust, well-functioning and user-friendly system allows governments to strengthen their debt management operations.

Most DMS can support core functions and business processes of a DMO. They should, at a minimum, handle the business flow between the resource mobilization and repayment teams. As a debt portfolio becomes more diverse and the range of responsibilities of a DMO evolves, the requirements for its Information Technology (IT) infrastructure will also change.

This evolution is presently taking place. An increasing number of countries have less access to sources of concessional and semi-concessional financing. In response, emerging and developing countries' DMOs are shifting their debt management strategies, issuing market-based bills and bonds in domestic and international capital markets and using less conventional instruments such as Islamic, green, and catastrophe infrastructure bonds. Accessing more diverse sources of financing means DMOs must manage more challenging cost and risk trade-offs. For example, governments focused on developing domestic government securities markets or introducing changes in cash management policies must set up repo/reverse repo or securities lending facilities and conduct liability management and derivatives operations. As debt portfolios become more diverse and transactions more complex, teams responsible for public financial management expect to have in place a connection between the DMS and the external systems, such as the Financial Management Information System (FMIS) or treasury system.[4]

With the need to adapt systems to the changing nature of government financing, DMOs must decide whether to upgrade their existing DMS or switch to other solutions that can be off-the-shelf or built specifically for them. The off-the-shelf systems currently available consist of public solutions directly targeting sovereigns and sub-sovereigns or commercial solutions that can be implemented for governments.

This study aims to contribute to the literature on (i) the essential requirements of a DMS, (ii) how to select software that fits the system modernization and integration needs of a DMO, and (iii) how the solutions currently being used by governments meet those requirements. The target audience is emerging and developing countries exploring ways of improving their IT platform.

The first section of this study describes the characteristics of a DMS and articulates the benefits of a well-functioning system. The second section touches upon the coverage and functions expected from a DMS, including its integration with external systems. The third section discusses the pros and cons of selecting and implementing an off-the-shelf versus an in-house developed system. The fourth section presents the findings of a survey covering 31 countries with the objective of collecting information on the DMS currently used by DMOs and the respondent countries' aspirations, while the closing section draws some general conclusions.

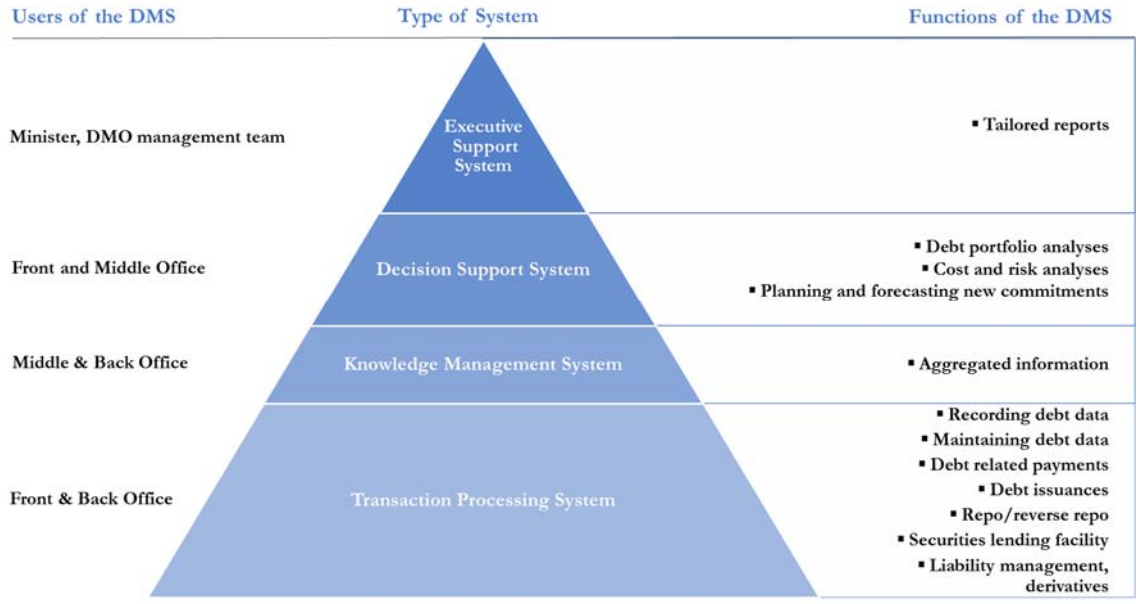
[4] This study focuses on systems related to the key responsibilities of a DMO that oversees the financing of the public investment of the government and the budget deficit through borrowing and guarantee operations. A related, and sometimes interconnected, system, but used for a different purpose is the treasury system that is responsible for treasury and cash management functions. Although section two will touch upon the relationship between the two functions, the treasury systems are not the primary focus of this study.

II. Benefits of a debt management system

According to Encyclopedia Britannica, an information system is an integrated set of components for collecting, storing, and processing data and for providing information, knowledge, and digital products. It consists of the following components: hardware, software, data, people, processes, and communication. Although the first three, fitting under the *technology* category, are what most people perceive to be an information system, it is the latter three that really separate the idea of information systems from more technical fields, such as computer science. Information systems play a significant role in transforming data into information, transferring that information into organizational knowledge, and supporting the business processes and workflow of the organization.

There are several types of information system classifications, such as systems for transaction processing, knowledge management, decision support, and executive information. Generally, information systems can be divided into distinct categories based on where and how they are used within an organization. Figure 1 shows the main types of information systems, adapted to show their application to a DMS.

Figure 1: Types of Information Systems and their application to a Debt Management System



Note: This figure is adapted from Turban, McLean, Wetherbe (2004)

A DMS, at a minimum, is a *transaction processing system*. A government's reputational risk is highly dependent on its ability to make accurate and timely debt service payments. Therefore, a DMS with complete and reliable debt records can significantly reduce the risk of a technical default. This outcome is one of the most critical risks countries face and can arise from the inability of the DMO to forecast accurate and timely debt service projections. Thus, a DMS that facilitates the maintenance of an accurate and up-to-date debt database and the extraction of reliable data contributes to the reduction of technical default risk. Still, even the best systems must depend on the quality of data recorded.

The effectiveness and efficiency of the business flow and processes between the resource mobilization and repayment teams also benefit from a well-running DMS. As these systems have built-in controls and validation rules, with clear delineation of the roles and responsibilities of staff accessing the system, they can easily support and enhance the workflow and the internal processes of the DMO. We should, however, note that no DMS can replace internal governance issues. If the business processes in the DMO are not sound, even a fully operational and high quality DMS will underperform.

Table 1: How does a DMS contribute to strengthening debt management operations?

Supports decision making
Reduces operational risk
Reduces reputation risk
Facilitates efforts to increase transparency and accountability
Stimulates efficiency and productivity

Source: Authors

A DMS can also serve as a *knowledge management system* that increases the productivity and efficiency of a DMO and contributes to supporting transparency of information by facilitating access to data. A knowledge management system lessens the challenges in maintaining and updating a consolidated debt database and is more reliable than maintaining records on Excel spreadsheets[5] or separate systems (e.g., for external and domestic debt). A DMS that functions according to the rules and processes required in a DMO (for example, front and back office teams with different authorizations to access the system) creates an incentive to improve the operations of the DMO. Moreover, a DMS that has well-functioning application controls such as input, processing and output controls is conducive to reducing vulnerabilities originating from human error and manipulation. For example, the software can reduce the amount of manual input by staff and enhance the reliability and security of information. Moreover, it creates the ability to generate standard and easily customized reports on individual instrument and portfolio levels. These products increase the DMO's effectiveness by generating inputs for debt bulletins and other analyses. A DMS that can run risk models and serve as a *decision support* and an *executive decision support system* further empowers DMOs by enabling staff to focus on these analyses and dedicate less time and effort to operations.

Overall, a well-functioning and reliable DMS can help strengthen debt management operations, reduce operational risk,[6] and improve decision making within a DMO. In the absence of such a system, a DMO cannot increase the volume of its transactions and the complexity of its instruments,

[5] In the absence of a full-fledged DMS, some countries use spreadsheets (e.g. Excel) as the technology for hosting debt management data. This is a suboptimal solution as it is prone to operational risks and incapable of addressing most of the complexities required in a DMS.

[6] Operational risk is the "risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events" (Basel II, June 2004). For a DMO, this risk arises when (i) proper workflows within and between the front, middle and back offices are not in place, (ii) there is weak segregation of responsibilities among staff, (iii) staff make mistakes in their daily jobs, (iv) there is no sound DMS, and (v) there is rogue activity such as fraud.

nor enhance its capacity to conduct more complicated analyses without facing significant operational risk.

III. Coverage and functions of a debt management system

Meeting user-requirements is critical for increasing the chances of an information system being accepted and integrated into an organization's workflow. These user requirements for any information system include characteristics such as (i) user-friendliness and intuitive interface and architecture, (ii) easy retrieval of data in a useful format and the ability to export data to other platforms, (iii) the ability to conduct searches within the system using keywords, and (iv) the availability of a detailed user manual.

Given that sovereign debt portfolios and debt management operations are similar across countries, every DMS should at least support core functions. The architecture of the DMS should also have enough flexibility to handle the evolving needs of a DMO. Ideally, the system should address the current and potential needs of the DMO including accounting for future business process re-engineering possibilities.

i. Coverage

The DMS should be able to support almost the complete array of debt instruments used by the DMO. The coverage of information should include, at a minimum, the debt securities and loans of the central government, i.e., the government's direct liabilities emanating from its borrowing for project and budget financing. These liabilities include both marketable instruments such as bills and bonds and non-marketable instruments such as loans, promissory notes, and structured contracts such as Islamic instruments or bilateral credits. Furthermore, the system should be able to cover instruments of different currencies and types such as fixed rate, floating rate, zero coupon or inflation indexed bonds, as well as other innovative instruments such as green bonds and infrastructure bonds if issued by the DMO. For all these instruments, the DMS should be able to capture the related stocks and flows, such as commitments, disbursements, realized and projected payments (principal, interest and other payments such as commitment fees, management fees), and any arrears, prepayments, or penalty payments.

The DMS should also be able to take into account special features of instruments such as non-standard day count and different holiday conventions. Some instruments may also have uncommon redemption profiles with different interest rates charged on different tranches, varying fee structures, and different disbursement and repayment profiles by tranche. These special features usually stem from the exposure to distinct types of lenders such as official, bilateral and multilateral sources, commercial banks, and export credits lenders, some of whom may be able to impose terms and conditions outside of standard structures.[7] The DMS should also be able to cover debt restructuring actions such as debt write-offs and debt rescheduling and other embedded options.

One of the most important characteristics of an optimal DMS is its ability to account for both external and domestic debt. A single database capable of capturing the diverse types of domestic and external debt instruments ensures data integrity and security across all operations of the DMO. It also enables a holistic approach to debt management and facilitates more comprehensive analysis of

[7] We should note that if a DMO's debt portfolio contains only a few of these non-standard features—either in terms of numbers of transactions or aggregate amounts—it may not be worthwhile to invest the time and resources to align the DMS to capture these non-standard loans.

a government's debt portfolio. In some countries, mostly emerging and developing, DMOs still manage domestic and external debt portfolios using separate software. This structure is largely the legacy of a time when emerging market countries could mainly borrow from multilateral and bilateral external sources and had shallow domestic markets. As these countries started to develop their domestic market for government securities, some decided to monitor domestic debt in Excel,[8] as their DMS did not support domestic securities. Separate databases are also sometimes a result of external and domestic debt managed by separate teams and units. This kind of debt database fragmentation significantly reduces a DMO's ability to undertake debt management operations in an integrated fashion.

A DMS should also capture data on debt-like instruments, such as the on-lending of government debt and sovereign guarantees, as these structures create credit risk for the government and ultimately have an impact on its finances if not repaid. Capturing this data in a DMS also enables holistic policy analysis. Coverage may further be extended to include debt obligations arising from other public-sector players such as local and state governments and financial and non-financial public corporations. Some countries also record private sector external debt and record and monitor their on-lending portfolio through the DMS. For a DMS to keep a comprehensive database of all other activities of the DMO, the software package should have a flexible architecture that allows the addition of new functions, and the DMO should have the resources required to maintain the expanded system.

ii. Core functions

A DMS should be a user-friendly, secure, accurate and reliable software solution. It should, at a minimum, be able to (i) securely record and maintain all debt-related transactions such as commitments, disbursements and debt service payments; (ii) produce payment projections of principal, interest, and other fees; and (iii) generate reports at individual instrument and portfolio levels. This basic DMS functionality delivers essential debt management support to all three of a DMO's offices (front, middle and back) (See Figure 1).

Table 2: Core functions and degree of importance

Recording, validating and maintaining debt data	Mandatory
Producing payment projections	Mandatory
Generating reports for analyses and decision	Mandatory
Conducting portfolio and risk analyses	Relevant
Planning future borrowings	Relevant
Resource mobilization	Relevant
Connection with FMIS	Relevant
Straight through processing	Desirable

Source: Authors

[8] In this study, we use system, solution, software and software package interchangeably.

Recording, validating and maintaining debt data

The DMS should enable the recording of the following information:

i) Terms and conditions of new debt: For loans, this includes creditor information, currency and amount of commitment, issuance/commitment date, maturity, grace period, interest rate, disbursement profile, amortization schedule, details of the various fees charged, agent bank details, and any other special clauses. For securities, this includes the face value, coupon, and tenor.[9]

ii) Realized disbursement for loans and proceeds of the securities, denominated in the currency(ies) of disbursement.

iii) Realized debt service information: This includes principal repayments, payment of interest and coupon, and payment of any other fees.

iv) Changes in the original terms or conditions of the loans. *e.g.*, cancellation, write-off, restructuring, prepayment, conversion, switch, buy-back, waiver, etc.

v) Reopening of marketable securities, liability management operations (switch, buyback, split) and repo/reverse repo transactions.

In addition to recording information, the DMS should also have a validation function, with proper internal controls, to ensure that the data recorded are correct. The system should be able to alert users if any of the actual data recorded are not in line with the terms of the loan or securities as initially recorded.

Producing payment projections

The projection of accurate and timely debt service payments is an essential DMS feature. The system should be able to generate a schedule of debt service payments for the whole portfolio, showing upcoming payments (principal, interest, fee), due dates, and the currency and amount of payments. These projections form part of the system's payment instructions and include any loan detail changes, such as modifications to actual disbursement profiles or fee waivers. Moreover, debt managers should be able to generate the debt servicing schedule for as long a period as required because this information is an essential input for the government's overall cashflow forecasts. Payment instructions can be transmitted directly to the central bank or to the central bank through a treasury unit's system if the unit is separate from the DMO.

Generating reports for analyses and decision support

Two of the most essential functions of a DMO are reporting the status of debt to concerned parties and conducting debt related analysis. DMOs generally provide debt-related input for national budget preparation and reports on debt to government officials and the public. They are also responsible for conducting portfolio analyses and planning future borrowing. A sound DMS should contain a reporting module that can easily produce both standard and customized reports based on accurate data. Debt managers should, therefore, be able to extract the right information, in the format, granularity, and the period they desire, and the extraction should be easy to reformat as required. This functionality facilitates a variety of critical tasks, including compliance, audit, policy decision making and communications. Experience shows that many systems, while able to generate information at the level of an individual loan or security, have challenges producing aggregated portfolio-level reports.

[9] Details of holders of security are usually held at the central bank that runs the auctions and keeps the registry.

iii. Additional functions

Several additional functions can enhance a DMS's contribution to sound debt management practices. The most important are portfolio and risk analysis; future borrowing planning; resource mobilization; systems integration; and Straight Through Processing (STP).

Conducting portfolio and risk analyses

Data analytics capacity significantly increases the usefulness of a DMS, making it more than a data tracking tool. Important abilities include computing risk indicators for public and publicly-guaranteed debt portfolios and conducting scenario analyses for different exchange rates, interest rates or indices, and default rates for guarantees.

A DMS that embeds risk models, *e.g.*, supporting historical variance/covariance or stochastic analyses and Monte Carlo simulations, further strengthens a DMO's analysis capacity.

Box 1. System and data security

For any software solution, access controls and system security are critical to protecting data and reducing operational risk (see Box 1). Security controls and protocols that personalize access to information should also be in place to mitigate human mistakes and data loss. A DMS can deliver these functions through providing an appropriate level of business continuity; meeting industry-standard internal control, audit and regulatory requirements; and storing historical data for reference purposes.

A DMS with a database housed on a DMO's hardware can enhance data privacy and related procedures so long as it is not connected to the Internet. Many sovereigns believe this approach helps protect sensitive information on their debt portfolio such as bids in government securities auctions and the lenders' identities.

At the same time, storing information on local databases might expose a DMO to increased operational risk. System malfunctions, deficient equipment, or changing technologies may make this option problematic. For some DMOs, a database that is stored on an external server or cloud-based service might be a better solution because these are professionally managed services that should have the proper safeguards in place.

Planning future borrowings

A DMS can further enhance a DMO's planning function by facilitating the development of borrowing plans. It should empower debt managers with the ability to test different borrowing scenarios and assess their impact on overall portfolio risk and various risk indicators. Debt managers should be able to visualize from within the system the impact of any new borrowings, as well as any potential debt restructuring or rescheduling. Based on the preferred borrowing scenario, the DMS should facilitate the preparation of borrowing plans for external and domestic debt. This function requires the ability to plan for the issuance of new debt, considering the redemption of existing debt, as well as cash and funding needs. The system can also be programmed to consider the different fiscal rules applicable to a sovereign such as debt limits, or rules being informally monitored by the

DMO such as the required minimum level of concessionality. The DMS should also alert the debt manager to borrowing scenarios that would breach these rules.

Resource mobilization

In most countries, the central bank acting as the agent of the Ministry of Finance undertakes the domestic bill and bond issuances. Some DMOs, however, prefer to run the auctions themselves, using their DMS as the bidding platform and recording the results directly.

Integration with other systems

Although not essential for core debt management, a DMS's ability to interact with other IT systems to exchange data is essential to streamlining debt management functions. Systems integration enables access to information essential to forecasting cash flows, such as exchange rates and interest rates from external data providers. It can also enable a DMS to supply timely and accurate information to other Public Financial Management (PFM) systems for budget preparation or debt related payments. Integration also facilitates the efficient and accurate updating of the debt database with information on realized transactions, such as disbursement proceeds provided by disbursement management systems and payments made through central bank systems or treasury systems.

Box 2: Financial Management Information Systems (FMIS)

A Financial Management Information System (FMIS) supports the automation and integration of public financial management (PFM) processes. These focus on (i) budget planning, usually consisting of the formulation of the government's budget; (ii) budget execution, covering functions such as budget authorizations, commitment controls, payments through treasury accounts, cash flow forecasting and management, and revenue collection; and (iii) budget monitoring, consisting of accounting and reporting.

Debt management operations constitute an important part of PFM processes, and a high-quality DMS supports the automation and integration of these activities. An effective DMS can provide vital input for budget formulation, execution and monitoring, thus contributing to the governance and efficiency of PFM operations.

Ideally, an FMIS integrates essential and satellite PFM functions using a single database and user interface. However, in practice, this integration is difficult to achieve because it requires powerful technology, strong coordination among all actors implicated in the PFM domain, standardized information, and well-aligned workflows. A more practical solution is to establish connections between the systems.

Information exchange through connections between the DMS and the Financial Management Information Systems (FMIS) (see Box 2) strengthens the budgeting and accounting processes and at the same time, reduces operational risk.

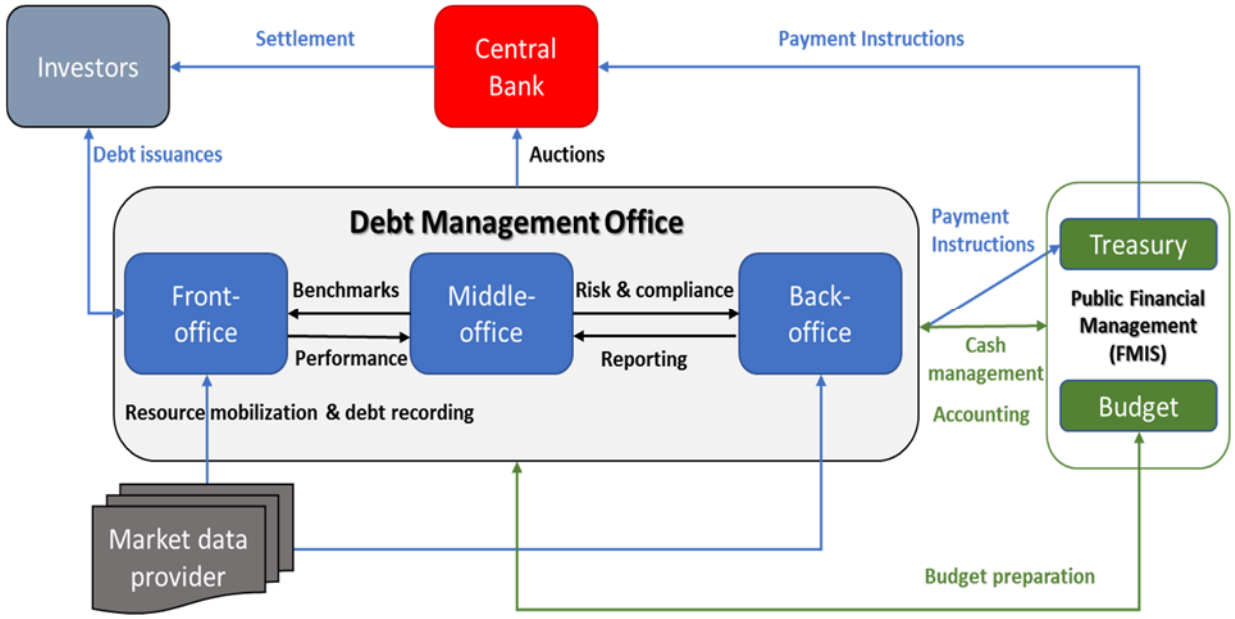
Of the FMIS modules, the most essential and typically well-established two-way connection is between the treasury system and the DMS, especially in cases where the DMO is separate from treasury operations or there is no STP (see Page 15). Even though it is best to have an integrated

DMS and treasury system, at a minimum, there should be a "file upload" connection, where a file downloaded from the DMS and placed on a shared drive can be picked up and uploaded into treasury system.

This integration creates several advantages. Debt service payments are typically made through the treasury system, which is linked to a central bank database, and these transactions are recorded on accounting tables. Furthermore, once a debt service payment is made through the treasury system, the details must be updated in the DMS. If the systems are not linked, recording operations must take place manually, which may result in less accurate and timely record keeping.

Establishing a link between the treasury system and the DMS also improves cashflow forecasting and facilitates the preparation of well-rounded borrowing plans. The connection enables more efficient debt operations as it allows the transfer of payment orders, and settlement and accounting between the two systems. It facilitates easier reconciliation of debt data between the Treasury, the DMO and creditors, but it also improves the integration of debt and cash management to meet funding needs, while managing risks efficiently.

Figure 2: Simplified information and transaction flow for a debt management office



Source: Authors

Still, the challenges associated with linking a DMS and treasury system are notable. The two systems are often led by different teams and have different objectives (*i.e.*, debt management operations to finance funding needs versus budget execution, cash management and accounting). This fragmentation may result in different systems management and maintenance issues. The use of different technologies and processes in various administrative and geographical locations may also pose a challenge. Additionally, changes in the PFM operations, such as adopting different accounting rules, introducing new instruments, or establishing a Treasury Single Account, may make it difficult to maintain sufficient interoperability, adding to the potentially significant cost of software and interface maintenance.

Integrating the DMS with systems related to the auction platform for domestic securities, usually operated by central banks, can also generate advantages. In many countries, the central bank conducts domestic debt auctions and keeps the debt registry in its role as the government's agent. Connecting the DMS with the central bank's securities auction and trading system, with an interface to the registry system, keeps operational risk at a minimum and cuts processing times. For countries that aim to develop their secondary market environment and at the same time achieve pre-trade transparency, an electronic platform can be used for the issuance of government securities.

For a DMO undertaking more complex transactions, having an IT system that can interact with the country's larger financial infrastructure can also deliver benefits. For example, countries like Denmark, Hungary and Sweden use derivatives to manage the risk exposure of their debt portfolio and usually deploy collateral to back these operations. DMS integration can allow it to capture the derivative transaction and information from the collateral management system, which is sometimes run internally or through a custodian. Countries that set up repo/reverse repo or securities lending facilities also benefit when their DMS can interact with the systems used by capital market actors.

Straight Through Processing

STP from front office to deal capture to back office settlement is another highly-recommended characteristic for a DMS. This allows for automatic settlement, payment, and registry of any payment in the DMS once the various actors in the chain complete its processing. In other words, the transaction flow principle enables a single data entry and modification point for transactions. The method for transmitting payment notices to the Treasury and then consequently to the payment agent (usually the central bank) for the actual settlement/repayment can be manual. However, by minimizing human interventions, STP reduces operational risk. Figure 2 presents a simplified illustration of the information flow and transactions for a DMO. All of these activities can be captured through an STP.

IV. Selection and Implementation of a DMS

When it comes to a DMS, debt managers often debate whether it is better to purchase an off-the-shelf solution or build their own software to achieve their objectives. Both approaches have pros and cons (See Table 3:). The answer depends mostly on the complexity of a DMO's operations and its available resources. At a minimum, making the right decision requires that the DMO have a solid understanding of its current and future business needs.

When evaluating the suitability of a DMS, the key parameters are the same as those for users of any IT system. First and foremost, the software package should capture most of the needs of the business and its users. Relevant factors also include cost, ease of installation and maintenance, sustainability, availability of training, and technology risk management capacity.[10]

[10] Technology risks consist of: i) software bugs, ii) over-customization, iii) hardware failure, iv) vendor dependence, v) key person risk, vi) business continuity, vii) hackers, and viii) rapidly evolving technology.

Table 3: Pros and cons of "in-house" versus "off-the-shelf" systems

Type of system	Pros	Cons
In-house system	• Tailored to DMO's country specific current and future needs • Full access to the source code; unlimited and free access to large number of users • Not dependent on software maintenance and upgrade contracts • Tailored to support DMO's organizational flows	• Not one of core competencies of DMOs; inexperienced team more prone to neglect key system features • Tendency to underestimate the extent of challenges for developing a software package in terms of complexity, time and cost • Require well prepared user-requirements, project plan and implementation • More likely to generate suboptimal solutions • Key IT person risk
Off-the-shelf solutions (General)	• Professionally developed and reliable; adhere to core financial industry standards • Capacity to handle large sets of data and transactions • Lower technology risks and positive externality if used by several countries	• More difficult to adapt to the DMO's current needs • Cost of linking to external systems
Public DMS (Specific)	• Specifically built for sovereign debt management portfolio • Perceived as public good and shared ownership of software by involved countries	• Originally built to manage external debt for back office, requiring work-arounds to handle other instruments (*e.g.*, inflation linked) and operations (*e.g.*, liability management) • Creates dependence on the existing system that was originally free or low cost
Commercial system (Specific)	• Complete product, with front, middle and back office functions usually captured in the same package, supporting STP • Well prepared to connect to external systems	• Not designed for sovereigns • Less flexible than the public DMS in addressing sovereign's needs related to country-specific instruments and transactions • Usually expensive installation, maintenance, upgrades and training

i. In-house built solutions[11]

The key advantage of developing an in-house DMS is the ability to tailor the system to the needs of the DMO. This is especially valuable in terms of meeting country-specific requirements, which off-the-shelf packages cannot generally address.

For example, a bespoke system can be built to house all the debt and debt-like instruments found in a sovereign's portfolio, including the non-plain vanilla ones (*e.g.*, multiple tranche project loans, structured disbursements and amortization schedules, different day count conventions, guarantees and on-lending instruments).[12] The software may also be constructed to cover the various types of transactions (*e.g.*, reopening securities, liability management operations, write-offs) necessary to discharge a given DMO's particular responsibilities. A tailored solution can also augment certain DMO strengths, such as processes that effectively support operations and decision-making, provided it conforms to a DMO's organizational structure and internal rules, and respects the specifics of its management framework. These qualities significantly reduce operational risk and strengthen the system's enabling environment.

In-house solutions also tend to give DMOs greater capacity to meet future needs, either through building additional system flexibility at the outset or through access to the source code. For example, selecting a system's architecture with a view toward potential requirements s and developing a DMS in modules can lay the groundwork for more efficient future modifications. Access to source code gives the DMO unlimited scalability in terms of users, as well as the power to better understand and control the assumptions and methodologies used for generating cash flows and risk models. This helps debt managers understand in a granular way how a DMS generates outputs and makes it easier to update these models to reflect new conditions.

Despite these benefits, a bespoke system may not be the optimal solution. Software development can be extremely challenging and is not a DMO's core competency. Building and maintaining a software package is a substantial undertaking and involves several steps (See Box 3). For entities without significant exposure to software development, there is also a tendency to underestimate the extent of the challenges of DMS development, which may result in substantial misunderstandings about the complexity, time and expense of the endeavor. The consequences can be severe, including failures to meet important deadlines, stay within budget caps, and deliver key functions, including audit trail production, backup systems, historical data storage, occurrence log, and sufficient data security. Many of these features are often the benefits of off-the-shelf systems, which take advantage of economies of scale to deliver a suite of high-quality features albeit within a more rigid framework. Given the potential consequences of an inadequately conceived and managed custom DMS project, a DMO should only undertake it where it has continuous support from senior management and is committed to mobilizing the input of debt managers and IT personnel.

DMOs that decide to build their own systems must choose between using in-house designers or enlisting the services of third-party developers. The best route often depends on a DMO's capacity, resources and expertise. The in-house option relies on an internal IT team with the DMO performing all development phases itself, from analysis to deployment. The other option involves the DMO creating user specifications and selecting a contractor to implement them using a software solution and potentially maintaining the system (Ruchkin, 2012, p. 5).

In both approaches, one of the most significant challenges is the definition of user requirements. Indeed, experience suggests that, along with insufficient commitment to building a custom system, a DMS development project often fails due to different expectations among stakeholders regarding

[12] The non-plain vanilla instruments can be bilateral or multi-lateral external loans with highly structured disbursement and redemption profiles, or domestic debt with conditions (e.g. day count) different from industry standards.

the system's functionality. Avoiding this pitfall demands generating consensus within the DMO on the features that are mandatory (must have), relevant (to have), nice to have (desirable), and optional (can live without it), (Coimbra, 2005). Identifying and prioritizing the core functions expected from the DMS is critical to the success of this process. For instance, it is paramount to be able to record the terms and conditions of new debt and the date it becomes available, but not necessary to record the day the contract is signed. And while it would be optimal to develop code for capturing a single loan with very different terms and conditions than others, the time and expense involved in designing this rarely-used feature may mean it should be incorporated into the next version of the software.

Box 3: Steps required for building a customized DMS

1- Decision on whether to build the system in-house or outsource to third party
2- Identification of the resources required
3- Establishment of the project team composed of upper management representatives, project managers, users and IT staff (in-house or external)
4- Identification of the user requirements by the project team
   - Scope definition
   - Specification of the functions and work flows
   - Risk model design
4. Development of the timeline and project milestones
5. Project implementation
   - Database Structure
   - Interface design
   - Coding and documentation
   - Testing and training
   - Deployment

Once a DMO has identified its user specifications, it must select an internal or external project manager able to develop and manage the project's timeline and milestones. The manager should have the knowledge and skills to be able to communicate with both software developers and DMO staff and maintain focus on the work plan and delivering the specified user requirements. These qualities are critical to ensuring the project keeps to its budget, is completed on schedule, the product is widely accepted within the organization, and staff are trained fully in its functionalities.

In addition to project managers, the DMO should engage sufficient staff able to communicate with the IT team (internal or external) to develop adequate solutions as quickly and efficiently as possible. Both teams require comprehensive knowledge of financial methodologies and instruments. In this process, there is a learning curve for IT professionals (especially if they are internal), who need to develop the proper programming skills and knowledge of financial instruments, calculation methodologies.

In the case of in-house DMS, the sovereign should have the budget and organizational flexibility to establish and keep a strong IT department with the proper skills and resources. Usually, an in-house

developed software is more vulnerable to key person risk, as few people might know the specificities of the system. On the other hand, not being dependent on maintenance contracts that are required by outsourced IT teams or off-the-shelf solutions might appear as a plus, from a cost and time point of view, assuming maintaining the specialized IT staff is more affordable. One advantage of having internal IT teams is that when a problem arises—especially in an emergency situation—experts might be mobilized and brought up-to-date faster than external maintenance teams. This is especially true when the maintenance team is in a different geographic location (abroad or in a different part of the country).

ii. Off-the-shelf solutions

The advantages of purchasing an off-the-shelf DMS are multiple. These professionally developed systems are reliable and adhere to core financial industry standards. They follow the universal bond pricing or interest payment formula and embrace financial conventions such as day count or face value. Functions such as keeping an audit trail, defining different user profiles, and storing historical data are already embedded in these systems. Moreover, the capacity to handle large sets of data and transactions warrants uninterrupted and complete database. These commercial systems deal well with technology risks and create positive externality should several countries use the same software. Furthermore, a DMO that lacks sound rules and processes can review and align its internal operations to an off-the-shelf software that follows sound practice.

A DMS equipped with all these characteristics would be a preferred option for governments. However, the decision to buy an off-the-shelf system depends on the availability of such solutions and whether they are deemed satisfactory, cost-effective or both. The existing off-the-shelf solutions for debt management can be split into public DMS or commercial software.

The public DMS consist of Commonwealth Secretariat Debt Recording and Management System (CS-DRMS) and Debt Management and Financial Analysis System (DMFAS), developed and managed by the Commonwealth Secretariat and United Nations Conference on Trade and Development (UNCTAD), respectively. Many sovereigns use the public DMS as they are solutions specifically developed for the needs of sovereign debt management offices (see Appendix 1). The two systems, originally, captured only the external debt portfolio of the public sector (especially central government) and primarily worked as back office systems. Over the years, both public DMS providers developed and improved other modules to include other instruments and transactions (e.g., domestic debt portfolio, liability management operations). Currently, regular upgrades of these software help meet the evolving needs of the user countries.

Box 4: Cost considerations

The cost of a DMS cannot be reduced to just acquiring the hardware and software package. The charge consists of i) software development or purchase, ii) software customization if purchased, iii) software installation, iv) software maintenance, v) connections with other systems, vi) software upgrades according to the evolving needs of the DMO, and vii) continuous training.

Since this is probably the most costly and complex decision facing debt managers, the cost considerations should encompass not only the development and installation cost but also the total cost of ownership consisting of long-term maintenance and upgrade costs. Customization of the system to fit the needs of the DMO might require changes to core functionality. These may not be supported under standard maintenance agreements. Additionally, not testing fully the impact of changes on core functionality, might lead to problems down the road. Cost of customization of the commercial systems can be very expensive. Such action might also lead to over customization which is a significant technology risk.

The cost drivers for an IT system are the following:

- Staffing, with IT professionals with the proper programming skills and DMO/Treasury officials with extensive knowledge and experience
- Infrastructure with hardware capable to host the software but also with the potential for expansion
- Software – development
- Software – licenses, for example when using a database management system such as Oracle, connections with market data providers such as Reuters
- Quality Assurance, not only during the development of the system but continuously
- Business Analysis
- Information Security
- Business Continuity

Being the leading solutions purely developed for governments, the public DMS are usually the first products considered by governments seeking a DMS. These softwares, being tailored to the needs of sovereigns, can meet most of the requirements of governments. The public DMS provide countries with the benefits of shared ownership of the software and a strong voice in decisions on the improvements that will be made. Moreover, the improvements are shared equally among countries. Commonwealth Secretariat and UNCTAD see themselves as custodians of the software as a public good and are committed to ongoing development of their respective systems, maintenance and training. Both organizations have a strong focus on capacity-building, offering a range of training and development services on the software and related areas of debt management.

However, they are less efficient and flexible at expanding according to the evolving needs of the governments (e.g., indexed debt, liability management operations) and connecting them to external systems might require extensive work. The revised versions of public DMS bring in the most debt related information and operations but not in the most user-friendly way and through work arounds.

In addition to the public DMS, several other commercial solutions (e.g., Wall Street systems, Quantum, Calypso, Murex, Star treasury system), although mainly targeting the private sector, are also available. These systems are typically used by the treasuries of corporations and financial

institutions but are customizable to fit the needs of a DMO. We note that usually advanced countries with a portfolio of market-based instruments, sound internal processes (for example integrated cash and debt management), and high number of daily transactions (for example repo operations for cash management, or secondary market trading) use these systems (e.g., New Zealand, France, Denmark).

There are some disadvantages in adopting a commercial software, especially for a DMO. First, these systems are known to be less flexible than the public DMS to cope with a sovereign's needs (e.g., recording guaranteed debt or receivables). Usually, a commercial system aims to capture the critical functions expected from an IT system based on the business needs of its average customer. This means a commercial system developed for the financial sector would not be able to cover all the debt and debt-like instruments in a sovereign's portfolio (e.g., sometimes highly structured instruments from international financial institutions or bilateral loans). Moreover, the decision to include functions or instruments that matter to a DMO might not be the priority for the vendor until requested by a critical mass of customers. Not having full control over modifications to the core system might become restrictive in maintenance and upgrading. Cost considerations might emerge as another area of concern as professional products are usually costly not only for installation but also maintenance, upgrades, and training.

A factor that might be an advantage or disadvantage depending on the sovereign's context is the need to change the processes to adapt to the commercial system's requirements. For a DMO with a suboptimal workflow of transactions and internal organization outside of sound practice, this might be a good thing.

iii. Suggestions

There is no standard or straightforward solution for deciding on buy or build - every situation is different.

To decide on whether to buy an off-the-shelf system versus developing the solution from scratch, DMOs should develop an information system strategy and identify business objectives and priorities and consider cost implications (See Box 4). A common mistake is to start exploring the information systems available or even worse developing one before having defined the business and user requirements. Consultation of the staff who will use the system is an important input for the development of such a strategy. However, an executive decision on whether the DMS will cope with 100 percent of its users' needs will be needed. The DMOs should decide what is needed and what is nice to have. (Do you need a Porsche or a Volvo (Bonde, 2009)).

DMOs should conduct comprehensive reviews of their business requirements not only for short to medium term but also for the long run. The primary objective of the system, not only focusing on the broad functions but also specific tasks, should be defined. Rather than concentrate on one area, the emphasis should be on all core functions expected from the system.

The project managers should involve all related parties at all stages of the development of the software or implementation of the off-the-shelf system. This approach will increase the ownership of the new system by its users, incorporate the feedback of the teams with diverse needs and priorities and avoid big mistakes. Furthermore, at various stages of project implementation, IT staff and DMO staff should be cross-trained to collaborate efficiently.

Regardless of which alternative the DMO opts for, it is critical to assign a senior experienced internal project manager. This person's experience, knowledge of how the institution works and

well-established network of professionals within the institution are valuable traits for the successful design or implementation of the new system.

Adequate senior management support is also essential. One way of showing staff the importance that senior management attributes to the project is to establish a steering committee. This and frequent progress report requirements would highly motivate them so that they carve out time for the project, meet milestones within the deadlines and feel accountable for fulfilling their responsibility.

Before deploying the software, considerable time should be dedicated to testing the new DMS.

V. Survey Results

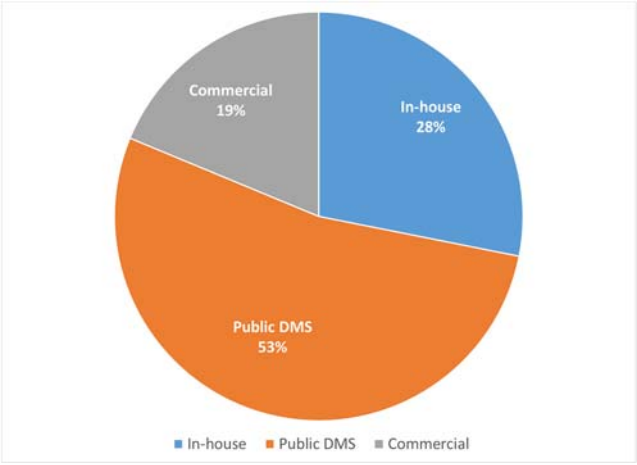
The WB conducted a survey in Spring 2017 covering 31 countries[13] (see the summary results in Appendix 1). The choice of countries aimed to have a fair distribution among users of off-the-shelf versus in-house built systems as well as income distribution.

The objective of the survey was to conduct a study about the core and related functions of an information system for DMOs. The institutions surveyed also responded to a variety of system satisfaction questions in order to attempt to link various parts of the survey for potential conclusions. The survey consisted of four key areas. First section concentrated on descriptive information regarding the current DMS the countries are using. The second section tried to capture the scope of functions that the DMS covers. It primarily concentrated on back office functions, such as debt recording, repayment and reporting. However, it also sought to check the functionality of the DMS with respect to middle-office (risk analysis) and front-office (borrowing operations). The next section of the survey focused on the DMS user satisfaction. Lastly, users were asked regarding various aspects of their DMS, such as technical support, resources, potential modifications and other development needs. The results will not be interpreted per section, but in conjunction in order to draw more meaningful and qualitative interpretations. The authors note that, although the participating countries were requested to fill the survey in coordination with all the units of their DMO, it was not possible to confirm this and thus the answers might be biased towards the perspective of the person submitting the response (e.g., an official from external debt team might provide favorable responses for public DMS which are strong on that area). Furthermore, given the majority of the survey respondents are from emerging and developing countries, where the public DMS are prevalent, there is not an equal distribution among the solutions assessed. Therefore, we treat the results as trends and not clear-cut conclusions. the results should be taken with a grain of salt.

The results show that 94 percent of the respondents use a software, either developed internally or purchased off-the-shelf, as a solution to capture debt management operations and functions. Only two countries covered in the survey did not have a DMS in place to record their operations. Nine of the surveyed countries use a system developed in-house, six use a commercial solution all of which are different and 17 institutions use a public DMS. The graph below shows the distribution of the DMS types.

[13] The Republic of Georgia filled two questionnaires due to separate systems being used for external and domestic debt. Therefore, the results are based on 32 surveys.

Figure 3: Distribution of Types of Debt Management Systems



Source: World Bank Survey on Debt Management Systems (based on 31 country cases)

Low Income Countries (LICs) and Lower Middle-Income Countries (LMICs) seem to have a clear preference for a public DMS, while the upper middle-income countries are almost evenly split between in-house and public DMS.[14] Part of this result can be explained by the public DMS being subsidized by its sponsors or donors and thus more affordable. The distribution among high income countries is scattered among possible choices where most of them are using a commercially developed solution (see Figure 4). The focus would thus be predominantly on High Income or Upper-Middle Income countries, which would have significantly influenced the results given the differences in needs between countries at different income levels.

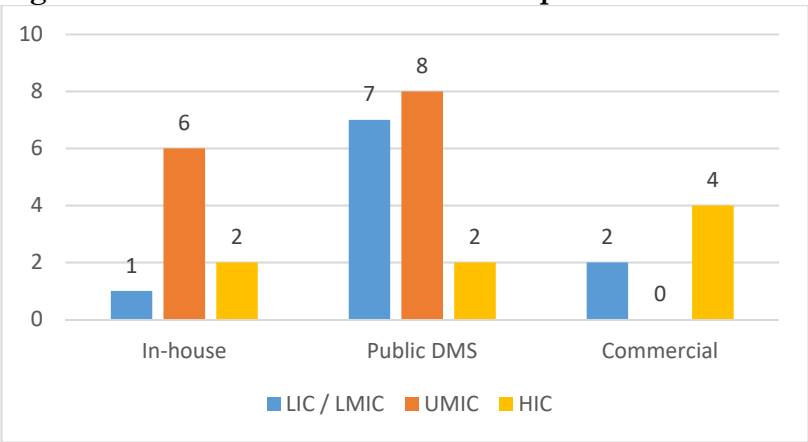
Regarding the DMS functionality, most respondents believe that their current system accommodates their transaction flows[15] such as payments, reporting capabilities, recording of data, etc. Close to 93 percent of respondents believe the system fully accommodates transaction flows while the rest believe it does so at least partially. No users believe their system cannot accommodate the flow.

The survey also captured the capacity of the debt system to process various debt instruments. The instruments listed were bills, bonds (bullet), bonds (amortizing), variable interest rate products (floaters), inflation-linked instruments, project finance loan, guarantees, on-lent debt, receivables (from on-lending, defaulted guarantees), fees, interest rates swaps, and cross currency swaps. Most users indicated that their system can process more common instruments, while the response for other products differed.

[14] The country classification by income level is based on the WB data. (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups)

[15] For each of the specified instruments, the users could answer that the system in use can fully, partially or is not able to capture or process these instruments. Respective scores were assigned to each answer where fully able was equal to one, partially able 0.5 and not able was equal to zero.

Figure 4: Income Distribution of Participants

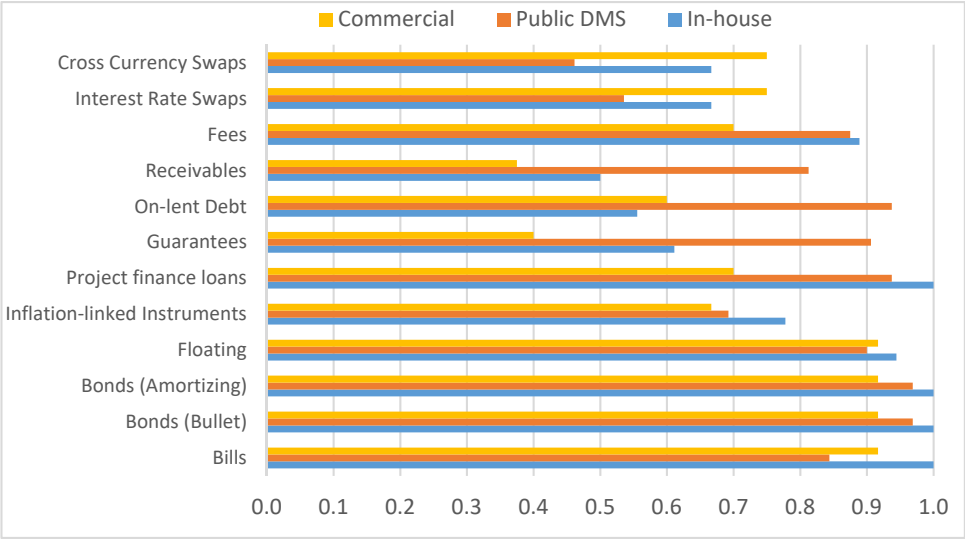


Source: World Bank Survey on Debt Management Systems

Figure 5 below shows the distribution of system ability to process different debt instruments. All systems seem to have no issues capturing the most common debts instruments, such as bills, bonds and floaters. Fees and project-finance loans also receive high marks across all three groups of systems. Interest and cross-currency swaps received the lowest scores on average, but so did inflation-linked instruments, guarantees, on-lent debt, and receivables for commercial software packages (public DMS and commercial).

Looking closer at the survey details provides possible explanations for these results. While the more common debt instruments represent ordinary course of business for most countries, other instruments may not be used and/or are only dealt with periodically. For instance, some developed countries use swap instruments to hedge risks in their respective debt portfolios. Most of these countries indicated that they successfully handle interest rate and cross currency swaps regardless of the system they use. At the same time, other countries that do not use swaps as instruments scored low on coverage of these instruments in their respective DMS. These results are not surprising and mainly due to the absence of these instruments from some DMO portfolios. The more complex transactions such as the derivatives are only undertaken and captured by developed countries DMS (e.g. Denmark, New Zealand). Another interesting observation is that countries using an in-house system have a better general coverage of the instruments they use. Possible reasons could be that the off-the-shelf systems do not fully accommodate their scope of needs and/or they already possess the necessary level of sophistication and support in-house.

Figure 5: Instruments Covered by the Debt Management System



Source: World Bank Survey on Debt Management Systems

For each instrument, possible answers were fully (F), partially (P) or unable (N) to capture with scores assigned to each where F =1, P =0.5 and N=0. A score approaching 1 implies a DMS fully able to process that instrument. As an example of the methodology, all nine institutions using an in-house DMS indicated they are fully able to process bills as instruments. On the other hand, five of the countries using a commercial solution indicated they are fully able and one indicated they are able to partially process the bills in their DMS (yieldinscore of >0.9).

The survey primarily evaluated the ability of the DMS to handle back, but also middle and front office functions. Figure 6 below shows the breakdown across functions. In-house and commercial solutions scored better on average across a variety of front-office functions covered by the survey, such as integration with auction platform to the debt database, interface with electronic platforms as well as market data provider. The users of these solutions also indicated a better setup to check whether a transaction violates any compliance or limit requirements. Results were more mixed in recording transactions not yet committed where approximately 90 percent of in-house, close to 50 percent of public solution and only one-third of commercial solution users indicating they are able to do so (See Appendix 1 for more results).

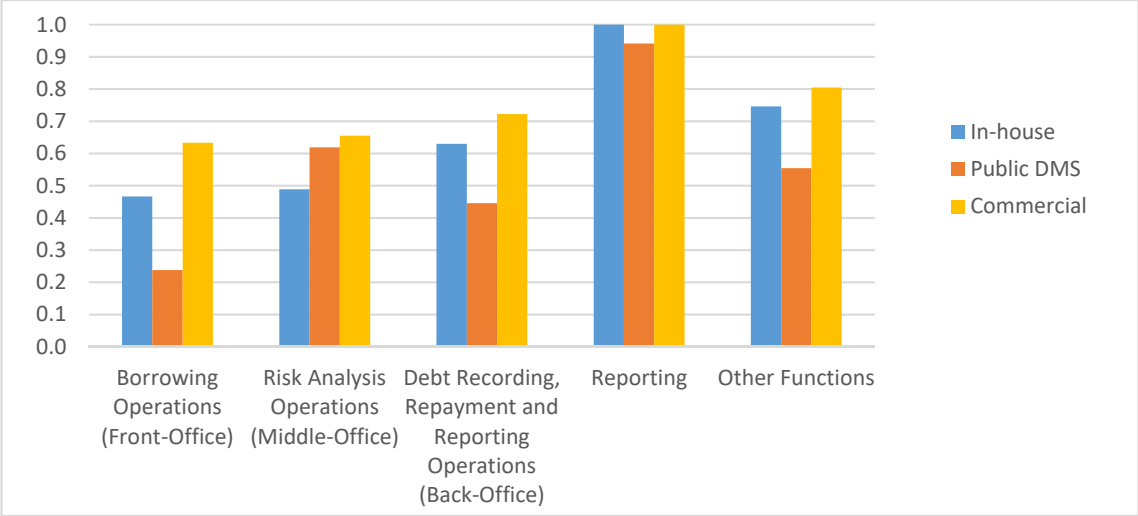
Commercial systems fared better in capturing middle-office functions stated in the survey compared to other solutions. Connecting to other software, such as Excel and Matlab scored high among especially among commercial systems. The same goes for generating risk indicators and providing analytical tools to perform market risk and scenario analysis. On the other hand, decomposition into composite currencies (i.e. from SDR to original currency) scored on average low among all users. Also, not many users indicated that their current solution supports credit risk management functions except for commercial solution users.

The survey respondents also generally seem satisfied with the overall ability of their DMS to capture back office operations (See Figure 6). In general, the systems seem to have no issues capturing the critical components, such as monitoring of the instruments during the entire lifecycle and checking calendar for holidays at the time of deal entry (see Appendix 1, part 4). Overall, support of STP scored higher than no support. However, other desired features, such as generation of SWIFT message and external events alerts generally received low marks, especially among users of public

DMS. One explanation could be that public DMS are not necessarily payment systems and do not need to generate direct instructions to the central bank or lenders.

Regarding report production (See Figure 6), users seems to be especially satisfied with the ability of their systems to generate reports across all solutions. The survey only queried the ability of the DMS to produce consolidated and individual reports without dwelling deeper into any specific reports. Security features, audit trails and getting technical support captured in other (back office functions) also received high marks across all solutions. On the other hand, connection with the FMIS scored low across all systems. In some areas, results were mixed. Public DMS scored especially low when it came to the connectivity with the treasury system.

Figure 6: Functions captured in the Debt Management System



Source: World Bank Survey on Debt Management Systems

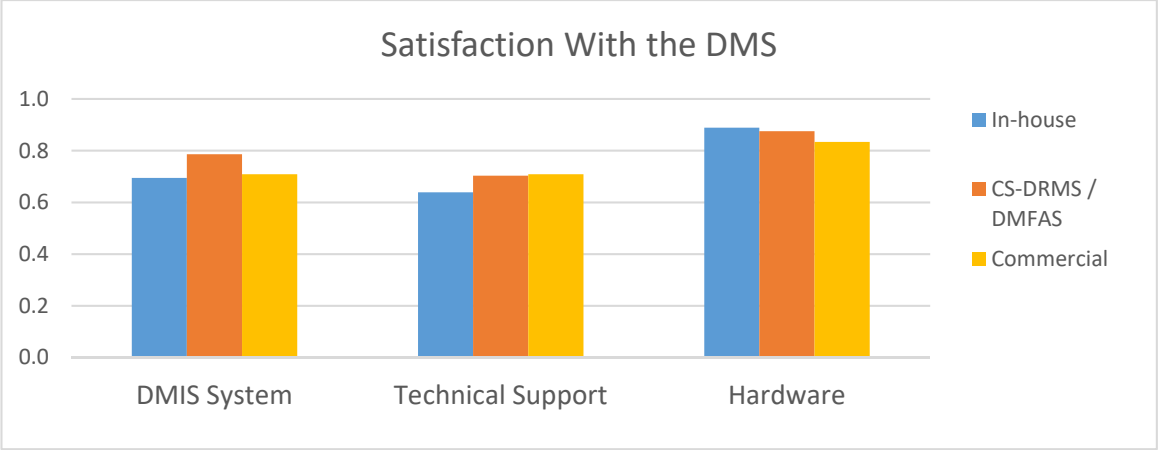
However, the inability of the system to handle some of these functions is most likely not essential to the operations of these institutions**.** Figure 7 represent the satisfaction of respondents with their overall DMS system, technical support and hardware. The users seem to be generally satisfied with the current DMS, but the graphs also show that public DMS users indicated the highest level of satisfaction among all despite the relatively lower scores regarding the results on the functionality of the systems.[16] This observation leads us to conclude that the current capabilities of the public systems are currently enough for the needs of the surveyed countries. These users are also more satisfied with the technical support and hardware they receive for their DMS. On the other hand, hardware results fare better than the technical support potentially indicating that the latter is not as up to par with the system hardware.

Typically, more people are needed to perform back office functions. On average, more people are required to perform back office compared to middle and front office operations. One exception are the higher income countries where the number of back and middle office staff is approximately the same. The reason for this could be because higher income countries may afford to have more staff on market risk and scenario projections and spend more time on analytics rather than back office

[16] For the satisfaction part of the survey, there were five possible answers ranging from very satisfied to very unsatisfied. For analysis purposes, scores were assigned to each possible answer where very satisfied equaled 1, satisfied equaled 0.75, neutral (indifferent) equaled 0.5, unsatisfied 0.25 and very unsatisfied a score of zero.

production work. In the rest of the countries, on the other hand, the number of staff in the back office is almost double in other offices. One reason could be that the higher income countries have better IT support, but also a simpler overall portfolio to handle. Another interesting observation is that the total number of people required to perform all functions does not differ notably across all systems. We note, however, that among all, the in-house solutions have on average the highest number of people for each function and irrespective of the income level. This could be an indication on the need to retain a larger team to maintain such as system.

Figure 7: Satisfaction with the Debt Management System: Overall



Source: World Bank Survey on Debt Management Systems

The survey also drilled deeper into the satisfaction with the system regarding various attributes. These can be summarized as user-friendliness, security of data, reporting features, speed, connection with other platforms (e.g. Treasury, Excel, Bloomberg), integration among modules (front, middle and back offices), STP (e.g., settlement, repayment), customization of the system (such as the ability to create new instruments or transactions), maintenance and upgrade costs, and access to historical information.

On average, there was no clear distinction between the systems and the feedback received did not lead to clear conclusions regarding the differences. Nevertheless, the next graph shows that the respondents generally considered the commercial and public institution systems more user-friendly compared to the in-house built systems. Reporting capabilities and speed of these systems also received better feedback. The in-house systems scored better when it came to integration across offices and STP as well as customization of the system (i.e. creating new instruments).

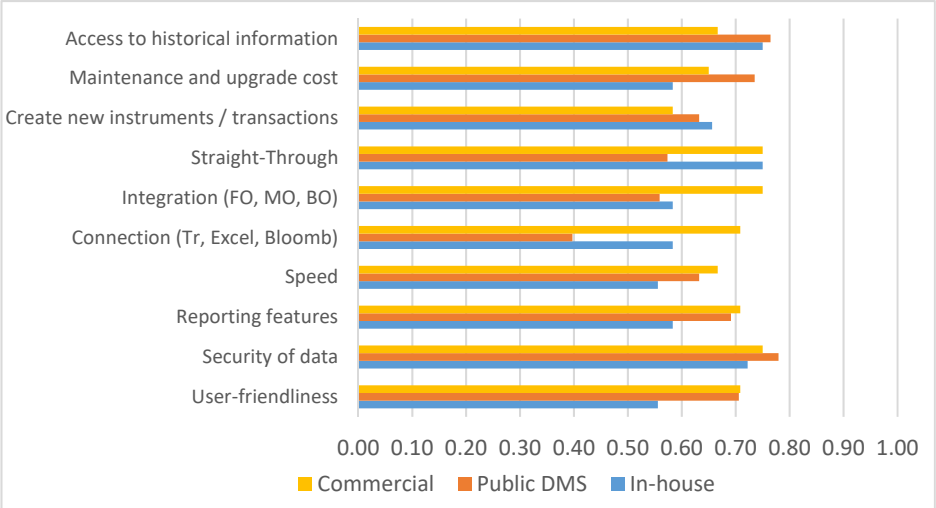
While it is intuitive for the commercial and public institution systems to have better or more advanced reporting capabilities, it is somewhat surprising that the in-house systems have scored better on STP. One possible explanation could be that the commercial and public institution systems were purchased for the needs of one function only (i.e. back office) and were not integrated accordingly with the other offices. Other reasons could be that these countries have not yet decided to integrate it or did not have the resources and/or capacity to do so. This may especially be true for countries using a public DMS. This could also partially explain why commercial and public institution systems scored better on technical support compared to in-house supported systems.

The survey could not draw a clear distinction between satisfaction level versus income level.

The overall satisfaction results across all users in various economies is high on average. Actually, users of in-house and commercial systems yield very similar results where LIC and LMIC as well as HIC show generally a high satisfaction with their DMS compared to UMIC countries.

Another interesting observation is that when the respondents were asked about the overall satisfaction with their current DMS, the results were on average higher than the average satisfaction calculated as a result of each individual DMS feature regarding connection, integration, etc.

Figure 8: Satisfaction with the Debt Management System: Individual Attributes



Source: World Bank Survey on Debt Management Systems

Despite the general satisfaction with the systems, the users still indicated a few areas that their current DMS is not covering. Respondents using a commercial system emphasized the lack of integration with the central bank to receive treasury debt issuance auction results. According to the survey results, system and IT limitations were listed as the main reasons for the lack of integration. Other reasons may include organizational policies and resource capacity, which the survey did not cover. Other issues raised in the survey were the connectivity with other platforms and lack of STP. Users were also asked regarding features they would like to see in their system that are not essential and they currently do not have. Improved report generation and reliability were listed as the most desired feature that needs improvement. Speed, deal capture and connection with other platforms were also brought up.

Perhaps for these and possibly more reasons, 72 percent of all users indicated their current software could use an upgrade while 19 percent prefer an entirely new system. Around 70 percent of users believe upgrading their existing system or installing a new system would cost less than a million while 22 percent believe the cost would be above two million dollars. Interestingly, the amount that the users indicated their respective institution could allocate toward such effort does not deviate too much with the cost. 80 percent of respondents believe their institution could allocate up to one million and 15 percent above two million dollars. Regarding the length to install a new DMS, more than 40 percent of the user believe that the implementation would take one to two years, while another close to 40 percent believe it could take more than two years to do so.

VI. Conclusions

This study attempts to highlight the key functions expected from a DMS and provide guidance to debt managers in emerging and developing countries on the options available to them. We conclude that it is fundamental for the DMS to meet the DMO's evolving needs, while at the same time making a differentiation between functions and coverage that are mandatory, relevant and desirable. This differentiation guides the debt managers' decision between building a DMS from scratch with the objective of tailoring the solution for the DMO or purchasing an off-the-shelf system that addresses most of its needs. We conclude that to favor an in-house solution requires the DMO to carefully consider how professionally it can lead the IT project, whether there is enough staff expertise, the time constraints, and the financial resources available to it.

Additionally, we share the results of a survey conducted by the WB, covering 31 countries with the objective of drawing the current landscape of solutions used by a sample of debt managers. The expectations of the debt managers for the future also were addressed by the survey. We find that the survey results show that most systems capture most standard instruments, but do not provide too much flexibility for capturing new instruments. This implies that the current systems can handle the critical functions and instruments these institutions deal with. However, a potential system limitation may arise if the nature of the debt portfolio evolves over time.

One clear result of the survey is that debt managers consider the ability of the DMS to interact with external IT platforms (e.g. FMIS) and within the DMO as an essential characteristic of the information ecosystem. This, however, appears to be the weakest feature of the current DMS used by the surveyed DMOs. The authors note that this might stem from the institutional weaknesses in a country rather than the software's inability to connect to other platforms.

Appendix 1: List of countries surveyed and summary of survey responses

Commercial	Public DMS	In-house
Denmark	Dominica	Brazil
France	Cyprus	Bulgaria
Georgia (*)	Fiji	Macedonia
Iceland	Ghana	Peru
Morocco	India	South Africa
New Zealand	Jamaica	Sweden
	Maldives	Turkey
	Thailand	Ukraine
	Albania	United Kingdom
	Costa Rica	
	Georgia (*)	
	Indonesia	
	Madagascar	
	Paraguay	
	Philippines	
	Trinidad	
	Vietnam	

(*): The Republic of Georgia filled two questionnaires due to separate systems being used for external and domestic debt.

1. Current Debt Management System

	Yes	No	Total
Do you currently use a software to record your debt management operations?	30	2	32
Was the software developed internally?	9	23	32

	< 1 year	1 – 5 years	> 5 years
How long have you been using your current DMS?	**2**	**6**	**24**

	Yes	No	Partially
Does the system accommodate your transaction flow (e.g. recording, payment, reporting)?	28	0	4

Assess the capacity of your DMS to process the below debt instruments pertaining to your needs	**Fully Able**	**Not Able**	**Part. Able**	**No Resp.**
Bills	28	2	2	0
Bonds (Bullet)	30	0	2	0
Bonds (Amortizing)	30	0	2	0
Variable Interest Rate Products	27	1	3	1
Inflation-linked Instruments	18	5	6	3
Project finance loans	26	1	3	2
Guarantees	21	6	4	1
On-lent Debt	23	6	2	1
Receivables (from on-lending, defaulted guarantees)	18	8	4	2
Fees	24	2	5	1
Interest Rate Swaps	15	8	7	2
Cross Currency Swaps	12	7	10	3

How many staff use the DMS?	Average	Maximum	Minimum
Front-Office Users	7	50	0
Middle-Office Users	5	27	1
Back-Office Users	11	45	1

2. Borrowing Operations (Front-Office)

Does your system:	**Yes**	**No**	**No Resp.**
Record transactions not yet committed (e.g. loan pipeline)?	21	11	0
Integrate your auction platform to the debt database?	11	20	1
Interface with external sources such as electronic trading platforms to record a transaction?	9	23	0
Integrate with market data providers (e.g. Bloomberg, Reuters, Central Bank, Eurostat, etc.)?	10	22	0
Check whether a transaction violates your compliance and limit requirements (e.g. debt strategy guidelines or budget limitations)?	9	23	0

3. Risk Analysis Operations (Middle-Office)

Does your system:	Yes	No	No Response
Connect to other software such as Excel, Matlab, etc.?	26	6	0
Decompose composite currencies, such as SDR, into original currencies?	12	18	2
Produce risk indicators (e.g. average time to maturity/refixing, share of debt to be refixed/refinanced, etc.)?	21	11	0
Provide analytical tools to perform market risk or scenario analysis?	20	12	0
Support credit risk management functions?	14	18	0

4. Debt Recording, Repayment and Reporting Operations (Back-Office)

Does your system:	Yes	No	No Response
Monitor instruments for the entire lifecycle (e.g. the recording of transactions and maintenance until maturity)?	32	0	0
Generate SWIFT messages?	10	22	0
Allow you to enter/track payment invoices from creditors?	14	18	0
Send alerts based on external events (e.g. upon receiving a payment invoice)?	8	24	0
Check calendars for holidays at the time of deal entry?	23	9	0
Support Straight-Through-Processing?	18	13	1
Produce consolidated/individual reports?	31	1	0
Support your cash management planning?	21	10	1
Connect with the Treasury management system if any?	12	18	2
Connect with the financial management information system (FMIS)?	6	23	3
Import market rates (e.g. interest rates, FX rates, etc.)?	20	11	1
Record audit trails?	24	7	1
Include security features (e.g. automatic backups, data validation controls, user hierarchy)?	29	2	1
Have a technical support and maintenance agreement/framework?	29	2	1

5. Satisfaction with Current Debt Management System

	Very S.	Satisfied	Indifferent	Unsatisfied	Very U.	No Resp.
Overall, how satisfied are you with your DMS?	6	18	4	1	1	2
Overall, how satisfied are you with the system technical support?	7	15	6	2	1	1
User-friendliness	7	14	5	5	0	1
Security of data	11	15	4	0	1	1
Reporting features	6	16	5	3	1	1

Speed	2	20	3	5	1	1
Connection with other platforms (e.g. Treasury, Excel, Bloomberg)	1	10	12	7	1	1
Integration among modules (front/middle/back offices)	4	15	5	6	1	1
Straight-Through-Processing (e.g. settlement, repayment)	7	11	9	2	1	2
Customization (e.g. ability to create new instruments/transactions)	5	14	7	2	2	2
Maintenance and upgrade cost	8	12	7	2	1	2
Access to historical information	9	18	2	1	1	1
Does your current hardware satisfactorily support the DMS?	28	0	0	0	3	1

6. Cost and Development Needs Associated with Debt Management Systems

	Yes	No	No Resp.
Do you have the appropriate systems technical support?	28	3	1
Do you think your DMS needs updating?	20	10	2
Do you have resources available to update your DMS?	22	7	3

	New	Upgrade	No Resp.
Would you prefer a new DMS or an upgrade to the existing system?	6	23	3

	< $1m	$1 - $2m	> $2m	No Resp.
What are your expectations of the total costs to update/implement a new DMS?	19	2	6	5
How much can your institution allocate toward updating/implementing a new DMS?	21	1	4	6

	< 1y	1y - 2y	> 2y	No Resp.
How long would you expect the implementation of a new DMS to take to become fully operational?	5	12	11	4

Survey Responses broken down by type of system

	Yes			No			Partially		
	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.
Does the system accommodate your transaction flow (e.g. recording, payment, reporting)?	14	7	7	0	0	0	2	2	0
Please assess the capacity of your DMS to process the below debt instruments pertaining to your needs									
Bills	13	9	6	2	0	0	1	0	1
Bonds (Bullet)	15	9	6	0	0	0	1	0	1
Bonds (Amortizing)	15	9	6	0	0	0	1	0	1
Variable Interest Rate Products	13	8	6	1	0	0	1	1	1
Inflation-linked Instruments	9	7	2	3	0	2	2	2	2
Project finance loans	15	8	3	0	0	1	1	0	2
Guarantees	14	5	2	0	3	3	2	1	1
On-lent Debt	15	5	3	0	4	2	1	0	1
Receivables (from on-lending, defaulted guarantees)	12	5	0	2	4	2	2	0	3
Fees	13	8	3	1	1	0	2	0	3
Interest Rate Swaps	6	6	3	5	1	2	3	2	2
Cross Currency Swaps	4	5	3	5	0	2	4	4	2
Does your system:									
Record transactions not yet committed (e.g. loan pipeline)?	9	8	4	7	1	3	0	0	0
Integrate your auction platform to the debt database?	5	4	2	10	5	5	0	0	0
Interface with external sources such as electronic trading platforms to record a transaction?	1	4	4	15	5	3	0	0	0
Integrate with market data providers (e.g. Bloomberg, Reuters, Central Bank, Eurostat, etc.)?	1	5	4	15	4	3	0	0	0
Check whether a transaction violates your compliance and limit requirements (e.g. debt strategy guidelines or budget limitations)?	3	3	3	13	6	4	0	0	0

	Yes			No		
	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.
Does your system:						
Connect to other software such as Excel, Matlab, etc.?	15	6	5	1	3	2
Decompose composite currencies, such as SDR, into original currencies?	7	4	1	8	5	5
Produce risk indicators (e.g. average time to maturity/refixing, share of debt to be refixed/refinanced, etc.)?	10	6	5	6	3	2
Provide analytical tools to perform market risk or scenario analysis?	11	6	3	5	3	4
Support credit risk management functions?	6	3	5	10	6	2
Does your system:						
Monitor instruments for the entire lifecycle (e.g. the recording of transactions and maintenance until maturity)?	16	9	7	0	0	0
Generate SWIFT messages?	2	4	4	14	5	3
Allow you to enter/track payment invoices from creditors?	7	3	4	9	6	3
Send alerts based on external events (e.g. upon receiving a payment invoice)?	2	4	2	14	5	5
Check calendars for holidays at the time of deal entry?	11	7	5	5	2	2
Support Straight-Through-Processing?	4	7	7	11	2	0
Produce consolidated/individual reports?	15	9	7	1	0	0
Support your cash management planning?	8	9	4	7	0	3
Connect with the Treasury management system if any?	2	5	5	12	4	2
Connect with the financial management information system (FMIS)?	3	1	2	11	8	4
Import market rates (e.g. interest rates, FX rates, etc.)?	6	8	6	9	1	1
Record audit trails?	12	7	5	3	2	2
Include security features (e.g. automatic backups, data validation controls, user hierarchy)?	14	9	6	1	0	1
Have a technical support and maintenance agreement/framework?	13	9	7	2	0	0
Do you have the appropriate systems technical support?	12	9	7	3	0	0
Do you think your DMS needs updating?	10	5	5	4	4	2
Do you have resources available to update your debt management system?	8	8	6	5	1	1

	Very S.			Satisfied			Indifferent			Unsatisfied			Very U.		
	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.	Public DMS	In-house	Comm.
How satisfied are you with your DMS?	4	2	0	7	5	6	2	1	1	1	0	0	0	1	0
How satisfied are you with the system technical support?	4	2	1	6	4	5	4	1	1	1	1	0	0	1	0
User-friendliness	5	0	2	6	5	3	3	1	1	1	3	1	0	0	0
Security of data	6	3	2	7	5	3	2	0	2	0	0	0	0	1	0
Reporting features	3	1	2	10	3	3	0	4	1	2	0	1	0	1	0
Speed	2	0	0	9	5	6	2	1	0	1	3	1	1	0	0
Connection with other platforms (e.g. Treasury, Excel, Bloomberg)	0	1	0	2	4	4	7	2	3	5	2	0	1	0	0
Integration among modules (front/middle/back offices)	3	1	0	4	5	6	4	0	1	3	3	0	1	0	0
Straight-Through-Processing (e.g. settlement, repayment)	3	4	0	2	3	6	8	0	1	2	0	0	0	1	0
Customization (e.g. ability to create new instruments/transactions)	3	2	0	7	5	2	3	0	4	2	0	0	0	1	1
Maintenance and upgrade cost	5	1	2	6	4	2	4	1	2	0	2	0	0	1	0
Access to historical information	5	3	1	9	5	4	1	0	1	0	0	1	0	1	0
Does your current hardware satisfactorily support the DMS?	14	8	6	0	0	0	0	0	0	0	0	0	1	1	1

Appendix 2: Modules of public DMS and one commercial software

CS-DRMS[17]

Evolution and Versions

CS-DRMS was first launched in 1985. Following the French version released in 1994, 3 main versions of CS-DRMS (2000+, version 1.3 and version 2.0) have subsequently been released. The current version of CS-DRMS is Version 2.3.

Cost of installation and maintenance

Commonwealth Countries:

- Cost of Installation: Free of charge
- Maintenance Fee - £1,500 per annum

Non-Commonwealth Countries:

- Cost of Installation (ranges between £24,000 for Low-Income Countries to £35,000 for High Income Countries)
- Maintenance Fee - £1,500 per annum

Modules (back-office solution)	
Loans	Record a variety of financing instruments from various external or domestic creditor sources, - (Multilateral, Bilateral and Commercial).
Securities	Record a wide range of domestic and external debt securities - Bonds (Zero and Fixed Coupon, Floating Rate, Indexed), T-Bills, Promissory Notes, and Commercial Papers)
Management Tools	Assess the cost of new borrowing, and perform "what if analysis" on their debt portfolio to check effects of debt restructuring. Sensitivity tests can also be performed on interest rates, exchange rates and exogenous economic variables under different scenarios, and the existing debt portfolio analyzed to identify 'high' cost loans for LMO.
Disbursements and Projects	Disbursement monitoring based on different disbursement methods (reimbursement, advance, direct payment, etc.). The system captures the chart of accounts and incorporates a detailed transaction-modelling feature, which allows for the recording of the various events throughout the individual transactions lifecycle. These features provide the data required for financial accounting of debt-related data.
Portfolios	Used to manage borrowing, guarantee and lending portfolios of Central Government Debt, Public enterprise, Private Sector External Debt, Sub-National Debt.
Reporting	Over 100 standard pre-formatted reports, user customized reports (report writer, aggregate report wizard, dynamic data query tool) and a dashboard with over 15 data summaries.

[17] Provided by Commonwealth Secretariat.

Interfaces and Data Exports	IFMIS Integration World Bank/IMF MTDS WB Debtor Reporting System (DRS) IMF Quarterly External Debt Statistics (QEDS – GDDS, SDDS) WB Quarterly Public Sector Debt Statistics (QPDS)
Other Key Functions	Debt Re-organization (Restructuring, Refinancing, Write-Off, Debt Conversations) Embedded Options (Interest Rate Cap, Interest Rate Collar, Currency Conversions, Prepayment) Non-Business Days

Supporting Systems	
CS-SAS (front-office solution)	CS-SAS supports the auctioning of government securities. Successful bids can be directly uploaded to the Securities module in CS-DRMS.
Horizon (middle office solution)	Decision support system enabling debt analysts to compare different borrowing strategies, implement the selected strategy through the development of an issuance calendar and analyze the impact of liability management options on the debt portfolio. System can analyze impact of various restructuring options (pre and post restructuring)

Commonwealth Meridian

Given the changes in public debt management coupled with significant advancement in technology, the Commonwealth Secretariat's Debt Management Unit (DMU) is in the process of developing a new public debt management system, **'Commonwealth Meridian'**, which incorporates advanced and improved functionalities to better address emerging debt management requirements while also taking advantage of the latest state-of-the-art technologies. Commonwealth Meridian will replace CS-DRMS and is scheduled for formal release to the general public in the first quarter of 2019. More information on Commonwealth Meridian can be found at (http://www.thecommonwealth.org/about-meridian).

DMFAS[18]

Number of versions: 6 main versions, first version launched in in 1983. Latest version is DMFAS 6 for which most recent release is 6.1.3 (distributed in April 2018).

Cost of installation and maintenance: Around $350K

Modules	
Loans module	Loans (the parties, the reference number, the date of signature drawing limit, and other characteristics such as purpose, economic sector, and classification in addition to the principal, interest and commission terms)
Debt securities module	All types of debt securities from short-term to long-term options, under the following categories: money market instruments, bonds and notes, promissory notes and others
Sukuk	Record different types of Islamic securities (short or long term)
Grants module	Record general and specific data relating to a grant
Private Non-Guaranteed External Debt module	Record and monitor data on PNED. It offers two modes for data recording: either manual (aggregated or detailed) or via import from Excel with pre-defined templates.
Short-term External Debt module	Recording short-term external debt with an original maturity of one year or less as aggregated data (manual entry or import from Excel)
On-lent Loans	Record on-lent loans and their relationship with the original loan
Auction module	Record auctions (competitive and non-competitive bids, yield, clean price, dirty price, etc. Linked to debt securities module
General agreements module	General information about frame agreements linked to related credit agreements (can then be linked to the individual agreements)
Debt reorganization module	Handles all types of debt reorganization, including refinancing, rescheduling, forgiveness, debt conversion and prepayments or buybacks for debt securities. Relationship between the old and new debt is maintained.
Mobilization and Debt Service module	Recoding real drawings on loans, grants, on-lent loans, and debt securities in addition to the debt service operations on principal, interest, commissions, and penalty interest. Budget period allocations can also be used and linked to each transaction.

[18] Provided by DMFAS team and DMFAS 6 training catalogue, April 2015.

Reports module	Generates a wide range of reports (standard and customized) for internal requirements as well as for Debt statistics, and international reporting such as World Bank reports (DRS etc.). The module provides also techniques for data control. It is aimed at debt managers seeking to set up quality control procedures for use with databases and reports (data validation reports).
Data validation module	An automated and coordinated workflow for data verification among different users. When data entry is done, notifications are sent to validators to check and confirm the data recorded.
Analysis module	Designed to calculate debt ratios, financial indicators, undertake sensitivity analysis, debt portfolio analysis, generate projections based on debt real outstanding, calculate the present value of a debt portfolio.
Security	Highly structured yet flexible system to administer users and user groups and to control and/or restrict access rights to the software modules and functions
Auditing	Extensive tracking facility of all database operations carried out by system users
Technical characteristics	DMFAS 6 is web-enabled, it can easily be interfaced with other integrated financial management systems using web services. The software is currently available in 3 languages (English, French, Spanish) and can be easily customized in other languages. Documentation and online-help are also available in the 3 languages.
Documentation	Extensive User Guides and On-help are available in the 3 languages.

WALL STREET SUITE FOR DEBT MANAGEMENT[19]

Wall Street Suite for Debt Management	
Debt recording	Information on all government debt held in a single database: Bond issuance, non-marketable concessionary finance, portfolio allocation, debt servicing profile
Active debt management	Calculation of risk figures: interest rate and foreign currency hedging strategies, portfolio rebalancing, what-if scenario analysis, debt measured at market value
Integrated debt and cash management	Integrated forecasting of revenues and expenditure: sophisticated risk figures, performance benchmarking, credit risk management
Total balance sheet management	Asset and liability management of consolidated government balance sheet: "Cost at Risk" testing of debt strategies, contingent liability management, provision of single treasury account, investment management, treasury service center

[19] One commercial solution as an example. From Wallstreet suite for debt management brochure.

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