



KINGDOM OF CAMBODIA

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Ministry of Economy and Finance

The Ministry of Economy and Finance Information Technology Architecture Framework

2024

To harmonize information technology systems within the Ministry of Economy and Finance through a decentralized digital ecosystem to achieve an efficient and effective digital transformation.

**Prepared by
The Ministry of Economy and Finance's Information Technology Council
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PREFACE

Over the last two decades, digital technology has become a vital part of economic and social activities, and it has provided new opportunities by bringing new innovative business models, increasing productivity and work efficiency, and improving public service for people and businesses. In line with regional and global trends, Cambodia also recognizes the importance of digital technology and has been preparing to grasp the opportunity to contribute toward building and developing the economy and society. On the journey toward digital transformation, the Royal Government of Cambodia has enacted many legal documents such as the “Pentagonal Strategy - Phase 1”, the “Cambodia Digital Economy and Society Policy Framework 2021-2035”, the “Cambodia Digital Government Policy 2022-2035”, the “Cambodia Financial Technology Development Policy 2023-2028”, and many other relevant policy and strategic documents.

As the Royal Government of Cambodia’s secretariat for building and developing economic and financial foundations, the Ministry of Economy and Finance has been adopting, utilizing, and promoting the digitalization and advancement of the work system. This has been set out as one of the priorities for increasing productivity and work efficiency as well as strengthening the public services in response to the policies that have been enacted. It also contributes to the government’s digital transformation. As a result, during these 10 years, the Ministry of Economy and Finance and its governed entities have built and developed many projects and information technology systems that are considered critical infrastructures for the nation. However, apart from providing many benefits for daily work, the increasing number of these systems poses new challenges for management, especially when these systems are starting to interop with each other. Hence, this requires further consideration and building a unified architecture framework as a roadmap for the digital transformation journey.

To drive digital transformation more effectively and comprehensively, the Ministry of Economy and Finance sets out the Information Technology Architecture Framework with the objective of **“harmonizing information technology systems within the Ministry of Economy and Finance through a decentralized digital ecosystem to achieve an efficient and effective digital transformation”** and with the goals of **“defining entities’ roles in managing information technology systems, developing data governance framework, developing interoperability framework, defining a standardized guide for developing and managing information technology systems, and promoting the use of common technologies and shared resources.”** This framework has three principles: (1)-The Only-Once Principle, (2)-Interoperability as an Ecosystem, and (3)-Land and Expand for Efficiency. These principles have been set out in the Cambodia Digital Government Policy 2022-2035. In addition, this framework adds six other principles, including (1)-Ownership, (2) Interoperability, (3)-Development Standards, (4)-Open Data, (5)-Common Technologies and Shared Resources, and (6)-Quality and Efficiency. These principles

must be implemented based on three approaches: **(1)**-People, **(2)**-Process, and **(3)**-Technology.

Overall, the Information Technology Architecture Framework can be considered an essential document for preparing and developing the Ministry of Economy and Finance and the Royal Government of Cambodia for digital transformation. To successfully implement this framework, relevant entities must fully participate with the spirit of proactiveness, interactiveness, ownership, and high responsibility, as well as consistently adhere to institutional values and function following the Whole-of-Government Approach and the Dynamics of the Stakeholder System.

On behalf of the Ministry of Economy and Finance and myself, I would like to thank every entity for their active participation and cooperation with the Information Technology Council until the completion of this framework. I would also like to thank His Excellency Dr. **KONG Marry**, Secretary of State of the Ministry of Economy and Finance and Permanent Deputy Director of the Information Technology Council, and members of the technical working group for putting in tremendous effort in preparing and completing this document successfully.

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ABBREVIATIONS

ACAR	Accounting and Auditing Regulator
AI	Artificial Intelligence
API	Application Programming Interface
ASYCUDA	Automated System for Customs Data
CamDX	Cambodia Data Exchange
CamDigiKey	Cambodia Digital Key
CFRSMC	Cambodia Food Reserve System Management Commission
CGMC	Commercial Gambling Management Commission of Cambodia
COBIT	Control Objectives for Information and Related Technologies
DEBC	Digital Economy and Business Committee
DMFAS	Debt Management and Financial Analysis System
DPI	Digital Public Infrastructure
EA	Enterprise Architecture
EFI	Economics and Finance Institute
EFPC	Economic and Financial Policy Committee
FMIS	Financial Management Information System
FSA	Non-Bank Financial Services Authority
GDB	General Department of Budget
GDCE	General Department of Customs and Excise of Cambodia
GDDE	General Department of Digital Economy
GDIA	General Department of Internal Audit
GDICDM	General Department of International Cooperation and Debt Management
GDR	General Department of Resettlement
GDNT	General Department of National Treasury
GDP	General Department of Policy
GDPFMIT	General Department of Public Financial Management Information Technology
GDPP	General Department of Public Procurement

GDPPP	General Department of Public-Private Partnerships
GDSNAF	General Department of Sub-National Administration Finance
GDSNR	General Department of State Property and Non-Tax Revenue
GDT	General Department of Taxation
GID	General Inspectorate Department
GS	General Secretariat
GSC	Steering Committee of the Public Financial Management Reform
GS-FSA	General Secretariat – Non-Bank Financial Service Authority
IRC	Insurance Regulator of Cambodia
IT	Information Technology
LC-MEF	Legal Council – Ministry of Economy and Finance
MEF	Ministry of Economy and Finance
NCPEC	National Committee of Productive Economy of Cambodia
NPCA	National Payment Certification Agency
NRMIS	Non-tax Revenue Management Information System
NSPC	National Social Protection Council
OBR	Online Business Registration
PFM	Public Financial Management
PFMRP	Public Financial Management Reform Program
RGC	Royal Government of Cambodia
RPR	Real Estate Business and Pawnshop Regulator
SARMIS	State Asset Register Management Information System
SERC	Securities and Exchange Regulator of Cambodia
SNEC	Supreme National Economic Council
SOC	Security Operation Center
SSR	Social Security Regulator
TR	Trust Regulator
TSC	Techo Startup Center

EXECUTIVE SUMMARY

Over the last three decades, the Ministry of Economy and Finance has served as a secretariat to the Royal Government of Cambodia in shaping and developing economic foundations aligning with local and regional contexts, as well as leading the development and implementation of policies for strengthening macroeconomics stability for economic development and livelihood enhancement. In the bigger picture, the Ministry of Economy and Finance has played an important role in transforming Cambodia from a nation that entirely relied on foreign aid for development to an independent and sovereign country that can collect, manage, and allocate its resources efficiently for strategic development. In the economic and financial sectors, the Ministry of Economy and Finance has been exerting tremendous effort in promoting the recovery of economic foundations in line with the local, regional, and global contexts, as well as taking part in leading the development and implementation of policies for strengthening macroeconomic stability. Moreover, regarding the public finance sector, the Ministry of Economy and Finance has continuously shaped and strengthened the public financial system in response to the country context while advancing toward Public Financial Management best practices.

Aligning with the global trend and the vision of previously enacted policies, the Ministry of Economy and Finance has been modernizing its work through the usage of information technology or digital technology for supporting, promoting, and driving the implementation of its policies and programs as well as the government's Public Financial Management Reform Program to ensure accountability, transparency, efficiency, and effectiveness. Significant achievements have emerged through relentless efforts and dedication, including the initiative to develop and implement various information technology systems as part of public services transformation at a national scale. Along with the achievements and excellent progress in using information technologies, new challenges have been encountered through the experience of usage and management, which need to be clearly defined, and it is necessary to establish clear directions or effective measures to address them.

The Ministry of Economy and Finance launched this Information Technology Architecture Framework with the goal of "harmonizing information technology systems within the Ministry of Economy and Finance through a decentralized digital ecosystem to achieve an efficient and effective digital transformation" and sets out the objective of "defining entities' roles in managing information technology systems, developing data governance framework, developing interoperability framework, defining a standardized guide for developing and managing information technology systems, and promoting the use of common technologies and shared resources." This framework defines three important approaches to achieve this goal and objectives: (1)-People, (2)-Process, and (3)-Technology. The Information Technology Architecture Framework upholds the concept of a decentralized digital ecosystem and aligns with

the Enterprise Architecture, which consists of four primary architecture layers: **(1)-Business Layer**, **(2)-Data Layer**, **(3)-Application Layer**, and **(4)-Technology Layer**. Principles, guidelines, and other important standards are issued at each layer, and every entity must comply accordingly.

As an implementation mechanism, every entity wishing to request the development of a new information technology system or update the existing system must prepare a proposal and submit it to the Secretariat of the Ministry of Economy and Finance's Information Technology Council for technical review and decision per provisions outlined in this framework. In addition, the Secretariat of the Ministry of Economy and Finance's Information Technology Council must lead and regularly monitor the implementation of the Information Technology Architecture Framework. The Ministry of Economy and Finance's working group responsible for the information technology and telecommunication project proposal will review the budgetary aspect of the project proposal. When the project proposal is completely prepared and met with both budgetary and technical aspects, the implementing entity can propose the project to the financing entity to obtain the necessary funding. Every entity under the guidance of the Ministry of Economy and Finance must fully participate and implement this framework with the spirit of high responsibility in order to achieve the goal that has been set out.

This Information Technology Architecture Framework is designed as a "living document" that may eventually be revised to ensure consistency and appropriateness with the advancement of technology and the changing socio-economic circumstances.



1. INTRODUCTION

1.1. Context and Concepts of Architecture Development

In the context of Industrial Revolution 4.0, the advancement of science and technology, especially digital technology, has been changing rapidly and bringing new concepts such as the digital economy, digital society, and digital government. Digital technology is considered a new catalyst for driving the growth of the economy and society and improving the efficiency of administrative work and other public services. Following these trends, the Royal Government of Cambodia (RGC) has enacted the “Cambodia Digital Economy and Society Policy Framework 2021-2035” to build a vibrant digital economy and society and the “Cambodia Digital Government Policy 2022-2035” to build and transform the government into a digital government. Moreover, the “Pentagonal Strategy - Phase 1” has included “Technology” as one of the key priorities among five priorities and has included “Pentagon 5 - Development of Digital Economy and Society” which consists of five sides. The effort through the implementation of these policies and strategies is to ensure a clear path toward digital transformation that Cambodia must achieve.

Over the last three decades, the Ministry of Economy and Finance (MEF) has served as a secretariat to the RGC in building and developing economic foundations aligning with local and regional contexts. Furthermore, the MEF has led the development and implementation of policies to strengthen macroeconomic stability, promote economic development, and enhance livelihoods. To accomplish its missions, the MEF has been using information technology (IT) and digital technology to support, promote, and drive the implementation of its policy programs as well as the RGC’s Public Financial Management Reform Program (PFMRP) to ensure accountability, transparency, efficiency, and effectiveness. Significant achievements have emerged through relentless efforts and dedication, including the initiative to develop and implement various IT systems to transform and automate tasks and deliver public services on a national scale. Entities under the MEF have begun developing IT systems to serve their daily operations and accomplish their missions more efficiently. Throughout numerous achievements, the MEF continues to operate actively with the spirit of dedication and extreme vigilance to ensure economic development and livelihood enhancement.

Recently, IT systems implementation within the MEF has gone through many stages starting from **(1)**-In a traditional approach, core tasks are carried out without using IT at all; **(2)**-In a digitization approach, the usage of IT is solely to store data for the ease of finding and retrieving them; meanwhile, core tasks are still carried out without using IT; and **(3)**-In a digitalization approach, most of the core tasks are carried out with the usage of IT systems. Currently, the MEF and RGC are in stage three, where most core tasks are carried out using IT systems, especially in key operational areas. Overall, the MEF and RGC have not yet reached the stage of

carrying out tasks fully in digital mode. In other words, they have not fully become a digital government yet. However, through relentless efforts and previous achievements, the MEF and RGC have driven Cambodia to reach the initial stage of digital transformation and provided strong foundations and excellent impacts for progressing toward complete digital transformation.

Moreover, operating and managing IT systems within the MEF involves complexities and challenges, such as system development and management, data management, and investment in developing and maintaining the systems. From an overall view of these complexities and challenges, those systems appear fragmented, lacking integration and data sharing between systems and common standards for development, operation, and monitoring. Upon closer examination, the challenges being faced include: **(1)**-Limited human resources both in quantity and technical skills, **(2)**-Limited investment and budget support for IT systems development, **(3)**-Fragmented and lacks standardization of data with the limited data sharing, **(4)**-Lack of unified standard for system development, **(5)**-Inefficiency and ineffectiveness in using network, infrastructure, and data centers, and **(6)**-Slow pace in transforming work culture.

Given the aforementioned contexts and situations, it is imperative and crucial to develop the IT Architecture Framework to harmonize existing IT systems and ensure the development and operation of relevant IT systems with clear principles and standards to serve the governed entities in fulfilling their duties. As it conforms with international best practices and technological advancement, defining all the MEF's IT systems as a digital ecosystem enables developed frameworks to be compatible with decentralized digital ecosystem architecture. In the initial phase of digital transformation, organizing the MEF's IT systems in a decentralized digital ecosystem must be established from a moderate-sized, slow, and steady, with a highly attentive mindset focusing on enhancing efficiency and productivity while minimizing threats and negative impacts. This IT Architecture Framework preparation will serve as a crucial role model and foundation for advancing the implementation of the Whole-of-Government Approach.

1.2. Scopes of the Architecture Framework

"MEF IT Architecture Framework" covers all entities under the MEF, as well as entities or institutions under guardianship and the Minister of the MEF. Entities or institutions under the guardianship of the MEF or the supervision of the Minister refer to inter-ministerial entities, permanent institutions, or other entities outside the administrative structure of the MEF but chaired by the Minister of the MEF, the General Secretariat or the Secretariat is located at the MEF or has a budget within the MEF's program budget. This framework focuses on relevant functions relating to IT system utilization and any operating, developing, and subsequent IT system development in compliance with principles within this framework.

2. STATUS OF THE MINISTRY OF ECONOMY AND FINANCE DIGITAL ECOSYSTEM

Examining the current the MEF's digital ecosystem highlights both the challenges and opportunities, serving as a solid foundation for examining and decision-making mechanisms for this architecture framework.

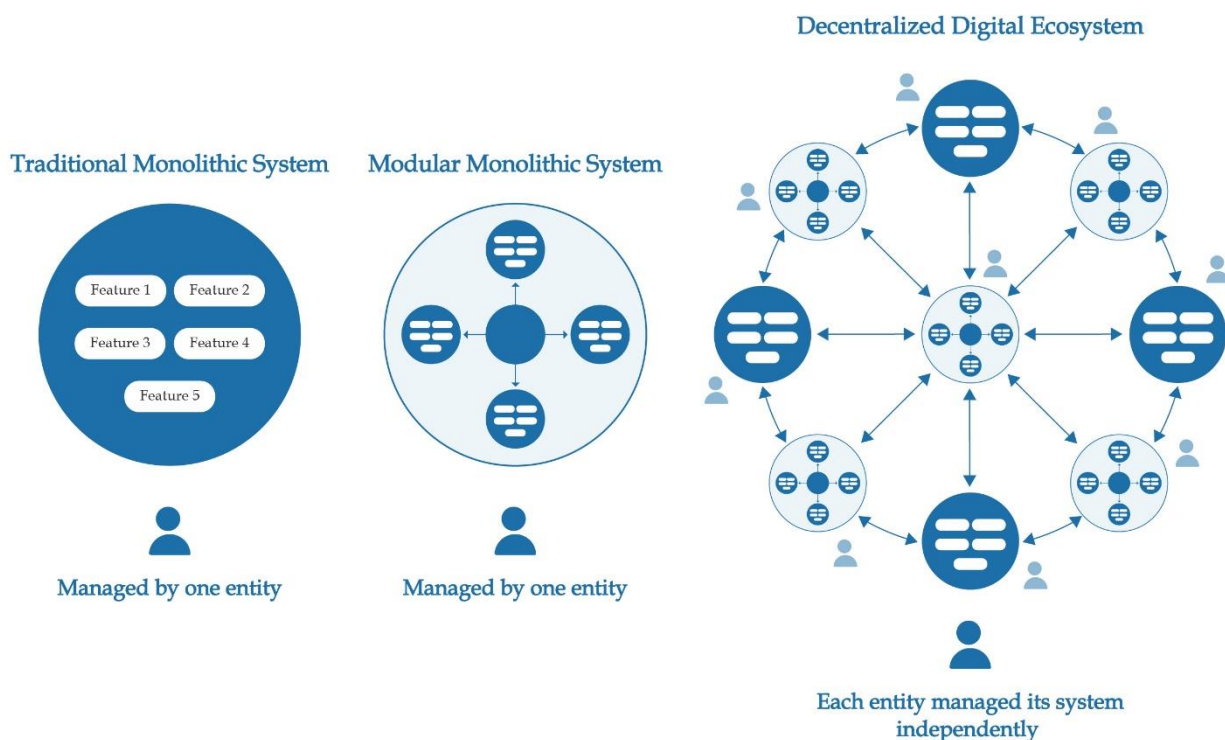
2.1. Concepts Related to Digital Ecosystem

The digital ecosystem in this architecture document refers to the interaction between entities under the MEF through the use of IT systems, applications, data, and technologies to serve the benefits of the entities as well as the MEF as a whole.

2.1.1. Digital Ecosystem

The digital ecosystem refers to a complex interaction network among individuals or institutions, businesses, systems or applications, data and technologies, as well as gaining the maximum benefits from that system. Generally, the model of developing this system can be categorized into three main types, which are (1)-Traditional Monolithic System, (2)-Modular Monolithic System, and (3)-Decentralized Digital Ecosystem (Figure 1). Each of these three models has distinct characteristics and is applied based on the specific context of each entity.

Figure 1: Comparison of Types of Digital Ecosystems



- 1)- **Traditional Monolithic System:** is a core system in which all development, operation, maintenance, and upgrades are conducted within a single core system without modular separation. This type of system is easy to develop and

implement when the entity's structure and functions are small. Additionally, it allows for easier adaptation and management as it does not require extensive inter-entity coordination. However, it has certain issues, such as difficulties in maintenance, modification, and adding multiple functionalities when the system needs to expand. It also carries a higher risk of a single point of failure during operations compared to other models.

- 2)- **Modular Monolithic System:** is a system that evolved from the Traditional Monolithic System to address some of its limitations, particularly the challenges of modification and adding multiple functionalities when the system needs to expand. The Modular Monolithic System overcomes these challenges by creating smaller modules that have independent functionalities from other modules. This approach allows for easier system modification when new modules are created or existing ones are updated. However, it also introduces three major issues: (1)-Limited independence of each module, (2)-Complexity in system scalability, and (3)-Challenges in system testing.
- 3)- **Decentralized Digital Ecosystem:** Unlike the previous two systems, Decentralized Digital Ecosystem has been developed to allow each entity's technology systems to operate independently while interfacing with one another as part of the core ecosystem. This type of system is generally used in large institutions with multiple governed entities. It offers benefits and solutions to issues encountered in Traditional Monolithic System and Modular Monolithic System. Those key benefits include increasing the ease of management, modification or addition of functionalities at each entity level, determining the rights to access and manage data, and reducing the risk of a single point of failure due to the independence between systems. However, this system also has challenges, such as difficulties coordinating workflows between entities and integrating and facilitating system-to-system interactions. Addressing these challenges requires establishing clear interoperability frameworks, along with well-defined workflows and management mechanisms.

Although the decentralized ecosystem has some negative aspects, it is becoming a popular choice for large institutions, especially those institutions with complex structures, multiple entities, and multiple functionalities. Several countries have adopted and are currently using decentralized digital ecosystems to manage their government IT systems, including the United States of America, the Republic of Singapore, the Republic of South Korea, Canada, Australia, and the United Kingdom. Giant international companies like Amazon, Netflix, and Spotify have also adopted the decentralized ecosystem. Among the three types, the decentralized digital ecosystem is the most suitable option, considering the current system usage, the

institutional structure, and the long-term vision for contributing to digital transformation for MEF.

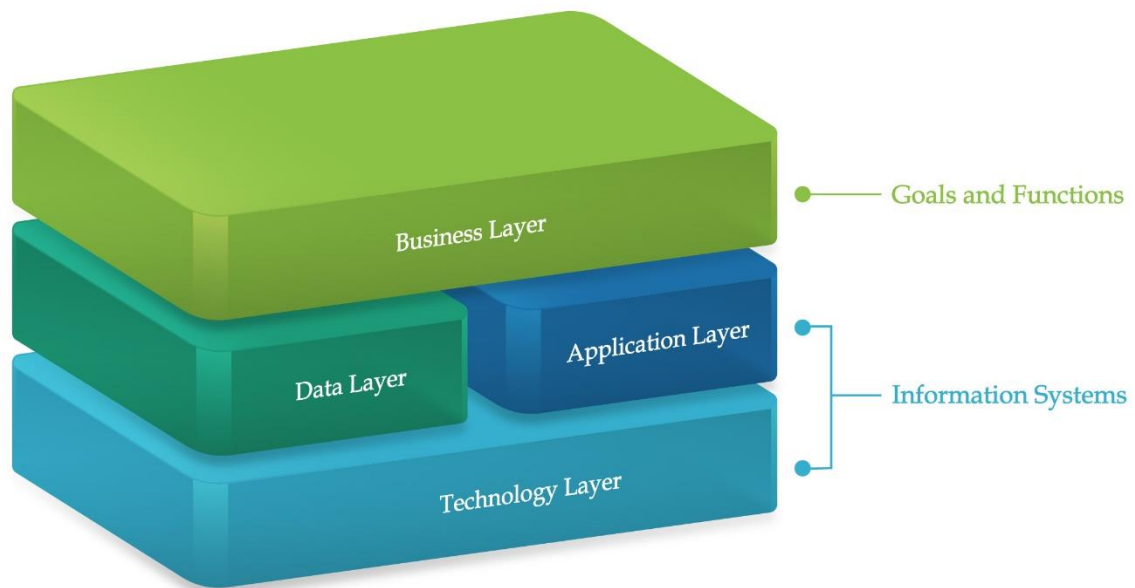
2.1.2. Enterprise Architecture

Enterprise Architecture (EA) is a conceptual framework and roadmap for organizing and optimizing the functions and operations mechanism of all stakeholders within an organization's digital ecosystem. The digital ecosystem is large and interconnected, designed to efficiently achieve the institution's objectives. In EA, "Enterprise" refers to a collection of entities within an institution, whether in the private or public sector, that share the common goal of serving the institution's benefits. Implementing EA ensures that all stakeholders align their IT systems' planning, development, and operations with established principles and standards. This alignment enables seamless interoperability between systems. Additionally, EA defines clear relationships between network connections, hardware (including servers and other IT equipment), software, and data to enhance institutional functionality and reduce unnecessary costs.

Noticeably, EA is not a new topic or a new word that was just recently invented. It has been used for over 50 years and has been through three phases along with technology advancement. EA has been initially used by large corporations, including IBM, Coca Cola and oil drilling companies. Later on, governments of several countries, such as the United States of America, Republic of Singapore, Republic of South Korea, Canada, Australia, as well as the United Kingdom began to embed Enterprise Architecture into the development and management of their technology systems to ensure efficiency in using IT to archive their missions and objectives.

After recent development, EA has been identified into four layers which are **(1)-Business Layer**, which determines the goals and objectives of the institution, **(2)-Data Layer**, which defines the development of the data governance framework to manage, share, and integrate data from all relevant systems, **(3)-Application Layer**, which defines the development, implementation, and management of systems and applications to ensure shared functionality and interoperability, and **(4)-Technology Layer**, which covers infrastructure, networks, data centers, and digital security operations. These four layers are the core structure of EA, yet institutions that use this architecture can adjust or add key components within each layer according to specific circumstances. This demonstrates the flexibility of EA, enabling institutions to adapt to their unique circumstance and context. Figure 2 below illustrates the four layers of EA.

Figure 2: The Latest Modernization of the Enterprise Architecture

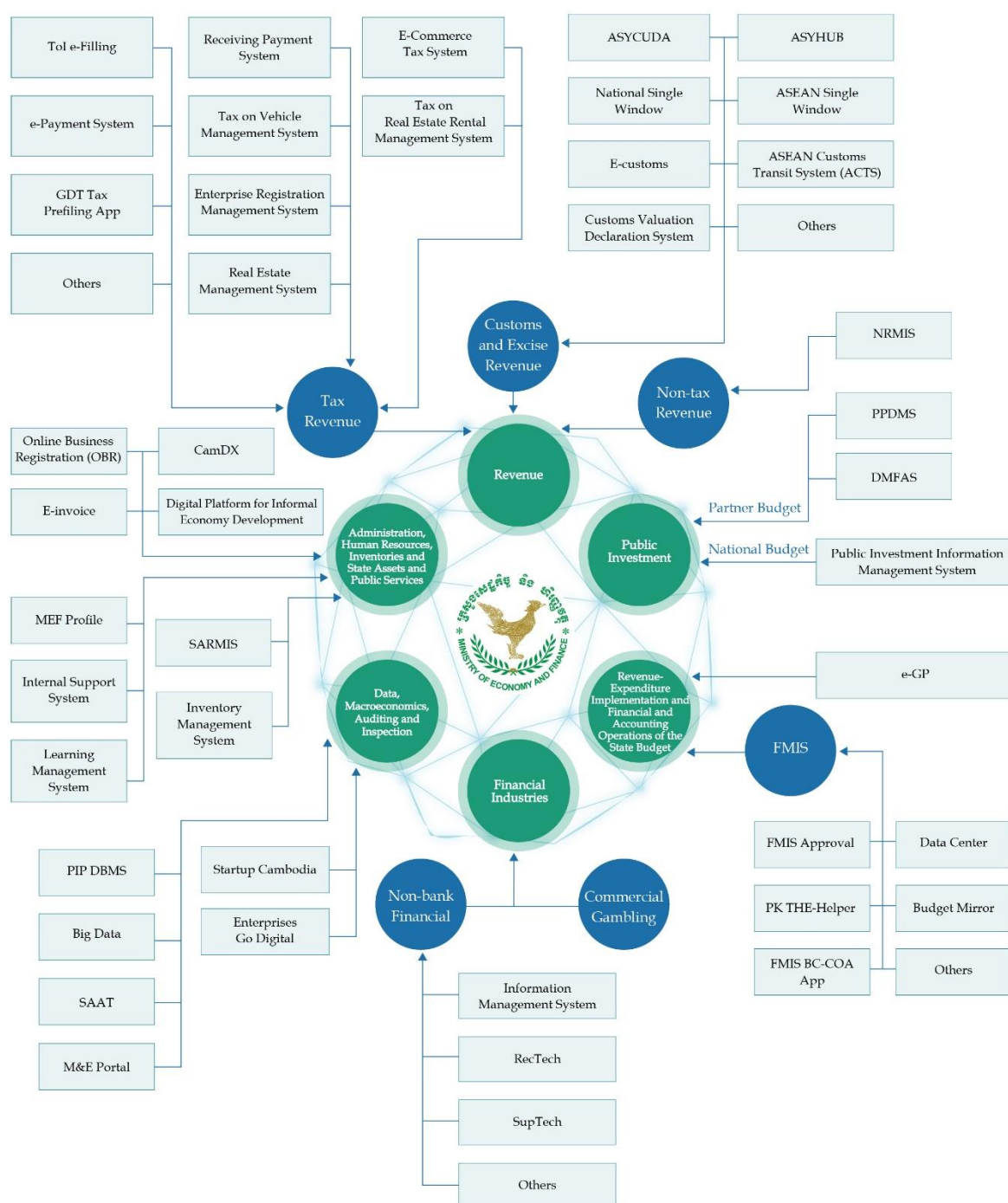


Compared to a city, EA can be seen as a master plan for developing the entire city. It requires detailed architecture for building various infrastructures, such as roads, sewage systems, water systems, electrical networks, and the overall layout of the city, along with the types of functions and services of each area within the city. Generally, a city can be divided into four major components: (1)-Zone, (2)-Human Capability and Materials, (3)-Physical Building, and (4)-Infrastructure such as roads, sewage system, water system, and electricity network.

2.2. The Study of the MEF's Current Digital Ecosystem

In early 2024, the estimation of existing IT systems within this ecosystem amounted to 200 systems, which have been crucial in driving transformation and maximizing work automation. In addition, such IT systems can be categorized based on identified six major functions, including (1)-Revenue Management, (2)-Revenue-expenditure Implementation and Financial and Accounting Operations of the State Budget, (3)-Public Investment, (4)-Financial Industries; (5)-Administration, Human Resources, Inventories and State Assets and Public Services, and (6)-Macroeconomics, Auditing, and Inspection. Figure 3 below illustrates core functionalities of IT systems in accordance to their respective functions.

Figure 3: Classification of IT Systems by Functions



All IT systems can also be classified into two groups, which include a set of IT systems responsible for PFM and another set, as the combination of these two sets is called “the Digital Ecosystem of Economics and Financial Management.”

(A) Public Financial Management Reform Program (PFMRP)

The PFMRP was officially announced for implementation in 2004 and is still being implemented today, separating it into four phases. Phase 1 was initiated in 2004, focusing on “Building Budget Credibility”, which was implemented until 2008 and

achieved noticeable key results, serving as the foundation for subsequent phases. Phase 2 began in 2009 and focused on “Building Financial Accountability,” which initially set out its 5-year action plan and extended another two years for implementation. After evaluating this 7-year implementation, RGC decided to implement the third phase from 2016 to 2022 by concentrating on “**Budget-Policy Linkages**”. As a result of nearly 20 years of implementation of these three phases, the RGC has a solid foundation to implement phase 4, focusing on “**Performance Accountability**”, which was announced in March 2023. In implementing this program, technology has been considered a key tool to drive work automation and increase work efficiency. Hence, various IT systems have been developed and utilized across relevant entities, serving their core functionalities and operations.

Financial Management Information System (FMIS) refers to the automation and integration system for managing public finance of the RGC, which encompasses budget preparation and execution, financial operation, report preparation, financial inspection and audit, etc. FMIS represents a crucial IT system of PFMRP in establishing financial transparency and accountability within every budget phase cycle, which includes (1)-Budget Preparation Phase (Budget Revenue-Expenditure Plan Preparation); (2)-Budget Execution Phase (Budget Expenditure Guarantee Request, Public Procurement Implementation, Budget Settlement, Budget Income Execution) and (3)-Budget Execution Monitoring and Evaluation Phase (via seven classifications of budget execution reports, which are Economics Classification, Administration Classification, Program Classification, Source of Fund Classification, Project Classification, Functional Classification, and Geographic Classification, as well as Performance reports) along with financial operation and accounting of state budget. In addition, FMIS has been used to support macroeconomics planning in the Medium-Term Budget Framework (MTBF), Medium-Term Fiscal Framework (MTFF), and Budget Status Forecast. Presently, FMIS is further used for inspection and audit by the National Audit Authority (NAA), the General Department of Internal Audit (GDIA), and the General Inspectorate Department, etc.

Pursuant to Article 13 of the Law on Public Financial System, promulgated on 10th March 2023, the management, preparation, execution, monitoring, and examination of implementation revenue and expenditure state budget, and financial operation and accounting of state budget as well as state property management, must be strictly used and reflected in FMIS only. Current functionalities of FMIS encompass budget planning, budget allocation, purchasing order, full procurement, account receivable, account payable, cash management, general ledger and state asset management, and inventory management, etc.

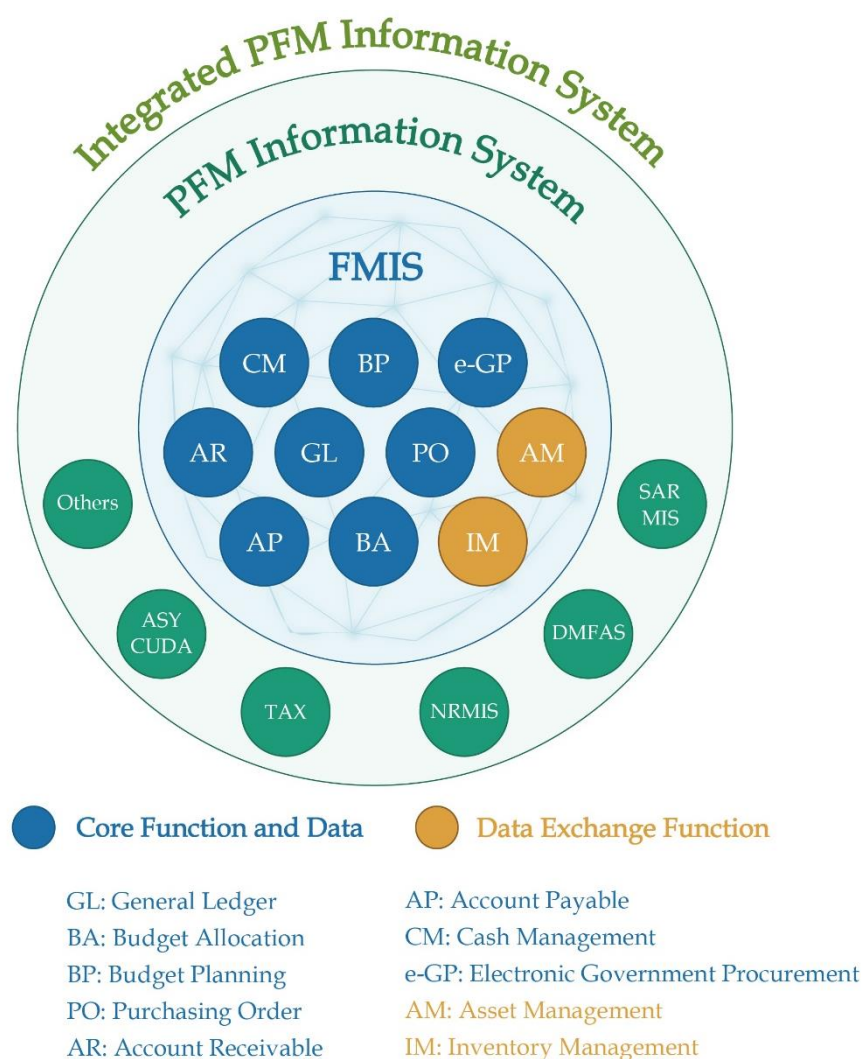
However, FMIS has not yet achieved complete development among the above-mentioned functionalities. Among those, state asset register management functionality has undergone a separate development. It is managed by the General

Department of State Property and Non-Tax Revenue (GDSNR), which is called the State Asset Register Management Information System (SARMIS). Meanwhile, inventory management is still underdeveloped. With respect to technical terms, ensuring possible integration between FMIS and SARMIS requires the activation of the Asset Management Module in FMIS. This will be a new module within FMIS. Nevertheless, this module is only applicable to some functionalities, while existing ones within SARMIS are utilized by ministries and institutions for the registration and management of state assets.

Besides FMIS, other IT systems act as satellite systems and play similar crucial roles for PFMRP such as Data Management System under the General Department of Taxation (GDT), Automated System for Customs Data (ASYCUDA) under the General Department of Customs and Excise of Cambodia (GDCE), Non-Tax Revenue Management Information System (NRMIS), Debt Management and Financial Analysis System (DMFAS) under the General Department of International Cooperation and Debt Management (GDICDM), etc. Every IT system operates based on its respective roles and responsibilities to ensure a vibrant ecosystem. Additionally, FMIS has been integrating with various IT systems such as bank statement integration with the National Bank of Cambodia and commercial banks, integration with DMFAS, ASYCUDA system, NRMIS system, civil servant pension management system under the Ministry of Civil Service, and other related IT systems.

All existing bundles of IT systems within PFMRP are identified differently. In fact, a document from the World Bank has placed a term for these collections as Integrated FMIS. In contrast, a report from the International Monetary Fund (IMF) based on an in-depth evaluation study on IT systems within PFMRP coined a new term called PFM Digital Ecosystem. Established upon these findings, **H.E. Dr. Aun Pornmoniroth, Deputy Prime Minister, Minister of MEF**, has advised and defined an appropriate term for this bundle as “**Integrated PFM Information System (I-PFMIS)**”. Figure 4 below illustrates an overview of I-PFMIS.

Figure 4: Integrated Public Financial Management Information System



(B) Sets of Various IT Systems

Apart from PFMIS, which incorporates FMIS and the above-mentioned IT systems, relevant general departments and entities under the MEF also possess IT systems capable of serving their core functions. For instance, public investment can also be divided into sets of IT systems, which involve multiple entities, including the General Department of Budget (GDB), GDICDM, General Department of Sub-National Administration Finance (GDSNAF), and General Department of Public-Private Partnerships (GDPPP). These entities operate on different budget sources for investments and distinct IT systems to fulfill their functionalities.

Furthermore, multiple supportive IT systems exist within another set relating to crucial functions like Economics and Financial Data management, Macroeconomics Forecast, Audit, and Inspection. For instance, the General Department of Digital Economy (GDDE) is developing a Data Lake for Economics and Finance. Entities with inspection and auditing duties also have their core-functioning supportive IT systems.

For example, the General Inspectorate Department uses a Financial Information Database System, and the GDIA uses the SAAT system.

At present, there are two important aspects regarding the working process within the financial industry sector: **(1)**-The non-banking financial sector and **(2)**-The commercial gambling sector. The Non-Bank Financial Services Authority (FSA) is established to integrate the mechanisms of management and supervision of the non-banking financial sector to strengthen and ensure the effectiveness of management, supervision, and development of the non-banking financial sector, including promoting the development and use of financial technology in the non-banking financial sector. FSA has six subordinate regulators and the General Secretariat as a secretariat. Furthermore, the General Secretariat and its six governed regulators operate on distinct IT systems, including data management systems, Supervisory Technology (SupTech), and Regulatory Technology (RegTech).

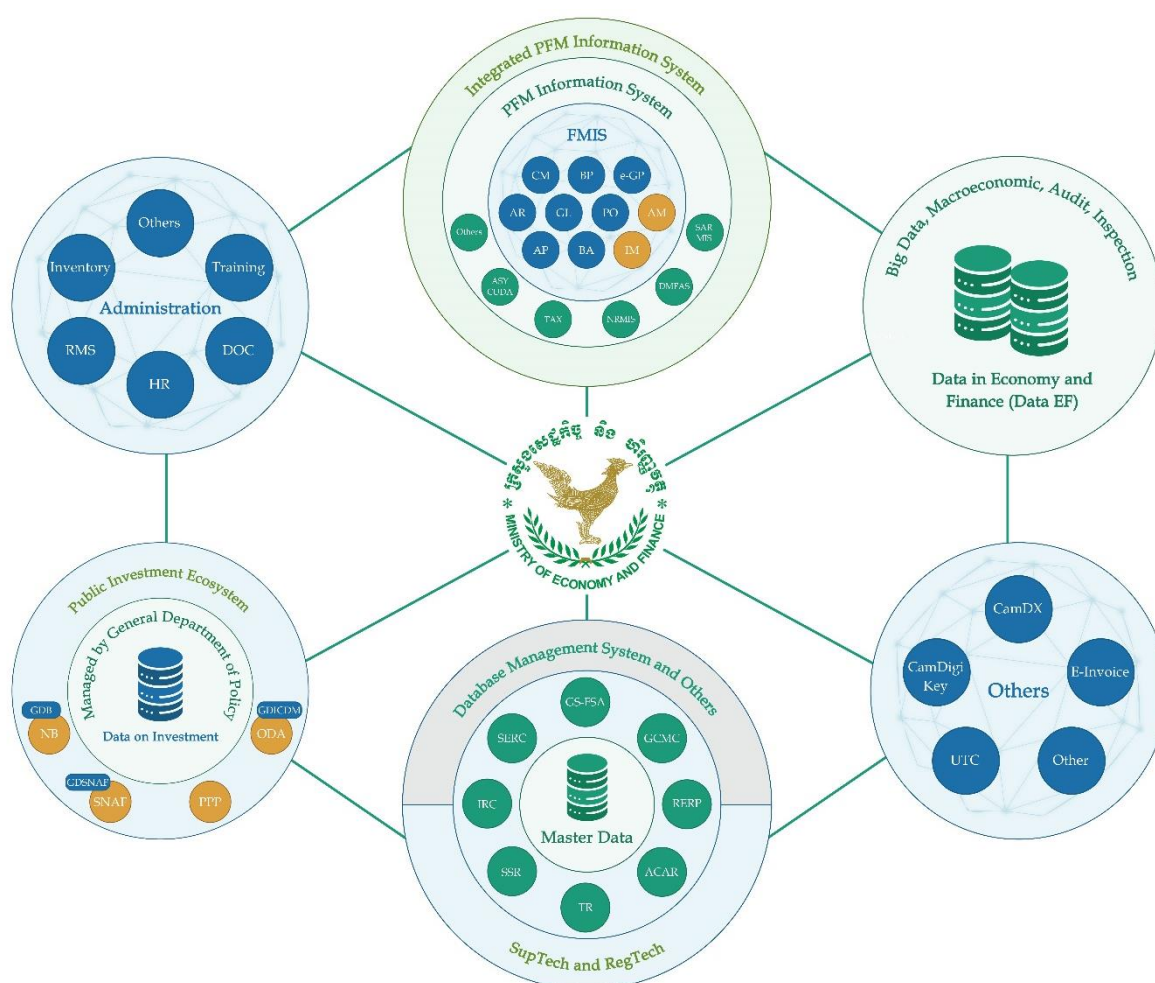
General departments and entities responsible for serving public service have been utilizing multiple systems and platforms, which comprise the Cambodia Data Exchange (CamDX), Cambodia Digital Key (CamDigiKey), Online Business Registration (OBR), and several IT systems for granting permits and licensing as well. Furthermore, GDT, GDCE, and GDPP maintain several systems that serve the provisions of public services by granting permits and licensing.

Some technologies are characterized as systems serving a common function on several work aspects, including administration, personnel and officer management, inventory management, state asset management, training, monitoring and evaluation, etc. In addition, there are other IT systems such as the Startup Cambodia platform, Enterprises Go Digital platform, Informal Economy Development Digital platform, Cambodia E-Invoicing System, and so forth.

(C) Ministry of Economy and Finance Digital Ecosystem

Both sets of existing IT systems within PFM RP and other sets of IT systems can be referred to as the “**Ministry of Economy and Finance Digital Ecosystem.**” Such IT systems are developed and operated separately; plus, some are capable of interoperability while others do not yet possess this capability. All IT systems are tasked with their distinct functions and offer significant contributions to enhancing PFM RP efficiency and managing the economy and financial sector, representing two main MEF policy objectives. Figure 5 below illustrates the MEF digital ecosystem.

Figure 5: MEF Digital Ecosystem



2.3. Challenges of Digital Ecosystem

As shown in Figure 5 above, the IT systems within MEF's digital ecosystem are divided into two main groups aligned with the objectives of the two policies. In this case, if we compare MEF's digital ecosystem to the Solar System, it consists of multiple planets, each with its role and complementing each other, collectively maintaining the stability of the entire Solar System. Based on the analysis of the MEF's digital ecosystem, the process of digital transformation has faced several challenges, such as:

- 1)- There are limited human resources, both in number and technical skill, to support IT systems' development, operation, and maintenance. The demand for human resources differs from one entity to another depending on some conditions and needs, such as the need to manage their infrastructure, the need to develop their system, and the need to operate their system. In this sense, the need for clear principles and guidelines to select and utilize human resources hinders the workflow in using IT.
- 2)- There is limited investment and budget support for the development of IT systems, leading to inefficiency and ineffectiveness. Some systems serve the

same or similar functionalities, leading to redundancy and resource wastage. Also, budget support seems overly directed toward certain entities or systems. Meanwhile, other systems still lack sufficient support to fulfill their roles and responsibilities.

- 3)- Data remains fragmented, lacks standardization, and is limited in data sharing between entities. Data sharing is not fully automated yet between systems due to the lack of an interoperability framework. The lack of a data governance framework also negatively impacts data usage and sharing for common use.
- 4)- Lack of unified standards for system development leads to system maintenance and expansion challenges. System development is mainly carried out based on the actual need and available resources without a clearly defined standard for development. A lack of clearly defined standards can cause the systems to encounter many difficulties when integrating. Moreover, the effectiveness of ensuring cybersecurity is a challenge when the development of each system does not fully comply with proper security principles.
- 5)- There is ineffectiveness and inefficiency in using connective infrastructure and data centers. Currently, only four entities operate and manage infrastructure by themselves. However, some general departments still use their infrastructure instead of switching to common infrastructure due to the lack of resources. On the other hand, the services provided by General Secretariats are still limited due to the lack of resources and staff.
- 6)- Slow pace in transforming work culture due to the unreadiness to adopt and utilize IT from some entities. Hence, those entities are not fully participating in the digital transformation pathway, causing bottlenecks in workflow that require comprehensiveness.

2.4. Rationality in Developing IT Architecture Framework

To address the above challenges and contribute to the government's digital transformation, the MEF must clearly and appropriately develop its IT architecture, aligning with international best practices and its context. IT architecture is considered the master plan and foundation for an institution's IT system development and operation. The necessity of preparing this architecture is based on the following crucial rationales:

- 1)- The MEF maintains around 200 IT systems belonging to numerous entities, bulky organizational structures, and the need for work process interoperability.
- 2)- International best practices and experiences, and the IMF 2024 study in Cambodia emphasized that adopting a decentralized ecosystem architecture conformed with the MEF's current situation as it maintained numerous governed entities and IT systems.

- 3)- The RGC enacted relevant policies and regulations, namely Cambodia Digital Economy and Society Policy Framework 2021 - 2035, Cambodia Digital Government Policy 2022 - 2035, Cambodia Financial Technology Development Policy 2023 - 2028, Pentagonal Strategy - Phase 1, along with various related policies and strategic documents. The Cambodia Digital Government Policy identified three crucial principles for implementing digital government, which comprise: (1)-The Only-Once Principle, (2)-Interoperability as an Ecosystem, and (3)-Land and Expand for Efficiency.
- 4)- In line with global trends, three fundamental platforms have been identified as Digital Public Infrastructure (DPI), which incorporate the data exchange platform, the digital identification platform, and the digital payment platform. At present, RGC holds key platforms in accordance with DPI, which include CamDX, CamDigiKey, Bakong system, and verify.gov.kh platform. These platforms functioned as digital enablers in facilitating, accelerating, and modernizing the public service delivery process and optimizing business operation efficiency within the private sector.

2.5. Positive Impacts

MEF IT architecture framework preparation must be organized through a **“Decentralized Digital Ecosystem Architecture.”** This preparation must be aligned with the current contexts of the MEF’s digital ecosystem situation, experiences, and international best practices, along with development partners' recommendations, digital enablers' availability, and policy frameworks' indications. Adopting this model will offer several beneficial impacts, such as defining clear IT systems and data ownership, enabling proper utilization of shared resources, and optimizing work and innovation efficiency.

The success of using a decentralized digital ecosystem architecture necessitates defining entities’ functions, data governance and interoperability frameworks, and possible common technologies that can be used in IT system development and infrastructure management. In this sense, adopting an EA will enable the development, operation, management, and maintenance of IT systems within the MEF to possess a clear and common model. MEF IT architecture has defined multiple elements as conforming to the enterprise architecture in which the IT system development and operation can lean on existing or common solutions. Furthermore, this architecture allows for efficient management and operation of IT system infrastructure. Noteworthily, data governance and interoperability frameworks are also necessary components for addressing plaguing challenges in data management and usage and enhancing data-driven work culture.

3. INFORMATION TECHNOLOGY ARCHITECTURE FRAMEWORK

3.1. Objective and Goals

The objective of the MEF IT architecture framework is to “harmonize IT systems within the Ministry of Economy and Finance through a decentralized digital ecosystem to achieve an efficient and effective digital transformation.”

At the same time, the goals of this framework are to “define entities’ roles in managing IT systems, develop data governance framework, develop interoperability framework, define a standardized guide for developing and managing IT systems, and promote the use of common technologies and shared resources.”

3.2. Principles and Approaches

The development and management of IT systems through a decentralized digital ecosystem allows each system to operate independently and interoperability to ensure efficient and effective performance. This framework allows for using some of the Ministry's common infrastructure or IT systems that have been built and are currently being used to the fullest extent, avoiding unnecessary investment or duplication development. In this sense, some IT systems that have common functions and are used by many other entities continue to operate and do not allow the development of systems that serve the same functions in other entities.

In line with the Cambodia Digital Economy and Society Policy Framework 2021-2035 and the Cambodia Digital Government Policy 2022-2035, this framework also follows key principles, including once-only principles, interoperability as an ecosystem principle, and land and expand for efficiency principle. In addition to these three principles, the framework adds six key common principles for implementation, including **(1)-Ownership**, **(2)-Interoperability**, **(3)-Development Standards**, **(4)-Open Data**, **(5)-Common Technologies and Shared Resources**, and **(6)-Quality and Efficiency**.

Following the above principles, the implementation of the MEF IT architecture framework must adhere to the following three approaches:

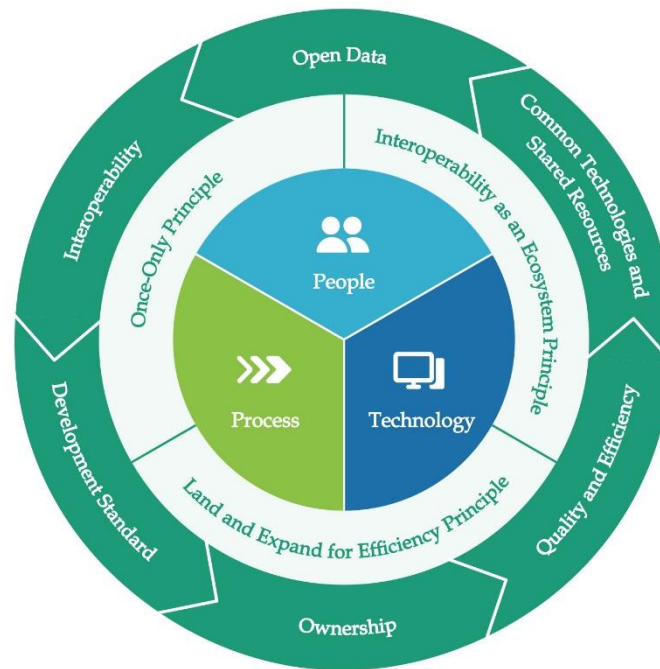
- 1)- People:** Define principles in building and using human resources for high-efficiency needs. Staff and officials must be able to use, develop, and maintain IT systems in accordance with the functions of their entity. In addition, staff and officials must have a mindset to adopt and adapt to the use of technology, especially how to work systematically through IT systems. The people approach also refers to entities under the Ministry of Economy and Finance and other stakeholders in the ecosystem of economy and finance, as well as the role of stakeholders in the ecosystem. This approach defines and sets out the principles or rules in the first layer, the business layer.

- 2)- **Process:** Define the structure of the development, operation, and management of IT systems to change how IT systems work and how they can work together. Furthermore, the process approach refers to defining a data governance and interoperability framework to ensure data exchange, use, and security. This approach defines and sets out the principles or rules in the second layer, the data layer.
- 3)- **Technology:** Identify standard devices, digital enablers, and means for developing and operating systems to ensure scalability, interoperability, and security standards for the systems. The development of IT systems needs to comply with the principles and standards set out in this framework and must have core functions in line with the functions of their entities. In addition, the use and development of IT systems must be based on infrastructure, including networks, data centers, technologies, and digital enablers. This approach defines and sets out the principles or rules in the third layer, the application layer, and the fourth layer, the technology layer.

3.3. MEF IT Architecture Framework

To develop the MEF IT architecture framework, a number of methods and tools, including a survey, face-to-face interviews, a consultative workshop, and a review of relevant documents, were conducted. The survey and face-to-face interviews using the Control Objectives for Information and Related Technologies (COBIT) 2019 framework are designed to provide an in-depth understanding of the situation of IT personnel, the roles and responsibilities of the entities, the situation of the IT system, the management of the IT system, and the situation of staff and officials for developing and operating the IT systems. In addition, a consultative workshop on data governance in the MEF digital ecosystem was organized to gain an in-depth understanding of the data available in each entity, manage data, and determine the data exchange. The workshop contributed to the development of the data governance framework and interoperability framework, which has become an essential part of the data layer of this framework. Along with the survey and face-to-face interviews, as well as workshops, sub-decrees on the establishment of general departments and entities, as well as Prakas on the organization and functioning of entities under the supervision and guardianship of the MEF, were collected and examined to understand the functions and responsibilities to be fulfilled by those general departments and entities.

Figure 6: Principles and Approaches in Implementing the the MEF IT Architecture Framework



The results from the COBIT 2019 Framework provide three key conclusions: (1)-The design of an IT system requires interaction between all units as necessary and ensures that the entities have the right to decide and manage their system and its data. In general, these entities still maintain their sovereignty, powers, and roles while actively participating in the digital ecosystem of the MEF, (2)-Transparent data sharing between organizations to increase the efficiency of the use of existing data, and (3)-The efficient use of resources and troubleshooting of IT systems through the use of existing shared resources and define clear roles and responsibilities. The results of using the COBIT 2019 framework are detailed in the Annex 2.

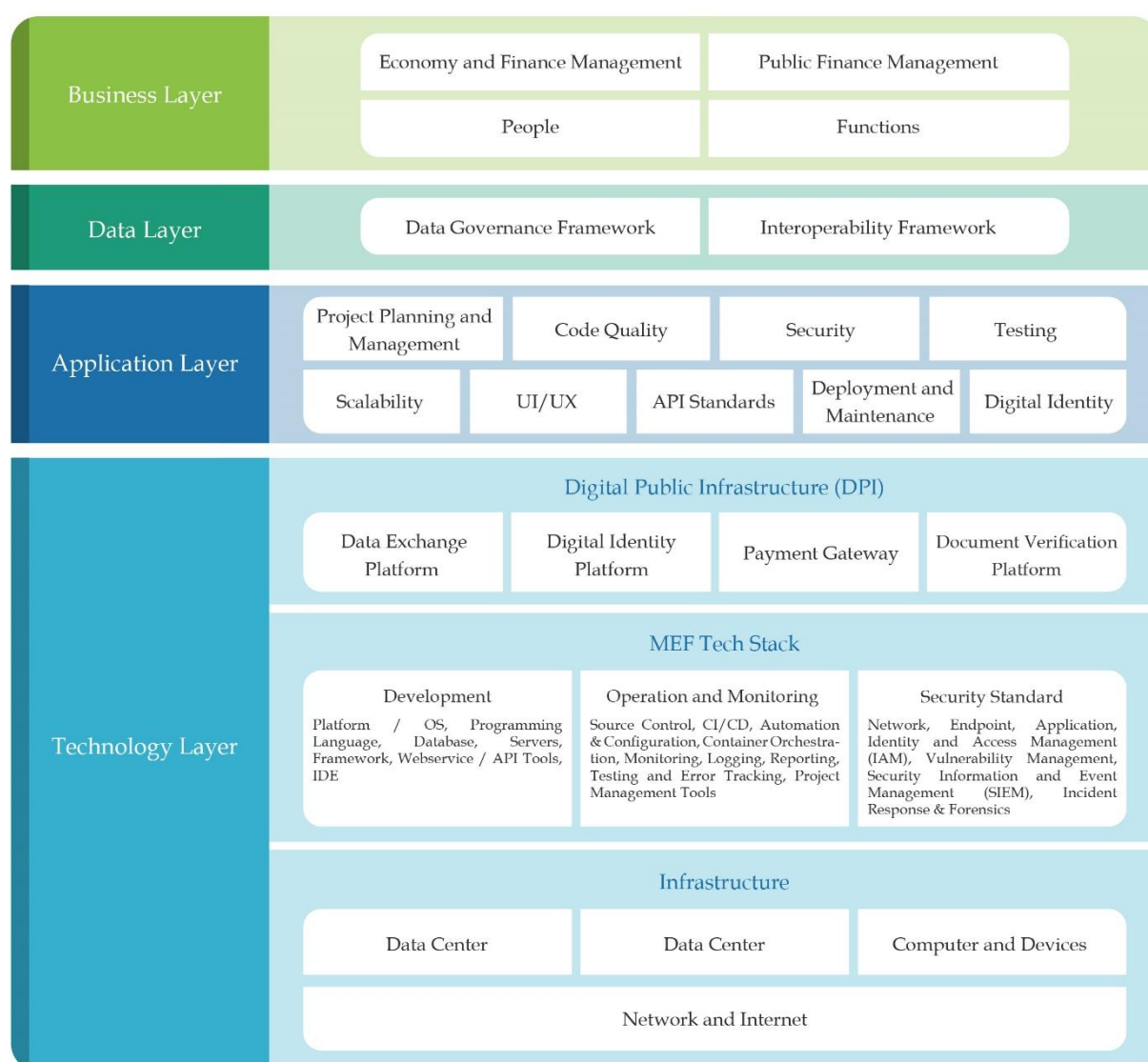
In accordance with the results of the COBIT 2019 framework, the organization of consultative workshops, and the review of other relevant documents, the MEF IT architecture framework was developed based on the enterprise architecture, which contains four layers, as shown in Figure 7 below. The principles in this framework are also composed following these four layers.

- 1)- **Business Layer:** Define the objectives and goals of the institution, functions, and human resources related to the use, development, and management of IT systems.
- 2)- **Data Layer:** Define the data governance framework to manage and share data widely and with clear principles, as well as determine the interoperability framework to integrate data in all relevant IT systems.
- 3)- **Application Layer:** Define the development, implementation, and management of IT systems and applications to ensure the use of common

functions and interoperability with each other, as well as ensure the security of IT systems.

- 4)- **Technology Layer:** Define the infrastructure, devices, and common technologies used in the process of developing and operating IT systems, as well as digital enablers that are used so that the development of IT systems has a high standard and can use shared resources to the maximum.

Figure 7: MEF IT Architecture Framework



3.1.1. Business Layer

The business layer refers to defining the objectives and goals that clearly define the functions of each entity, defining the division of functions according to the situation of the entity, as well as defining the principles of the use of human resources following the needs and resources. In this framework, the principles set out in each section in this layer include:

(A) Entities' Function: Focusing solely on the development and operation of IT systems, all entities must comply with the key principles set out in this section of the business layer.

- 1)- Comply with the division of all units under the supervision and guardianship of the MEF by dividing into three groups according to the level of use of IT, including **(1)-Full Stack**, **(2)-Development**, and **(3)-Operation**, each group has the right to develop and operate IT systems, as shown in Figure 8 and the following content:
 - **Group 1 - Full Stack:** Be able to manage and operate infrastructure and data centers and develop and operate IT systems independently.
 - **Group 2 - Development:** Be able to develop and operate IT systems independently, using the infrastructure managed by the Secretariat of MEF's IT Council or any general department in the first group.
 - **Group 3 - Operation:** Be able to operate IT systems to serve their functions, those systems being developed by other entities or hiring technology service providers to develop.
- 2)- Strengthen and organize its existing structure following the functional analysis and respond to the performance of its functions and responsibilities.
- 3)- Examine the possibility of adjusting the organizational structure and IT team following the functional analysis.

Figure 8: Level of IT Usage by Entities



(B) Utilization of Resources: The recruitment and use of human resources in IT or technical officers shall comply with the requirements of each group. Recruitment requests may also vary if the entity is added a new function. At the same time as the

mechanism of digital transformation, officials and staff who operate IT systems need to be trained in the use of technology.

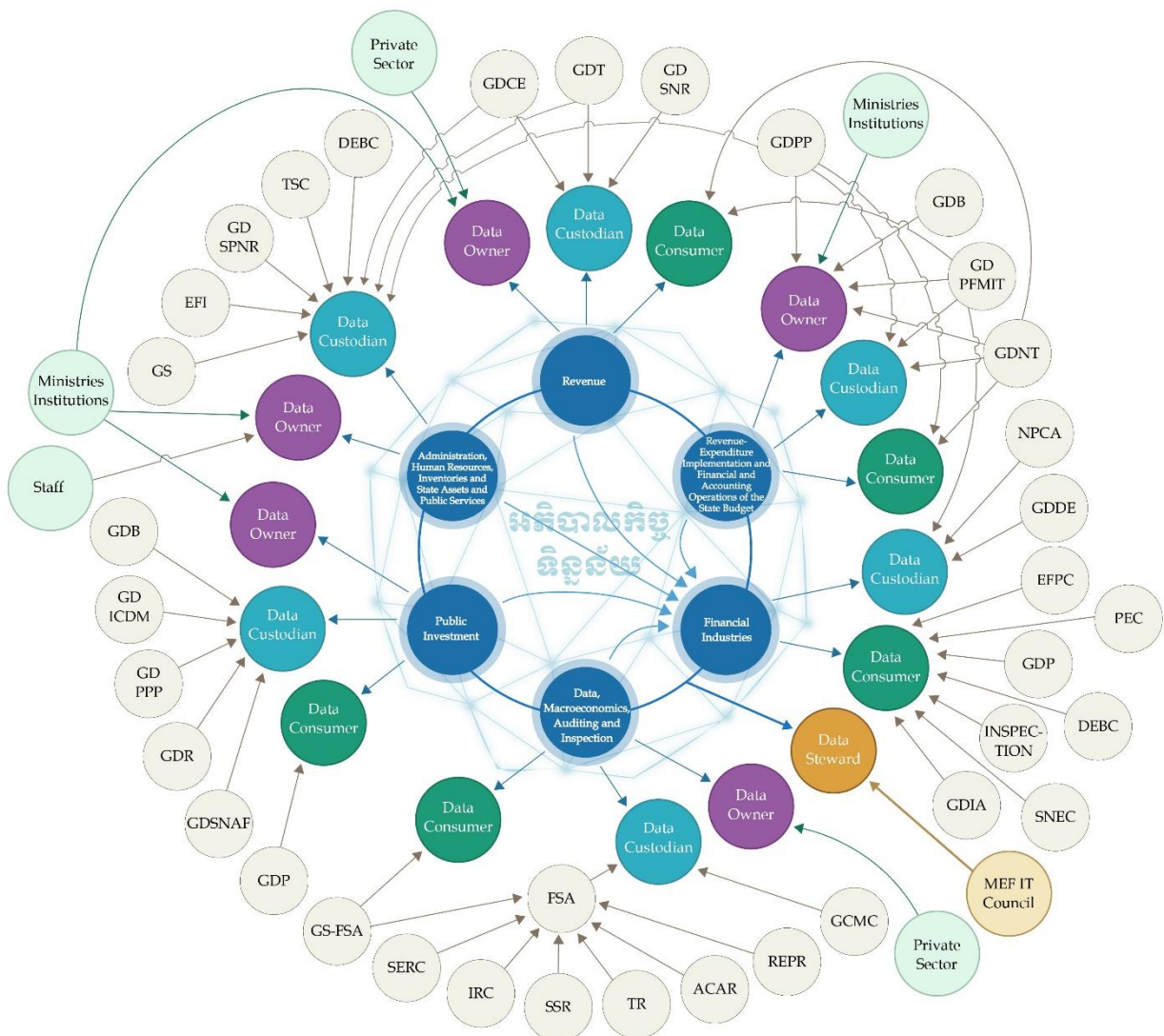
- 1)- Establish a mechanism for the selection and use of human resources in IT, in accordance with the division of the level of use of IT into the above three groups, including:
 - **Group 1 - Full Stack:** Be able to recruit IT professionals in all fields and skill sets.
 - **Group 2 - Development:** Be able to recruit IT or software development professionals.
 - **Group 3 - Operation:** Be able to recruit IT support and operations staff.
- 2)- Establish cross-organizational working mechanisms based on the principles of cooperation and efficiency to ensure effective use of resources and full mutual support.
- 3)- Build performance-based incentives in the form of financial incentives, medals, and opportunities for capacity development.
- 4)- Organize training for officials and staff, focusing on relevant and necessary knowledge and skills in accordance with the development of new technologies and definitions within the framework.
- 5)- Develop a plan for the needs of human resources or technical officers in IT and plans to build human resources to respond to the development of new technologies.

3.3.2. Data Layer

The data layer defines the data governance framework to manage and share data widely and with clear principles. It also determines the interoperability framework to integrate data in all relevant IT systems.

(A) Data Governance Framework: Refers to a set of definitions of roles, authority, processes, management, and joint decisions to collect, process, store, share, and use data properly for the entity. The 200 systems and functions of all entities under the MEF can be divided into six groups, including **(1)**-Revenue Management, **(2)**-Revenue-expenditure Implementation and Financial and Accounting Operations of the State Budget, **(3)**-Public Investment, **(4)**-Financial Industries; **(5)**-Administration, Human Resources, Inventories and State Assets and Public Services, and **(6)**-Macroeconomics, Auditing, and Inspection. Such divisions allow for a clear definition of the relationship between an entity's working process and each entity's role. Figure 9 below shows the data governance framework for the MEF, which divides the functions of all entities into six groups and defines the roles and relationships of all entities on data. Defining this data governance framework will allow each entity to be clear about its role and comply with it to share data effectively. A detailed table showing IT systems and the role of units in the data governance framework is presented in Appendix I.

Figure 9: Data Governance Framework for the MEF



In this data governance framework, roles and responsibilities on data are divided into four groups and set out the following key principles:

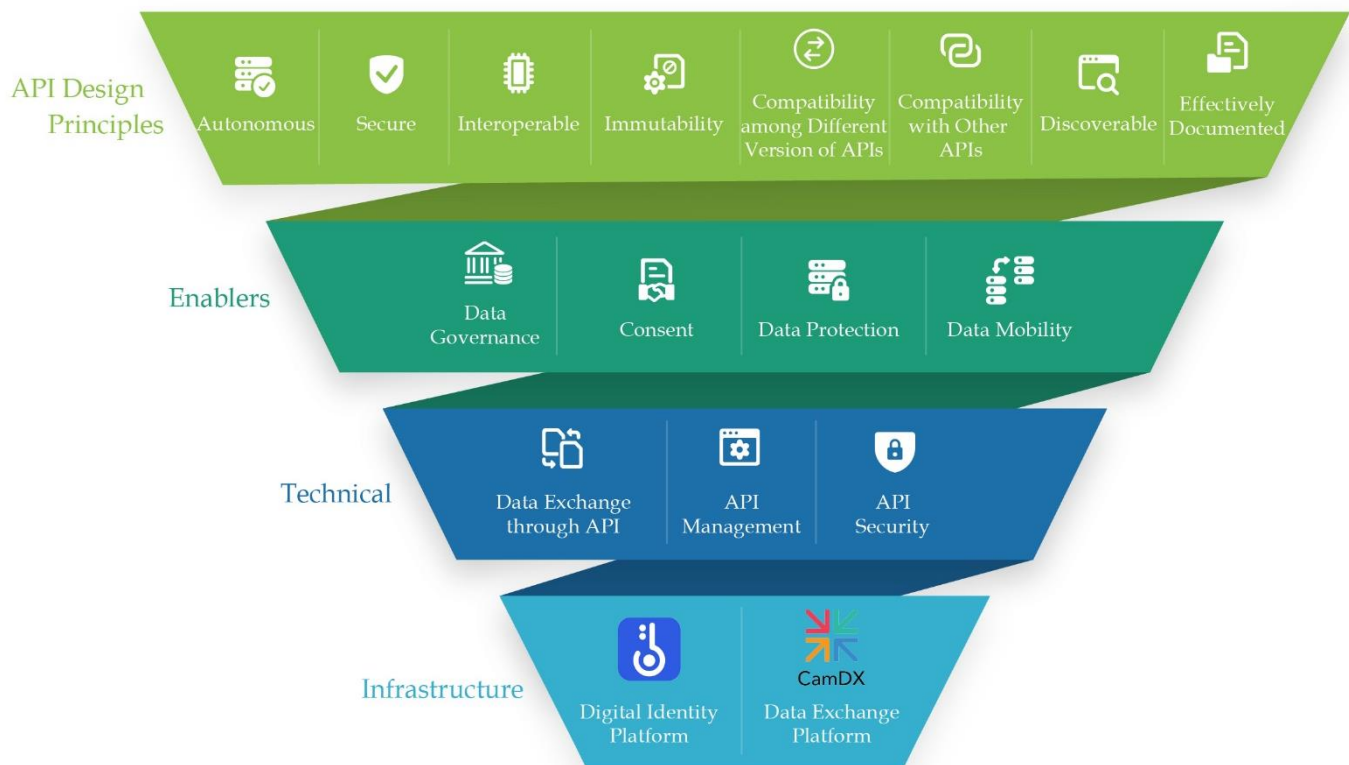
- 1)- **Data Owner:** Refers to those responsible for the content, definition, and quality of the data, as well as consent provision to the sharing of data with other persons for any purpose. In this framework, data owners can be general citizens, businessmen, companies, enterprises, and employees and officials in ministries, institutions, or relevant entities. At the same time, each entity is also a data owner for specific data such as expenditure, revenue, performance, achievements, spending plans, action plans, employees, inventory lists, etc. The principles for data owners in this framework are as follows:
 - The data owner is responsible for the accuracy and reliability of their data.
 - The data owner has the right to access, modify, and use their data as needed without preparing a formal request to the data custodian.

- The data owner has the right to grant consent for collecting, modifying, deleting, or sharing data.
- 2)- **Data Custodian:** Refers to those responsible for determining the purpose and means of collection, use, or disclosure of data. Based on the function of the entities, most entities have the role of data custodian, meaning they have the role of collecting data from users or service recipients. Most of these entities own or manage IT systems:
- The data custodian shall prepare clear instructions and request consent from the data owner for all data processing operations in its IT system.
 - The data custodian shall share data with the data consumer per the data owner's authorization and the entity's data list for exchange, which is attached in Appendix 2.
 - The data custodian shall design its IT system to ensure interoperability for data with other IT systems following the principles in the interoperability framework set out in point (b) Interoperability Framework below.
 - The data custodian shall ensure the security of the data and ensure compliance with the data usage with the interoperability framework set out in Appendix 1 and the entity's data list for exchange, which is attached in Appendix 2.
- 3)- **Data Consumer:** Refers to those who consume the data from the data owner on behalf of the data custodian or public authority.
- Data consumer is responsible for ensuring data security, trustworthiness, and ethical use.
- 4)- **Data Steward:** Refers to those who oversee, research, monitor, and promote the implementation of the agreed data governance framework.
- The data steward is responsible for developing guidelines for data management as well as assessing data quality and security.
 - The data steward is responsible for monitoring, overseeing, and promoting the implementation of the agreed data governance framework.

To illustrate the implementation process of the interoperability framework in the IT architecture framework, data in public investment projects will be taken as an example. In the implementation process of public investment projects, data on project information and the eight-stage project cycle are important data, and the ministry or institution owning the project is the data owner. The data custodian can be a number of entities such as the GDB in the case of using the national budget, the GDICDM in the case of using loan funds, the GDSNAF in the case of using sub-national funds, and the GDPPPP in the case of using partner funds, etc. The data consumers are the General Department of Policy and the Secretariat of the Public Investment Project Committee. The Secretariat of MEF's IT Council has the role of data steward.

(B) Interoperability Framework: refers to the mechanism that allows two or more IT systems to interop with each other to share data or use data from each other. Lack of interoperability is a significant obstacle in the use of IT systems for large organizations with multiple departments and multiple IT systems. In an interoperability framework, it is necessary to establish a set of standards, principles, and procedures that all IT systems must comply with in order to allow each IT system to communicate and exchange data with each other, and use each other's functions. As an international best practice, the set of standards, principles, and procedures consists of four main elements: **(1)-Application Programming Interface (API) Design Principles**, **(2)-Enabling Factors**, **(3)-Technical Specifications**, and **(4)-Supporting Infrastructure**. All organizations must review and develop their IT systems following these standards, principles, and procedures, as shown in Figure 10 and the following content. The four main elements in this set are:

Figure 10: Interoperability Framework



- 1)- **API design principles:** Technically, designing an API to be standardized and ensure interoperability requires several key elements. These include:
- **Autonomy:** Avoid dependency on any service provider or technology that makes adapting to changes and trends difficult.
 - **Secure:** Establish a set of methods consistent with clear standards and procedures to prevent and ensure security.
 - **Interoperable:** Establish APIs that are standardized, documented, and easy to use to reduce complexity for users.

- **Immutability:** Establish stable APIs over the long term by adding versions for each API, ensuring that minor changes will not break what was designed.
 - **Compatibility among Different Version of APIs:** Ensure that new API versions can still work with the same Request and Response information based on older versions without making many code changes.
 - **Interoperability with other APIs:** Ensure the API can interact well with other APIs.
 - **Discoverable:** Ensure that the API can be reused and presented in a way that is easy to discover and use for different purposes in the future.
 - **Effectively Documented:** Prepare clear and accurate documentation and instructions on how the API works and the details of the API.
- 2)- **Enablers:** Key driving factors must be clearly identified to ensure the effective implementation of the interoperability framework.
- **Data Governance Framework:** As detailed in section (A) above.
 - **Consent:** Establish a mechanism to provide consent from the data owner for all data interactions, such as storage, processing, and access.
 - **Data Protection:** Ensure that data is well protected within an interoperability framework, which is essential for maintaining trust and integrity of the system. Key points regarding data protection include:
 - **Secured by Design:** Defines data protection from the very beginning of the API design.
 - **Data Encryption:** Converts data into an unreadable form before it is transferred and stored.
 - **Hashing:** Converts data into another form of letters and numbers (String) that cannot be converted back to the original data and has a specific size. This hash value can be used as an identification (Data Fingerprint) of the original data.
 - **Tokenization:** Protects highly sensitive information by converting the information into small parts so the system or machine can reread this information.
 - **Masking:** Masks some information when sharing, especially highly sensitive information.
 - **Digital Signature:** Provides precise verification of the identity and integrity of the original data.
 - **Data is protected by law or regulation (Protected by Law):** Defined or complies with existing regulations to ensure data protection and privacy protection.
 - **Data Mobility:** Ensure the ability to transfer data from one IT system to another, as defined and required. To ensure data portability, it is necessary to have in place a number of key elements, such as:
 - **Data Replication:** Data can be copied and stored in different locations.

- **Data Relocation:** Data can change its physical storage location from one location to another.
 - **Data Migration:** Data can be moved from one system to another when there is a need to change or upgrade the system.
 - **Data Backup:** Data is backed up regularly (daily, weekly, monthly, or annually, etc.) depending on the type of data to prevent loss or to be able to restore data in the event of a disaster or damage, etc.
- 3)- **Technical Specifications:** The API design focuses on some key technical specifications, as follows:
- **Data Format for API Exchange:** Each system must define a specific data format standard to allow for API exchange. Popular data formats used for exchange include JSON, XML, Text, CSV, or File Upload, etc.
 - **API Management:** Create, manage, and monitor API usage to ensure efficiency, security, and success, adhering to the following key points:
 - **API Gateway:** Receives API requests from outside. The API requests received are determined by a policy and must be allocated to a service based on the API request.
 - **API Catalogue:** Provides an API catalog to provide detailed information about the API.
 - **API Discovery Service:** Provides a mechanism to support automatic API discovery.
 - **API Meta Information:** Provides summary information about the API that helps developers, administrators, and API users better understand the features, functions, and how to use the API.
 - **API Security:** API setup must have a policy of regular security management and protection to ensure stability, respecting the following key points:
 - Establish a mechanism to verify the user's or system's identity before allowing API requests to be made to ensure that all API access is appropriately authorized.
 - Identify potential risks and take steps to mitigate them.
 - Identify API changes through the CamDX library, including encryption, digital signing, and time stamping functions.
 - **Supporting Infrastructure:** CamDigiKey is a user digital identity platform that enables integration with other systems and allows users to easily and quickly verify their identity. Data exchange via APIs must be done through the CamDX platform, which uses security mechanisms during data exchange, including encryption, digital signatures, time stamping, etc. These digital enablers are the existing supporting infrastructure, and the technology platform is already in place to support them.

3.3.3. Application Layer

The application layer is defined as developing, implementing, and managing IT systems or applications to ensure that they are used in a common and interoperable. All IT systems that serve core and common functions must have a list of requirements and non-requirement functions. Non-requirement functions must comply with the standard principles defined in this layer. These principles are divided into major areas: project planning and management, code quality control, security, testing, scalability, user interface/user experience (UI/UX) standards, API standards, deployment and maintenance, etc. Each area defines the key principles to be followed, the standards to be used, and the tools to be used based on best practices, etc. (See Appendix 3 for details). There is no requirement for IT systems that serve operational functions to comply with non-requirement functions unless the system becomes common once. *All entities must review and develop their IT systems to comply with the following standards and principles.*

- 1)- **Project Planning and Management:** Establish a clear plan, manage the development process efficiently, and ensure effective implementation by using one or more standards and popular tools as detailed in Appendix 3.
- 2)- **Code Quality:** Ensure the quality of the code of the system, including coding in a common standard, easy to understand, easy to maintain, as well as efficient and reusable, and must consider the security, scalability, test and prepare proper documentation by using one or more standards and a choice of popular tools as detailed in Appendix 3.
- 3)- **Security:** Ensure the application is secure from common vulnerabilities.
- 4)- **Testing:** Optimize the application for performance to provide a smooth user experience and ensure the stability of systems by using one or more standards and a choice of popular tools as detailed in Appendix 3.
- 5)- **Scalability:** Design the application to scale efficiently as demand increases.
- 6)- **UI/UX:** Ensure the application is user-friendly, accessible, and visually appealing for software or application by using one or more standards and a choice of popular tools as detailed in Appendix 3.
- 7)- **API Standards:** Design, develop, and maintain APIs with best practices to ensure reliability, scalability, and ease of use by using one or more standards and a choice of popular tools as detailed in Appendix 3.
- 8)- **Deployment and Maintenance:** Ensure the smooth deployment and maintenance of the systems or applications effectively by dividing the development environments into three major components: development environment, application testing environment, and production environment by using one or more standards and a choice of popular tools as detailed in Appendix 3.

3.3.4. Technology Layer

Defines the infrastructure, technology tools, and shared technologies used in the development and operation of IT systems, as well as the digital enablers used to ensure that the development of IT systems has high standards and can maximize the use of shared resources. This layer is divided into three parts: Digital Public Infrastructure, Tech Stack, and infrastructure. *All entities must use the digital enablers, tech stack, and principles as defined below.*

Within the framework, the principles set out in each section in this layer include:

(A) Digital Enabler or the Global Trend Called Digital Public Infrastructure

(DPI): refers to the of key digital enablers, which are the essential foundations for digital transformation, and there are at least three digital infrastructures that IT systems must be used, including **(1)-The Data Exchange Platform, (2)-The Digital Identity Platform, and (3)-The Digital Payment Platform.** These three digital enablers are a global trend that determines the requirements for developing government technology. In particular, in the case of Cambodia, the fourth digital enabler is document authentication. In this sense, entities under the advice and guardianship of the MEF must use the four digital enablers described below.

- 1)- Use CamDX to exchange data for all IT systems that have data exchange functions.
- 2)- Use CamDigiKey to identify the user's identity for all IT systems that have digital identification functions.
- 3)- Use the payment system of a bank or financial institution that is part of or a member of the Bakong system for digital payment to all IT systems that have payment functions.
- 4)- Use the verify.gov.kh portal to digitally authenticate documents for all IT systems that have document verification functions.
- 5)- Review and research other emerging digital enablers to further define and implement them according to actual situations and needs.

(B) MEF Tech Stack: Refers to the determination of the use of some existing technologies to facilitate the development and operation of IT systems to be developed under the MEF. This section defines a list of existing technologies according to the IT system lifecycle, starting from development, testing, implementation, monitoring the operation, monitoring the security, and data backup. This tech stack is divided into three parts, including **(1)-Development Tech Stack, (2)-Operation/Monitoring Tech Stack, and (3)-Security.** The use of tech stack or existing technologies is aimed at ensuring that all IT systems have a similar modernization and digital security system and that software development teams from different general departments can work together and are easy to train and support. New IT systems that serve core and

common functions must comply with the principles defined in this layer, and legacy IT systems must be gradually modified to comply with these principles.

- 1)- Develop all systems by selecting tools relevant to key areas, such as operating systems, programming languages, databases, servers, and data exchange systems (Webservices), as detailed in Appendix 4.
- 2)- Operate and monitor all IT system operations by selecting tools relevant to key areas, such as tools for project management, code management, and access control to IT systems, testing and error tracking, reporting, etc., as detailed in Appendix 4.
- 3)- Comply with security standards by selecting tools that are relevant to key areas, such as network connectivity, IT system development, identity and access management, vulnerability management, security and event information management, incident response and forensics, etc., as detailed in Appendix 4.
- 4)- Regularly research and review new technological developments such as artificial intelligence, blockchain, cloud technology, and other emerging technologies to update the technologies identified in the tech stack.

(C) Infrastructure: Define the use and management of common computers, shared networks, and use of data centers and disaster recovery data centers. Computers or technology devices should be able to be used as a means of accessing IT systems under the MEF. Regarding security, these computers are used only for the entity's functions, not for personal use. The design and operation of the data center shall be shared, except for the GDT, the GDCE, and the General Department of Public Financial Management Information Technology (GDPFMIT), which previously managed a separate personal data center. The other general departments are to use the shared data center, which is managed by the Secretariat of the MEF's IT Council. Using a disaster recovery data center already includes policies and must be complied with.

- 1)- The Secretariat of MEF's IT Council is responsible for managing the shared infrastructure, including the management of the network, data centers, data recovery centers, servers, etc., to serve the operations of all entities under the MEF.
- 2)- The GDT and the GDCE, which are operating their respective infrastructures, will continue to manage and operate that infrastructure, except for data recovery centers to be used jointly and managed by the Secretariat of MEF's IT Council.
- 3)- The GDPFMIT shall plan to relocate the current data center to a joint location managed by the Secretariat of MEF's IT Council.

- 4)- All general departments and entities that do not have their own infrastructure will use the shared infrastructure, which is managed and supported by the Secretariat of MEF's IT Council.
- 5)- Computers or devices meant for using IT systems must clearly define the security conditions and be used to serve the entity's functions.

Unofficial Translation

4. IMPLEMENTATION, INSTITUTIONAL, AND BUDGETING MECHANISMS

Implementation, institutional, and budgeting mechanisms shall be specific to ensure the effective and efficient implementation of the MEF IT Architecture Framework.

(A) Implementation Mechanism

During the implementation, in cases where an entity requests the development of an IT system to streamline its operations in line with the functional analysis, the institution can develop the system as requested. Hence, the entity must draft a project proposal following the six stages depicted in Figure 11 below. **First**, the entity, in its role as a data owner and custodian, needs to clearly determine the system's functional requirements, which serve the entity's objective and mission. **Second**, the entity needs to identify shareable data in line with the data governance framework at the data layer. Simultaneously, the system development entity must set up the system following the interoperability framework to ensure that, once developed, the system can interoperate with other systems. **Third**, the system development entity must check the functional requirements determined in the first stage, along with the data governance and interoperability frameworks determined in the second stage, and add any non-functional requirements following the guidelines in the program layer. **Fourth**, the system development entity must check that the planned system requires which functions are available within the government's digital enablers or public digital infrastructures. For instance, the system must use CamDigiKey if need of a user identification function, CamDX if need of a data exchange function, and Bakong if need of a payment function. **Fifth**, the system development entity must check and select technologies, applications, or tools determined in the technology layer to ensure that the developed system follows advanced technology and safety standards. **Last**, the system development entity must work with the Secretariat of the MEF's IT Council to launch the system in the shared infrastructure. In cases where the entity manages its infrastructure, it must also check and work with the Secretariat of the MEF's IT Council to determine aspects needed for shared operation, including the security operation center aspect. In this regard, the developed system will encompass complete functional requirements as determined, utilize shared resources, follow rightful technology standards and demonstrate full capability to interoperate in data exchange, and provide convenience for security operation center team when conducting system safety check.

Figure 11: IT System Development Stages in Accordance with the Framework



According to the above stages, even if the entity develops its own IT system, hands it over to another entity under the guardianship or purview of MEF to develop, or outsources to a technology service provider to develop, the IT system must comply with the IT Architecture. Furthermore, based on the principle of IT system development through a decentralized ecosystem, the system must operate independently and be able to interoperate with other IT systems. Therefore, the system must not integrate into existing systems through traditional or modular monolith systems.

Beyond the abovementioned stages, entities must implement further important points as follows:

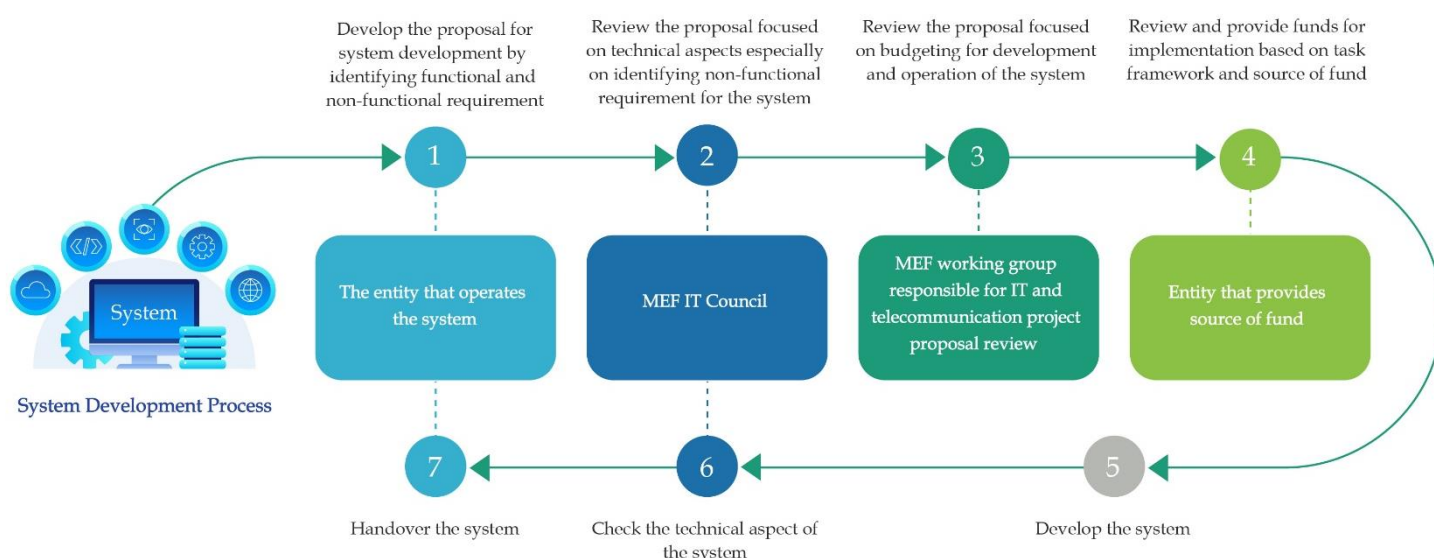
- 1)- For an existing IT system, gradual updates and modernization must follow a specific timeline to ensure the system adheres to determined principles and standards.
- 2)- For an outdated IT system, there must be a request for new system development to respond to this architecture framework, and the request must adhere to the procedures of a new project proposal.
- 3)- The data of a previous IT system that requires new development must be stored and transferred to the newly developed systems.
- 4)- All entities must develop plans for the updates and modernization of an existing system or request for a new IT system to replace the previous system within the short-term (1 year), medium-term (3 years), and long-term (5 years) based on actual needs and priorities.

Based on the above-mentioned implementation mechanism, all entities must introduce implementation plans for executing, managing, and developing IT systems determined in Annex 5.

(B) Institutional Mechanism

After the project implementation entity completes the project proposal for IT system development, the proposal will be submitted to the Secretariat of MEF's IT Council to review technical aspects, especially those relevant to determining non-functional requirements and utilizing shared resources for system development and operation. Upon the clear determination of such technical aspects for system development, the project implementation entity must submit the proposal with both technical and budgeting aspects to the MEF working group responsible for IT and telecommunication project proposal review to assess budgeting aspects in detail. Once the proposal is ready and correct in technical and budgeting aspects, the project implementation entity can submit the proposal to the financing entity for budget allocation. Multiple financing entities can exist based on the task framework and source of funds, including subnational budgets, loans, partnership budgets, and other legal sources. For example, the proposal for IT system development under I-PFMIS can be submitted to the Steering Committee of Public Financial Management Reform (GSC) for budget allocation. Other proposals can be submitted to the GDB for national budget allocation, to the General Department of International Cooperation and Debt Management for loan allocation, or to the GDPPP for partnership budget allocation. Before launching the developed system, the project implementation entity, as a system owner or developer, must work with the Secretariat of the MEF's IT Council to monitor system compliance and ensure that it aligns with this architecture framework. Figure 12 below shows the institutional and implementation mechanisms of the IT architecture framework.

Figure 12: Institutional Mechanism for Implementing the IT Architecture Framework



Apart from the implementation mentioned above and institutional mechanisms, institutions under the guardianship and purview of the MEF can develop comprehensive implementation frameworks or guidelines for internal use and follow the principles outlined in this framework. For instance, the independent FSA can develop implementation frameworks for each regulator and institution, using the principles outlined in this framework.

Unofficial Translation

5. CONCLUSION

Based on the clear foundation of leveraging IT to enhance work efficiency across all entities and in contribution to the RGC's digital transformation journey, MEF has set out the **MEF IT Architecture Framework** to harmonize IT systems in MEF through a decentralized ecosystem to facilitate the functional performance of entities under its purview towards enhancing work efficiency and to contribute to the government's digital transformation. The principles to implement this framework will follow the Cambodia Digital Economy and Society Policy Framework 2021-2035 and the Cambodia Digital Government Policy 2022-2035. This framework's approach identifies three important components: **(1)-people**, **(2)-technology**, and **(3)-process**. The MEF IT architecture has been considered highly realistic, thoroughly taking into account the contemporary landscape of IT system utilization, international best practices in IT system management, recommendations from relevant partners, and consultations with all entities under the guardianship and purview of MEF. This establishes a strong foundation for introducing IT architecture to address the challenges confronted and enhance work efficiency.

This framework aims to determine the institutional functions of IT system management, design the data governance and interoperability frameworks, develop guidelines as standards for IT system development and management, and encourage the utilization of common technologies and shared resources. To ensure alignment with the Cambodia Digital Economy and Society Policy Framework 2021-2035 and the Cambodia Digital Government Policy 2022-2035, the IT Architecture Framework also follows the once-only principle of data entry, the principle of interoperability as an ecosystem, and the principle of land and expand for efficiency. In addition to the three principles, this framework adds six more principles for implementation, namely ownership, interoperability, development standard, open data, common technologies, shared resources, as well as quality and efficiency.

Enterprise architecture is utilized and adapted according to the actual context in which there exists four significant layers: **(1)-Business** layer defines the entity's objective and goal, **(2)-Data** layer defines the establishment of the data governance framework for management and dissemination as well as interoperability framework for data integration among all relevant IT systems, **(3)-Application** layer defines the development, operation, and monitoring of IT systems and applications to guarantee the utilization of shared functions and interoperability as well as safety for IT systems, and **(4)-Technology** layer defines infrastructure, technology tools, technologies used for operating IT systems, and digital enablers which are all needed for equipping the developed IT system with common standards and shared resources. Under each layer exists shared principles and standards for all entities to follow, aimed at realizing the set objective and goal.

The Secretariat of the MEF's IT Council functions to lead, facilitate, and frequently monitor the implementation of this IT architecture framework. All entities under the purview and guardianship of MEF must participate in the implementation with high accountability, aimed at achieving the outlined objective. The MEF IT Architecture is considered a "**living document**" that may eventually be revised to ensure consistency and appropriateness in line with technological advances and the actual evolution of the socio-economic situation.



Unofficial Translation

Unofficial Translation

Appendix 1: Systems and the Functions of Entities Within the Data Governance Framework

N.	Functions	Systems	Data Owner	Data Custodian	Data Consumer
1	Revenue Management	e-Tax Services	Private Sector, Ministries and Institutions	GDT	
2		e-Filing for Web Application	Private Sector	GDT	GDNT
3		Tax on Income - ToI e-Filing	Private Sector	GDT	GDNT
4		e-Commerce Tax System	Private Sector	GDT	GDNT
5		e-Payment System	Private Sector	GDT	GDNT
6		Incentive Request Management System	Private Sector	GDT	GDNT
7		Custom e-Services	Private Sector	GDCE	
8		ASYCUDA	Private Sector	GDCE	GDNT
9		ASYHUB	Private Sector	GDCE	GDNT
10		e-Customs	Private Sector	GDCE	GDNT
11		ASEAN Single Window (ASW)	Private Sector	GDCE	GDNT
12		National Single Window (CNSW)	Private Sector	GDCE	GDNT
13		ASEAN Customs Transit System (ACTS)	Private Sector	GDCE	GDNT

14		Global Travel Assessment System (GTAS)	Private Sector	GDCE	GDNT
15		NRMIS	Private Sector, Ministries and Institutions	GDSNR	Ministries and Institutions, GDNT
16	Revenue-Expenditure Implementation and Financial and Accounting Operations of the State Budget	FMIS	Ministries and Institutions, GDB, GDNT, GDPP, GDPFMIT	GDB, GDNT, GDPP, GDPFMIT	GDNT, GDP
17		e-GP	Ministries and Institutions	GDPP	GDNT
18	Public Investment	PPDMS	Ministries and Institutions	GDICDM	Ministries and Institutions
19		DMFAS	Ministries and Institutions	GDICDM	Ministries and Institutions
20		Public Investment System	Ministries and Institutions	GDB	Ministries and Institutions
21	Financial Industries	Supervisory Technology (SupTech)	Private Sector	F.S.A, Regulators	GS-FSA
22		Regulatory Technology (RegTech)	Private Sector	F.S.A, Regulators	GS-FSA
23		Licensing System in Commercial Gambling	Private Sector	CGMC	CGMC
24		MEF Profile	Entities under MEF	GS	GS

25	Administration, Human Resources, Inventories and State Assets and Public Services	State Asset Management in MEF	Entities under MEF	GS	GS
26		SARMIS	Ministries and Institutions	GDSNR	GDNT
27		Learning Management System	EFI	EFI	GS
28		OBR (Phase 1)	Private Sector	GDT, MOC, MLVT	GDT, MOC, MLVT
29		OBR (Phase 2 & 3)	Private Sector	Ministries and Institutions	Ministries and Institutions
30		Licensing System	Private Sector	GDT	GDT
31		Licensing System	Private Sector	GDCE	GDCE
32		CamDX	Private Sector, Ministries and Institutions	Private Sector, Ministries and Institutions	Private Sector, Ministries and Institutions
33		Digital Platform for Informal Economy Development	Private Sector	MISTI	Ministries and Institutions
34		E-invoice System	Private Sector	GDDE	Private Sector, Ministries and Institutions
35	Data, Macroeconomics, Auditing and Inspection	PIP DBMS	Ministries and Institutions	GDP	GDP
36		Startup Cambodia	Private Sector	TSC	Private Sector, Ministries and Institutions

37		Enterprises Go Digital	Private Sector	TSC	Private Sector, Ministries and Institutions
38		SAAT	Entities under MEF	GDIA	GDIA
39		M & E Portal	Ministries and Institutions	DEBC	Ministries and Institutions
40		Data EF	Ministries and Institutions	GDDE	Ministries and Institutions
41		Patient Management and Registration System (PMRS)	Health Care Provider	NPCA	NSPC

Appendix 2: List of Data for Exchange from Entities

Data Fields	Data Types	Roles	Frequency	Approach	Sensitivity
1. Revenue Management					
1. General Department of Taxation					
I. Chart of Account (COA)					
National Budget Revenue					
1. Tax on Income - Tax on Income (Individuals) - Tax on Income (Legal Entities) - Tax on Salary - Tax on Gross Sales - Value Added Tax	Transactional	Data Custodian	Monthly	API	Internal
2. Specific Tax - Specific Taxes on Certain Merchandises - Specific Taxes on Certain Services - Penalty Taxes	Transactional	Data Custodian	Monthly	API	Internal
Sub-national Budget Revenue					
1. Tax on Rental of Movable and Immovable - Tax on Rental of Movable and Immovable (Individual) - Tax on Rental of Movable and Immovable (Legal Entities) - Public Lighting Tax	Transactional	Data Custodian	Monthly	API	Internal

- Accommodation Tax - Slaughter Tax - Patent Tax - Tax on Means of Transportation					
2. Registration Tax Base - Registration Tax on the Transfer of Ownership or Possession of The Property - Registration Tax on the Transfer Vehicle and Transportation Ownership - Registration Tax on Transferring Shares - Registration Tax on the Contract of the Supplies of Goods and Services - Registration Tax on Legal Documents	Transactional	Data Custodian	Monthly	API	Internal
3. Tax on Immovable Properties - Tax on Immovable Properties (Individual) - Tax on Immovable Properties (Legal Entities) - Unused Land Tax - Tax on Stamp	Transactional	Data Custodian	Monthly	API	Internal
Non-tax Revenue					
- Selling documents, documents and other printed materials - Benefits from Establishing Enterprises - Registration Tax Fee - Revenue on Vehicle and Boat Registration	Transactional	Data Custodian	Monthly	API	Internal

- Other Financial Benefits					
II. Revenue by Types of Taxpayers					
- Larger Taxpayer - Medium Taxpayer - Small Tax Payer - Others (Tax on Rental House-Land, Registration Tax Base on Immovable Properties and Vehicles, Tax on Immovable Properties, Unused Land Tax, Penalty on such taxes)	Transactional	Data Custodian	Monthly	API	Internal
III. Revenue by Branches (Data from FMIS)	Transactional	Data Custodian	Monthly	API	Internal
IV. ព័ត៌មានក្នុងសលាកបត្រចំណូល (Data from FMIS)	Transactional	Data Custodian	Monthly	API	Internal
V. Registered enterprise data					
- Business's Name in Khmer - Business's Name in Latin - Main Business Activities - Address - Phone - Taxpayer Identification Numbers - Forms of Business - Business's Status - Amount of Patent Tax	Base Registries	Data Custodian	Monthly	API	Internal
VI. Data on declaration and payment of patent tax	Base Registries	Data Custodian	Monthly		Internal
- Business's Name in Khmer	Base Registries	Data Custodian	Monthly	API	Internal

- Business's Name in Latin - Main Business Activities - Address - Phone - Taxpayer Identification Numbers - Forms of Business - Business's Status - Amount of Patent Tax					
2. General Department of Customs and Excise					
ព័ត៌មានសលាកបត្រចំណូល	Transactional	Data Custodian	Monthly		Internal
3. General Department of State Property and Non-Tax Revenue					
Revenue Data	Transactional	Data Custodian	Monthly	API	Internal
Revenue by Types of Service	Transactional	Data Custodian	Monthly	API	Internal
Revenue by Ministries and Institutions	Transactional	Data Custodian	Monthly	API	Internal
Companies and Legal Entities Data	Base Registries	Data Custodian	Monthly	API	Internal
2. Revenue-Expenditure Implementation and Financial and Accounting Operations of the State Budget					
1. General Department of Budget					
Budget Classification - Administrative Classification - Economic Classification - Program Classification - Project Classification (Domestic Investment) - Functional Classification	Master Data ទិន្នន័យមេ	Data Owner	Monthly, Quarterly, Semesterly, 9 Months, Annually	PDF	Public

Budget Law (Revenue-Expenditure)	Statistical or Report	Data Custodian	Monthly, Quarterly, Semesterly, 9 Months, Annually	PDF	Public
Budget Implementation (Revenue-Expenditure)	Statistical or Report	Data Custodian	Monthly, Quarterly, Semesterly, 9 Months, Annually	Excel & PDF	Internal
Investment Plan	Statistical or Report	Data Custodian	Monthly, Quarterly, Semesterly, 9 Months, Annually	Excel & PDF	Internal
Implementation of Investment Projects	Statistical or Report	Data Custodian	Monthly, Quarterly, Semesterly, 9 Months, Annually	Excel & PDF	Internal
Financial Statement	Statistical or Report	Data Custodian	Monthly, Quarterly, Semesterly, 9 Months, Annually	Excel & PDF	Internal
2. General Department of National Treasury					
7 Budget Classification - Administrative Classification	Base Registries	Data Consumer	Annually	PDF	Public

- Economic Classification - Program Classification - Project Classification - Functional Classification - Source of Fund Classification - Geographic Classification					
Chart of Accounts (COA)	Base Registries	Data Owner	Annually	Excel & PDF	Public
Budget Law (Revenue-Expenditure)	Statistical or Report	Data Consumer	Annually	PDF	Public
Budget Implementation and Report on Revenue and Expenditure	Statistical or Report	Data Owner	Daily, Quarterly, Semesterly	Excel & PDF	Internal
Bookkeeping	Statistical or Report	Data Owner	Daily, Quarterly, Semesterly	Excel & PDF	Internal
Single Account Treasury and Cash Management	Statistical or Report	Data Owner	Daily, Quarterly, Semesterly	Excel & PDF	Internal
Financial Statement	Statistical or Report	Data Owner	Annually	Excel & PDF	Internal
Law on Payment of the General State Budget	Statistical or Report	Data Owner	Annually	PDF	Public
International Public Sector Accounting Standards (IPSAS) Report	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
3. General Department of Public Financial Management Information Technology					
7 Budget Classification					
- Administrative Classification - Economic Classification - Program Classification	Base Registries	Data Custodian	Annually	Excel & PDF	Internal

- Project Classification - Functional Classification - Source of Fund Classification - Geographic Classification					
Budget Law (Revenue-Expenditure)	Statistical or Report	Data Custodian	Annually	PDF	Public
Budget Implementation	Statistical or Report	Data Custodian	Quarterly, Semesterly	Excel & PDF	Internal
Budget Regulation	Statistical or Report	Data Custodian	Quarterly, Semesterly	Excel & PDF	Internal
Bookkeeping	Statistical or Report	Data Custodian	Quarterly, Semesterly	Excel & PDF	Internal
Financial Statement	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
4. General Department of Public Procurement					
7 Budget Classification	Base Registries	Data Consumer	Annually	Excel & PDF	Internal
Procurement Plan	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Bidding Announcement	Statistical or Report	Data Custodian	Semesterly, Annually	Excel & PDF	Internal
Contract Award	Statistical or Report	Data Custodian	Semesterly, Annually	Excel & PDF	Internal
Bidder List	Statistical or Report	Data Custodian	Semesterly, Annually	Excel & PDF	Internal
Data on bidder registration	Base Registries	Data Custodian	Monthly	Excel	Internal
Blacklist Data	Base Registries	Data Custodian	Monthly	Excel	Internal
Procurement Implementation Report	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
5. General Department of Sub-National Administration Finance					
7 Budget Classification	Statistical or Report	Data Owner	Annually	Excel & PDF	Internal

Budget Law (Revenue-Expenditure) for Sub-National	Statistical or Report	Data Custodian	Annually	PDF	Public
Budget Implementation for Sub-National	Statistical or Report	Data Custodian	Quarterly, Semesterly, 9 Months, Annually	Excel & PDF	Internal
Financial Statement	Statistical or Report	Data Consumer	Annually	Excel & PDF	Internal
6. General Department of International Cooperation and Debt Management					
Budget Classification - Project Classification (Foreign Financing) - Source of Fund Classification - Amount of Fund - Project Implementation - Investment Budget Plan (Foreign Financing & Subsidy) - Implementation of Investment Projects (Foreign Financing & Subsidy) - Public Debt	Statistical or Report	Data Owner	Annually	From FMIS	Internal
3. Public Investment					
1. General Department of Budget					
Project Name	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Type of fund	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Source of Fund	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Amount of Fund	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal

Project Implementation Period	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Type of Project	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Sectors	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Project Implementation Status	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Project cycle information - Project Identification - Monitoring and Evaluation - Compliance Monitoring - Review and Budgeting - Project Management and Implementation - Project Changing - Use and Registration of State Asset - Closing the Project	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
2. General Department of Sub-National Administration Finance					
Project Name	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Types of fund	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Source of Fund	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Amount of Fund	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Project Implementation Period	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Type of Project	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Sectors	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Project Implementation Status	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Project Cycle Information - Project Identification - Project Prioritization	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal

- Project Compliance Monitoring and Integration at the Capital and Provincial Levels - Budgeting - Documentation and Project Implementation - Project Changing - Use and Registration of State Asset - Project Evaluation for Closing					
3. General Department of International Cooperation and Debt Management					
Project Name	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Type of fund	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Source of Fund	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Amount of Fund	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Project Implementation Period	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Type of Project	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal

Sector	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Project Implementation Status	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
Project Cycle Information - Project Identification - Monitoring and Evaluation - Compliance Monitoring - Review and Budgeting - Project Management and Implementation - Project Changing - Use and Registration of State Asset - Closing the Project	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF, PPDMS	Internal
4. General Department of Public-Private Partnerships					
Project Name	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Type of fund	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel, PDF	Internal
Source of Fund	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal

Amount of Fund	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Project Implementation Period	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Type of Project	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Sector	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Project Implementation Status	Statistical or Report	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Project Cycle Information - Project Identification - Monitoring and Evaluation - Compliance Monitoring - Review and Budgeting - Project Management and Implementation - Project Changing - Use and Registration of State Asset - Closing the Project	Statistical or Report	Data Custodian	Quarterly, Annually	Excel & PDF	Internal
5. General Department of State Property and Non-Tax Revenue					
Asset Information	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal

- Asset Identification Number - Administrative Code of Units - Geographic Code of Units - Asset Classification ID - Asset ID					
Financial Information - ៧ Budget Classifications - Cost of Asset - Lifespan of Assets - Salvage Value - Depreciation Price	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
Assets by Project	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
6. General Department of Resettlement					
Resettlement Information - Annual Budget Estimation for Resettlement - Resettlement Plan	Statistical or Report	Data Custodian	Annually	Excel & PDF	Internal
4. Financial Industries					
1. Securities and Exchange Regulator of Cambodia					
I. Equity Market					
1. Main Board					
Number of Listed Entities of Equity Securities	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Fund Raised (Million KHR)	Statistical	Data Owner	Annually	Excel & PDF	Public

Total Fund Raised (USD)	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Market Capitalization (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Market Capitalization (USD)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Volume (Share)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Trading Volume (Shares)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Daily Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
2. Growth Board					
Number of Listed Entities of Equity Securities	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Fund Raised (Million KHR)	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Fund Raised (USD)	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Market Capitalization (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Market Capitalization (USD)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Volume (Share)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Trading Volume (Shares)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public

Average Daily Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
3. Both Markets					
Number of Listed Entities of Equity Securities	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Fund Raised on Equity Securities Offering (Million KHR)	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Market Capitalization (USD)	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Market Capitalization (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Market Capitalization (USD)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Volume (Share)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Trading Volume (Shares)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Daily Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Number of Trading Days	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
CSX Index (Closing Index)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
II. Debt Securities Market					
Number of Listed Entities of Debt Securities	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Market Capitalization (Million KHR)	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Market Capitalization (USD)	Statistical	Data Owner	Annually	Excel & PDF	Public

Number of Listed Entities of Corporate Bond Market	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Number of Bonds Reached Its Maturity Date	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Trading Volume (Unit)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Total Trading Value (Million KHR)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Number of Trading Days	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Trading Value	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
Average Trading Volume (Unit)	Statistical	Data Custodian, Data Consumer	Annually	Excel & PDF	Public
III. Derivatives Market					
Number of Traded Derivative Products	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Trading Volume	Statistical	Data Owner	Annually	Excel & PDF	Public
Total Trading Value (USD)	Statistical	Data Owner	Annually	Excel & PDF	Public
IV. Securities Intermediaries and Other Stakeholders					
1. Securities Business					
Securities Underwriter	Statistical	Data Owner	Annually	Excel & PDF	Public
Securities Dealer	Statistical	Data Owner	Annually	Excel & PDF	Public
Securities Broker	Statistical	Data Owner	Annually	Excel & PDF	Public
Financial Advisory Firm	Statistical	Data Owner	Annually	Excel & PDF	Public
Investment Advisory Firm	Statistical	Data Owner	Annually	Excel & PDF	Public
Securities Selling Firm	Statistical	Data Owner	Annually	Excel & PDF	Public
Cash Settlement Agent (CSA)	Statistical	Data Owner	Annually	Excel & PDF	Public
Registrar Agent, Transfer Agent, and Paying Agent (RTP)	Statistical	Data Owner	Annually	Excel & PDF	Public

Audit Firm	Statistical	Data Owner	Annually	Excel & PDF	Public
Law Firm and Attorney at Law	Statistical	Data Owner	Annually	Excel & PDF	Public
Translation Agency	Statistical	Data Owner	Annually	Excel & PDF	Public
Valuation Company	Statistical	Data Owner	Annually	Excel & PDF	Public
Bondholder Representative	Statistical	Data Owner	Annually	Excel & PDF	Public
2. Derivatives Market					
Central Counterparty	Statistical	Data Owner	Annually	Excel & PDF	Public
Derivative Broker	Statistical	Data Owner	Annually	Excel & PDF	Public
3. Joint Venture Company					
Fund Management Company	Statistical	Data Owner	Annually	Excel & PDF	Public
Trustee	Statistical	Data Owner	Annually	Excel & PDF	Public
Fund Distribution Company	Statistical	Data Owner	Annually	Excel & PDF	Public
Fund Administrator	Statistical	Data Owner	Annually	Excel & PDF	Public
2. Insurance Regulator of Cambodia					
Insurance Market Shares	Statistical	Data Custodian	Monthly	Excel & PDF	Public
- Gross Premium					
- Claims					
Insurance Companies	Base Registries	Data Custodian	Monthly	Excel & PDF	Public
Product Types	Statistical or Report	Data Custodian	Monthly	Excel & PDF	Public
Licencing Data	Statistical or Report	Data Custodian	Monthly	Excel & PDF	Public
Public Service Fee	List of Public Services	Data Custodian	Monthly	Excel & PDF	Public
Expenditure Report	Report	Data Custodian	Monthly	Excel & PDF	Internal

3. Trust Regulator					
Licensing	Statistical or Report	Data Owner	Monthly	PDF	Internal
Certification or Permit Letter	Statistical or Report	Data Owner	Monthly	PDF	Internal
Types of Trusts	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Operators	Base Registries	Data Custodian	Monthly	Excel & PDF	Public
Types of Operation	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Total Number of Trust Registration	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Total Trust Fund	Statistical	Data Custodian	Monthly	Excel & PDF	Public
4. Accounting and Auditing Regulator					
Accounting Practice License Level 1	Base Registries	Data Custodian	Monthly	Excel & PDF	Public
Accounting Practice License Level 1	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Audit License	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Suspension or Revocation Accounting and Audit License	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Number of Accountants and Auditors	Statistical	Data Custodian	Monthly	Excel & PDF	Public
5. Real Estate Business and Pawnshop Regulator					
Business Profile	Base Registries	Data Custodian	Monthly	Excel & PDF	Public
Types of Business	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Types of Licenses	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Numbers of Licenses	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Services Fee (License, Administration Fee, Contribution Fee)	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Amount of Services Fee	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Types of Financial Report for Enterprise	Statistical	Data Custodian	Monthly	Excel & PDF	Internal
6. Commercial Gambling Management Commission of Cambodia					
Types of Gambling Business	Base Registries	Data Custodian	Monthly	Excel & PDF	Public
Services Fee	Statistical	Data Custodian	Monthly	PDF	Public

Deposit	Statistical	Data Custodian	Monthly	PDF	Public
Number of Requests	Statistical	Data Custodian	Monthly	PDF	Public
Issuance, Extension, Suspension, Termination, Withdrawal, Revocation, and Return of Licenses to Institutions	Statistical	Data Custodian	Monthly	Excel & PDF	Public
Types of Gambling	Statistical	Data Custodian	Monthly	PDF	Public
Other Complaints	Report	Data Custodian	Monthly	Excel & PDF	Internal
Preparation of accounting and auditing standards	Statistical	Data Custodian	Monthly	Excel & PDF	Public
5. Administration, Human Resources, Inventories and State Assets and Public Services					
1. General Secretariat – Ministry of Economy and Finance					
I. Data on Asset in MEF					
Asset Identification Number	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Administrative Code of Units	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Geographic Code of Units	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Asset Classification ID	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Asset ID	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
II. Data on Staff and Official					

Number	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Age	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Working Unit	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Position	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Education Level	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Employment Status (Working, Suspension, Retirement, ...)	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
Category, Grade, Step (Salary Classes)	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
2. General Department of State Property and Non-Tax Revenue					
Asset Information - Asset Identification Number - Administrative Code of Units - Geographic Code of Units - Asset Classification ID	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal

- Asset ID					
Financial Information					
- Financial Information					
- ៧ Budget Classifications					
- Cost of Asset	Base Registries	Data Custodian	Monthly, Quarterly, Annually	Excel & PDF	Internal
- Lifespan of Assets					
- Salvage Value					
- Depreciation Price					
3. Economics and Finance Institute					
Training Information					
- Training Programs	Statistical or Report	Data Owner	Annually	Excel & PDF	Internal
- Trainers					
- Trainees or Students					
4. Techo Startup Center					
Enterprises Data	Base Registries	Data Custodian	Annually	Excel & PDF	Internal
Startup Data	Base Registries	Data Custodian	Annually	Excel & PDF	Internal
Courses	Statistical	Data Custodian	Annually	Excel & PDF	Internal
Level of Enterprise Go Digital	Statistical	Data Custodian	Annually	Excel & PDF	Internal
Service Providers	Statistical	Data Custodian	Annually	Excel & PDF	Internal
Types of Service Provision	Statistical	Data Custodian	Annually	Excel & PDF	Internal
5. Digital Economy and Business Committee					
Action Plan (3-Year Rolling Action Plan for DEBC and 3-Year Rolling Action Plan for Cambodia Financial Technology Development Policy)	Report	Data Owner	Annually	Excel & PDF	Internal
Achievements (Indicators Results)	Report	Data Custodian	Annually	Excel & PDF	Internal

Performance (Result or % of Achievement of Implementation Action Plan)	Report	Data Owner	Annually	Excel & PDF	Internal
Data on Enterprises in Informal Economy - Number of Enterprises - Number of Enterprises by Sector, Size and Location	Base Registries	Data Custodian	Monthly	Excel & PDF	Internal
6. National Payment Certification Agency					
Patient Information (Name, Date of Birth, Gender, Occupation, Place of Work, Phone Number, Address)	Base Registries	Data Custodian	By Case, Daily, Monthly	API	Internal
Basic Health Information (Public, Private, Name, Level, Contract Number, Local Code, Phone Number, Address)	Base Registries	Data Custodian	By Case	API	Internal
Insurance Information Card Type (Benefit Type, Key Information of the Card)	Base Registries	Data Custodian	Daily	API	Internal
Information related to the Provision of Services (Time of Entry and Exit, Type of Service, Diagnosis, Reason for Entry and Exit)	Base Registries	Data Custodian	Monthly	API	Internal
Payment Request Information	Base Registries	Data Custodian	By Case	API	Internal
7. Cambodia Food Reserve System Management Commission					
Annual Food and Seed Stock Data	Base Registries	Data Owner	Annually	Excel & PDF	Internal
Information on the Process of Providing Food and Seeds of Rice and Vegetables to the Poor and Vulnerable People Affected by Natural Disasters and Disasters	Report	Data Consumer	Quarterly, Semesterly, Monthly	Excel & PDF	Internal

Information on the Supply of Vegetable Seeds to Promote Family Farming	Base Registries	Data Owner	Quarterly, Semesterly, Monthly	Excel & PDF	Internal
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Appendix 3. Guideline for System Development

1. Project Planning and Management

A. Guideline: Establish a clear plan, manage the development process efficiently, and ensure effective implementation.

B. Standards:

- **Software Development Methodologies:** Choose the software development methodology that best suits the specific project. Each methodology offers unique strengths and weaknesses, tailored to different project needs and circumstances. Example: Agile Methodology, Scrum Methodology, Waterfall Methodology or Spiral Methodology...etc.
- **Documentation:** Maintain detailed documentation of requirements, design, development, and testing phases. Use tools like Confluence, GitBook for documentation.
- **Version Control:** Use a version control system like Git to track changes and collaborate efficiently. Platforms such as GitHub, GitLab, and Bitbucket are commonly used.

2. Code Quality

A. Guideline: Ensure the quality of the code of the system, including coding in a common standard, easy to understand, easy to maintain, as well as efficient and reusable, and must consider the security, scalability, test and prepare proper documentation.

B. Standards:

- **Coding Standards:** Follow established coding standards for each language to ensure consistency, simplicity and readability. Example: Google Java Style Guide, PEP 8 (Python), Airbnb JavaScript Style Guide or TypeScript Style Guide...etc
- **Code Reviews:** Conduct regular code reviews using tools like GitHub/GitLab Pull Requests to ensure code quality, adherence to consistent coding patterns and modularization. Incorporate pair programming for real-time feedback and knowledge sharing and apply automate checks with tools like SonarQube. Establish clear review objectives with checklists to ensure reviewers follow best practices and coding standards.
- **Static Analysis:** Use static analysis tools to detect potential errors, code quality inspection, and ensure adherence to coding standards by using analysis tools or linters.

3. Security

A. Guideline: Ensure the application is secure from common vulnerabilities.

B. Standards:

- **OWASP Guidelines:** Follow OWASP best practices for web application security.
 - **Access Control:** Users must have specific permission to access the private data or private part of the application and ensure the system access control is manageable by the system manager.

- **Cryptographic:** Ensure that every data transaction, data exchange, or sensitive data storing are encrypted with modern and strong cryptography mechanism.
- **Injection:** Ensure that all data inputted by users is sanitized and validated to prevent malicious input that could compromise the system.
- **Security Misconfiguration:** All use of security functions must ensure proper application of other functional settings.
- **Vulnerable and Outdated Components:** Ensure that all third-party dependencies, libraries, software, and tools are up-to-date and free of vulnerabilities.
- **Identification and Authentication:** Users must be authenticated with specific permission before using the data or application.
- **Software and Data Integrity:** Ensure the integrity of third-party dependencies, libraries, software, or tools.
- **Security Logging and Monitoring:** Every action related to users and system security in the system must be logged and stored securely. Sensitive data should be masked when logging.
- **OWASP MAS:** Follow OWASP Mobile Application Security checklist.
 - **Storage:** use the right mobile storage for the right data categories, especially sensitive data.
 - **Cryptography:** use mobile data protection mechanism by using encryption with strong key.
 - **Authentication:** Ensure the user authenticated data is stored securely on mobile by with biometric authentication.
 - **Network:** Ensure data exchange via network request are encrypted or at least using TLS/SSL protocol.
 - **Platform:** Check the possibility of data leak via the vulnerabilities during development, mobile device features, or unnecessary mobile permissions (location data, microphone, camera).
 - **Code:** Ensure the code quality is vulnerabilities free such as data storage, third-party dependencies or libraires.
 - **Resilient:** ensure the mobile app is resilient from attacking such as reverse engineer, data leak, credential leak, device jailbreak or root.
 - **Privacy:** mobile app must have ability for users to manage their own data and use least user data as much as possible and the data usage transparency.

4. Testing

A. Guideline: Optimize the application for performance to provide a smooth user experience and ensure the stability of systems.

B. Standards:

- **Unit Testing:** Ensure individual components are rigorously tested with comprehensive scenarios, leveraging mocks and stubs to isolate units. Maintain

high code coverage and align tests with evolving codebase changes to catch issues early and maintain code quality.

- **Integration Test:** Validate the interactions between integrated modules and external services, ensuring data flows and interfaces operate as intended. Simulate real-world conditions and edge cases to uncover integration issues and validate end-to-end functionality.
- **Security Test:** Conduct in-depth security assessments, including static and dynamic analysis, penetration testing, and threat modelling. Implement security best practices, regularly update tests for emerging vulnerabilities, and ensure compliance with security standards and regulations.
- **Load and Profiling Testing:** Perform stress and load testing to evaluate system performance under expected and peak conditions. Use profiling tools to identify and address performance bottlenecks, optimize resource usage, and ensure scalability and reliability in production environments.
- **UX/UI Test:** Assess the user experience and interface design for usability, accessibility, and consistency with design specifications. Utilize user feedback and usability metrics to drive iterative improvements and ensure alignment with user needs and business objectives.
- **User Acceptance Test:** Facilitate UAT by defining clear criteria and engaging stakeholders in realistic testing scenarios. Address feedback promptly, ensure that all functional requirements are met, and validate that the application aligns with business goals and user expectations before deployment.

5. - Scalability

A. **Guideline:** Design the application to scale efficiently as demand increases.

B. Standards:

- **Stateless approach:** Design the application so that each request is independent and contains all necessary information. This simplifies scaling by allowing easy distribution across multiple servers without managing session state, improving load balancing and failover.
- **Software architecture:** Choose an architecture that matches the system's needs. Monolithic is suitable for simpler systems, while Microservices offer better scalability and flexibility for complex applications by allowing independent scaling of components.
- **Containerization:** Package the application and its dependencies into containers to ensure consistent deployment across environments. Containers enable rapid scaling and efficient resource management, and can be orchestrated with tools like Kubernetes for automated scaling and deployment.

C. Popular Tools:

- **Nginx:** is a commonly used tool that helps manage stateless applications by efficiently distributing requests across multiple servers, enhancing load balancing and failover capabilities.
- **Docker:** is the leading tool for creating and managing containers, providing a standardized environment for applications.

- **Kubernetes:** Use for automating the deployment, scaling, and management of containerized applications. It helps manage containerized applications at scale, ensuring efficient resource utilization and handling increased demand.

6. UI/UX - UI/UX

A. Guideline: Ensure the application is user-friendly, accessible, and visually appealing for software or application.

B. Standards:

- **Accessibility:** Follow accessibility standards (e.g., WCAG) to ensure the application is usable by all.
- **Design Consistency:** Maintain consistency in design elements across the application using design systems like Material Design or Bootstrap.
- **Color:** Follow a standard color pattern that ensures accessibility and consistency across the application. Use tools like Material Design Color Tool to create a cohesive color palette.
- **Font:** Use standard font sizes and styles to ensure readability. Maintain a hierarchy of typography and use web-safe or brand-specific fonts.
- **Screen Size:** Design responsively to ensure a seamless user experience across all platforms. Use fluid grids and media queries to adjust the layout based on the device size.
- **Icon:** Use cohesive, open-source, or licensed icon sets. Ensure icons are consistent in style and provide alternative text for accessibility.
- **Image:** Use high-quality images that are either free licensed or properly paid for. Ensure images are optimized for web to maintain performance.
- **Less click:** Simplify user interactions by reducing the number of clicks needed to complete tasks. Streamline navigation and design intuitive workflows to enhance user efficiency and satisfaction, making it easier for users to achieve their goals with minimal effort.

C. Popular Tools:

- **UserTesting:** For user experience research.
- **Hotjar:** For heatmaps and user session recordings.
- **Material Design:** For consistent design guidelines.
- **Bootstrap:** For responsive design and component library.
- **Material Design Color Tool:** For creating a cohesive color palette.
- **Google Fonts:** For selecting web-safe fonts.
- **FlatIcon:** For accessing open-source icons.
- **Freepik/Adobe Stock:** For sourcing high-quality images.

7. API - API Standards

A. Guideline: Design, develop, and maintain APIs with best practices to ensure reliability, scalability, and ease of use.

B. Standards:

- **RESTful Design:** Follow REST principles for API design. Use meaningful resource names, and HTTP methods (GET, POST, PUT, DELETE) appropriately.
- **Versioning:** Implement API versioning to handle changes without disrupting existing clients. Use URI versioning (e.g., /v1/resources) or header versioning.
- **Documentation:** Provide comprehensive API documentation using tools like Swagger or Postman to ensure developers can easily understand the API's capabilities, endpoints, and how to integrate it effectively.
- **Naming Convention:** Use meaningful names to describe the entity or action they represent, use plural nouns to represent collections and stick to one case style (e.g., kebab-case or camelCase) throughout the API to enhance clarity and maintainability.
- **Authentication:** Secure APIs using robust authentication mechanisms such as OAuth2 or JWT (JSON Web Tokens). These methods ensure that only authorized users can access or modify the API's resources, enhancing security.
- **Rate Limiting:** Implement rate limiting to protect the API from abuse and ensure fair usage.
- **Error Handling:** Standardize error codes and messages to help clients diagnose and handle errors effectively. Clear and consistent error reporting aids developers in troubleshooting issues and improving their integration with the API.

8. Deployment and Maintenance

A. Guideline: Ensure the smooth deployment and maintenance of the systems or applications effectively by dividing the development environments into three major components: development environment, application testing environment, and production environment.

B. Standards:

- **Plan and Test Deployment:** Create a comprehensive deployment plan that outlines each step, dependencies, and rollback procedures. Thoroughly test deployments in a staging environment to ensure configurations and application functionality perform as expected, simulating production conditions as closely as possible.
- **Automate and Monitor Deployment:** Leverage automation tools like Jenkins, GitHub Actions, or GitLab CI/CD to streamline the deployment process and minimize manual errors. Set up monitoring with tools such as Grafana, ELK Stack, New Relic, Datadog, or Prometheus to track performance, detect issues early, and receive alerts for prompt action.
- **Container Orchestration:** Automates the deployment, scaling, and management of containerized applications to ensure efficient resource utilization and high availability. Popular tools include Kubernetes, Docker Swarm, and OpenShift....etc.
- **Implement Version Control and Backup:** Integrate version control systems (e.g., Git) to manage code changes and configurations, facilitating easy rollbacks and maintaining traceability. Establish a backup strategy to regularly back up critical data and configurations before deployments, and test recovery processes to ensure quick restoration in case of failures.

- **Conduct Regular Maintenance and Testing:** Perform routine maintenance, including applying updates, security patches, and optimizations, to keep the system stable and secure. Continuously test the application to identify and address issues proactively. Keep maintenance procedures and documentation current to ensure effective handling of ongoing tasks and incident responses.

Unofficial Translation

Appendix 4. MEF Tech Stack

1. Development Tech Stack

- **Server Side**: Refers to the technology or tools used to develop back-end systems.
- **Client Side**: Refers to the technology or tools used to develop frontend systems, mobile applications, or desktop applications.

	Server Side	Client Side		
Platform / OS	Linux, Windows	Web	Mobile (Android/iOS)	Desktop (Windows, Linux, macOS)
Scripting	Shell, Python, Ruby, Perl	JavaScript, TypeScript, VBScript	JavaScript, Dart, Kotlin	PowerShell, Shell, AppleScript, Python, Batch
Programming Language	Java, JavaScript, C#, Python, PHP, Ruby, Go	JavaScript, TypeScript	Java, Kotlin, Swift, Dart	C#, Java, Python
Database	PostgreSQL, MySQL, MongoDB, Oracle, MS-SQL Server, IBM DB2, Redis	WebStorage	Core Data, SQLite	SQLite, MySQL, PostgreSQL, MS-SQL Server
Application Server	Node.js, Tomcat, Jetty, WildFly, GlassFish, Wapper service, NSSM			
Web Server	Node.js, Nginx, Apache, Tomcat, Jetty, WildFly, GlassFish, Microsoft IIS, Oracle Web Logic, IBM PAW, Tomcat	-		
Framework	Spring, .NET, ExpressJS, NestJS, Django, Flask, Laravel, Koa.js, Ruby on Rails, Node, Odoo	AngularJS, ReactJS, VueJS, NuxtJS, NextJS	Flutter, React-native	.NET, Electron, JavaFX, Qt, Avalonia

Package	pip, mvn, Composer, Nexus, Bundler, Conan, Jfrog Artifactory	npm, Yarn, Bower	pub, pod, CocoaPods, Gradle, Swift Package Manager	Homebrew, Chocolatey, npm, Yarn, NuGet
Build Tools	Maven, Gradle, MSBuild, Rake	Webpack, Gulp, Grunt, Parcel	Gradle, XCode, Carthage	MSBuild, CMake, Xcode, Gradle, Bazel
Webservice / API Tools	Rest-API, JSON, gRPC, Postman, Swagger, CURL, SOAP UI	-		
Libraries	PyJWT, Gson, Lodash, Requests	jQuery, Bootstrap, Axios, Lodash	Retrofit, Alamofire, Firebase, Glide, Realm, Provider, Dio	WinForms, GTK, Newtonsoft.Json
SMS Provider	OneSignal, Nomsa.gov.kh, Plasgate, MekongSMS	-		
Development Tools	IntelliJ, VS Code, Eclipse, Spring Tool Suite, Maven, Gradle, etc.	IntelliJ, Netbeans, VS Code	Xcode, Andriod Studio, VS Code	

2. Operation/Monitoring Tech Stack

Category	Tools & Technologies
Source Control	GitHub, GitLab, Bitbucket, Subversion (SVN)
Infrastructure as Code	Terraform, Pulumi, Ansible, Vagrant
Automation & Configuration	Ansible, Chef, OpenStack, Puppet, Terraform, SaltStack, Consul
CI/CD	Jenkins, GitHub Actions, GitLab CI/CD, Travis CI, CircleCI, Argo CD, Spinnaker, Helm, Maven, Git, JFrog
Container Orchestration & Management	Docker, Kubernetes, OpenShift, Rancher, Nomad, Portainer
Virtual Machines	Proxmox, VMware vSphere, VirtualBox, Oracle OVM, Nutanix AHV
Monitoring, Logging, Reporting & Log Analytics	ELK Stack (Elasticsearch, Logstash, Kibana), ZooKeeper, Fluentd, Prometheus, Grafana, New Relic, Loggly, Sentry, Dynatrace, AppDynamics, Splunk, FortiSIEM, Panorama
Security, Identity & Compliance	MEF's Security Operations Center (SoC), Web Application Firewall (WAF), Docker Image Scanner (Snyk, ...), Cloudflare, OpenVPN, HashiCorp Vault
Incident Management	TheHive Project, OpsGenie, Jira, Clickup,
Testing	JUnit, JMeter, pytest, Mocha, Selenium, Cypress, TestNG, Cucumber, Postman, K6
Error Tracking	Sentry, Firebase Crashlytics
SSL Provider	Let's Encrypt, Certbot, DigiCert, Comodo SSL, GlobalSign, SSL2buy, Entrust
Message Queue	Kafka, RabbitMQ, ActiveMQ, IBM MQ, TIBCO EMS
Project Management & Tools	Agile, Scrum and Kanban Confluence, JIRA, ClickUp, Asana Notion, Trello
Big Data Tools	Apache Spark, Hadoop, Python, R, Apache Kafka, Apache Flink, Dask
Computer Vision Tools	OpenCV, TensorFlow, CUDA, MATLAB, DeepFace, YOLO, Keras, ML Kit

Data Science / AI Tools	TensorFlow, R, Pandas, NumPy, Keras, Scikit-learn, PyTorch, MATLAB
Khmer NLP	• Frameworks: Django, FastAPI, Flask, • Servers (ASGI/WSGI): Uvicorn, Gunicorn, Hypercorn, • Machine Learning Frameworks: TensorFlow, PyTorch, • NLP Libraries: NLTK, Transformers, TextBlob, Sentencepiece, Levenshtein, Phonetisaurus, SymspellyPy, Fasttext, Hunspell
Graphic	Figma, Sketch, Adobe XD, Draw.io

3. Security

Categories	Sub-categories	Tools and Technologies
Network Security	Firewall	FortiGate, Cisco, Palo Alto, pfSense, iptables, Checkpoint
	Intrusion Detection/Prevention Systems (IDS/IPS)	Snort, Suricata, OSSEC, Bro (Zeek)
	VPNs	OpenVPN, WireGuard, Fortinet, Cisco AnyConnect, SoftEther VPN
	Content Delivery Network (CDN)	Cloudflare, Akamai
Endpoint Security	Antivirus/Anti-malware	Kaspersky, McAfee, Bitdefender, Symantec Endpoint Protection, ClamAV, ESET, Trend Micro
	Endpoint Detection and Response (EDR)	CrowdStrike, Carbon Black, SentinelOne, OSQuery, Trend Micro XDR, Cortex XDR, FortiEDR, Kaspersky EDR Optimun
Application Security	Static Application Security Testing (SAST)	SonarQube, Checkmarx, Fortify,
	Dynamic Application Security Testing (DAST)	OWASP ZAP, Burp Suite, App Spider, Arachni
	Software Composition Analysis	WhiteSource, Snyk, Black Duck, OWASP Dependency-Check
	Web Application Firewalls (WAF)	AWS WAF, Cloudflare WAF, F5, Imperva WAF
Identity and Access Management - IAM	Single Sign-On	CamDigiKey, Auth0, KeyCloak, Okta, Azure AD, OneLogin
	Multi-Factor Authentication	Google Authenticator, RSA SecurID, FreeOTP, Cisco Duo
	Phone Authentication	Firebase, Twilio Authy
	Privileged Access Management (PAM)	CyberArk, BeyondTrust, Delinea
Vulnerability Management	Vulnerability Scanner	Nessus, OpenVAS, Nmap, Lynis, Burp suite, Acunetix

	Patch Management	Microsoft SCCM, Ivanti Patch Management, ManageEngine Patch Manager Plus
Security Information and Event Management (SIEM)		OSSEC, Wazuh, ELK Stack (Elasticsearch, Logstash, Kibana), Graylog, Splunk, IBM QRadar, ArcSight (Micro Focus), Azure Sentinel, LogRhythm, FortiSIEM
Security Orchestration, Automation and Response (SOAR)		TheHive, Cortex, Shuffle, Wazuh, Splunk Phantom, IBM Resilient, FortiSOAR, LogRhythm SOAR
Threat Intelligence		MISP, Open Threat Exchange (OTX), Yeti, Anomali ThreatStream, FireEye Threat Intelligence, Palo Alto Networks Auto Focus
Incident Response & Forensics		Autopsy, Volatility, GRR, The Sleuth Kit, CrodStrike Falcon Insight
Security Awareness	Phishing Simulation	GoPhish, PhishSim, King Phisher

Appendix 5. Action Plan for the Implementation, Management, and Development of IT Systems

N.	Entities	Action Plan
1	General Secretariat	- Operate and manage MEF Profile - Operate and manage State Asset Management in MEF and vehicle management system - Operate and manage network, data center and disaster recovery data center
2	General Department of Policy	- Collect relevant data that serve macroeconomic analysis and policy development - Operate and manage PIP DBMS
3	General Department of Budget	- Continue using FMIS for budget control
4	General Department of Taxation	- Operate and manage e-tax services system - Operate and manage data center
5	General Department of Customs and Excise	- Operate and manage custom e-services - Operate and manage data center
6	General Department of National Treasury	- Continue using FMIS based on own function including FMIS Portal, Edoc, CMS and NRMIS
7	General Department of Public Procurement	- Owns, operates and promotes the use of Electronic Government Procurement (e-GP) as a core function in FMIS, including Procurement Plan, Catalog Management, Notification, Bidder Registration, Tendering, and Contract Management, Supplier Center, Shopping Cart and so on. - Participate in providing input, testing, and comprehensive development of the e-GP system, as well as promoting the management and operation of this system with all stakeholders, especially the General Department of International Cooperation and Debt Management and the GDPFMIT.
8	General Department of Non-tax Revenue Management Information System	- Operate and manage SARMIS and NRMIS - Develop Public Enterprise Information Management System (PEMIS)
9	General Department of Sub-National	- Develop an IT system for managing public investment that uses sub-national administration finance

	Administration Finance	
10	General Inspectorate Department	- Operate and manage Financial Information Database System
11	General Department of International Cooperation and Debt Management	- Operate DMFAS and Project Portfolio Database Management System – PPDMS
12	General Department of Resettlement	- Develop an IT system for managing the resettlement projects.
13	General Department of Public-Private Partnerships	- Develop an IT system for managing public investment
14	General Department of Internal Audit	- Manage and operate SAAT
15	General Department of Digital Economy	- Manage e-Invoice system and Data EF system
16	General Department of Public Financial Management Information Technology	- Operate and manage the core and cluster FMIS, which focuses on the functions of implementing state budget revenue, expenditure, and financial and accounting operations of the state budget, in accordance with Article 13 of the Law on Public Finance System - Operate and manage all physical infrastructure of FMIS and the intranet
17	Economics and Finance Institute	- Operate and manage learning management system
18	Techo Startup Center	- Operate and manage Startup Cambodia, OBR, Enterprises Go Digital - Operate and manage CamDX, CamDigiKey, CamDL, ...
19	Supreme National Economic Council	- Manage the related-data for policy development
20	Legal Council – Ministry of Economy and Finance	- Operate and manage systems and platforms that serve for own functions
21	National Social Protection Council	- Operate and manage IT systems for NPC and Social Protection Portal and Social Protection Registry and

22	General Secretariat, Steering Committee of the Public Financial Management Reform	- Operate and manage Performance Management and Accountability System (PMAS)
23	Commercial Gambling Management Commission of Cambodia	- Operate and manage the registration and licencing systems - Manage compliance reports
24	Digital Economy and Business Committee	- Operate and manage Digital Platform for Informal Economy Development and M&E Portal
25	Economic and Financial Policy Committee	- Collect relevant data for macroeconomic analysis and policy development
26	Productive Economy Committee	- Manage data related to Cambodia's economic productivity
27	Cambodia Food Reserve System Management Commission	- Develop an IT system such as data management system, data verification system, location risk management system and benefit management system.
28	National Payment Certification Agency	- Operate and manage Patient Management and Registration System (PMRS) - Develop an IT system for payment certificate in social protection
29	Non-Bank Financial Service Authority	- Lead, manage, develop, and operate data management systems, supervisory technology, regulatory technology and other systems to support the development of the non-bank financial sector.
29.1	General Secretariat – Non-Bank Financial Service Authority	- Lead, manage, develop, and operate data management systems, supervisory technology, regulatory technology and other systems to support the development of the non-bank financial sector.
29.2	Securities and Exchange Regulator of Cambodia	- Operate and manage the registration and licensing systems - Manage compliance reports
29.3	Insurance Regulator of Cambodia	- Operate and manage the registration and licensing systems - Manage compliance reports
29.4	Social Security Regulator	- Manage Data and Reporting System

29.5	Trust Regulator	- Operate and manage the registration and licensing systems - Manage compliance reports
29.6	Accounting and Auditing Regulator	- Operate and manage the registration and licensing systems - Manage compliance reports
29.7	Real Estate Business and Pawnshop Regulator	- Operate and manage the registration and licensing systems - Manage compliance reports

Appendix 6: Glossary

N.	Terms	Definition
1.	Artificial Intelligence	The technologies allowing the computers to learn, think, analyze, and understand a specific issue through the emulation of the human brain.
2.	Application Programming Interface	The interface of interactions in data sharing between two or more ICT systems
3.	Big Data	A large volume of data – diverse in shapes but in general with unclear structure – that are used to analyze the patterns, trends, and associations from one point to another.
4.	Data Consumer	Refers to Legal Persons, Legal Entities, Public Administration Institutions or Public Enterprises that consume the data from data owner on behalf of the data custodian or public authority.
5.	Data Custodian	Refers to Legal Persons, Legal Entities, Public Administration Institutions or Public Enterprises that determine the purpose and means of collection, use or disclosure of data.
6.	Data-literate Culture	Refers to an environment within an organization where employees at all levels have the ability to understand, interpret, and use data effectively in decision-making and daily operations.
7.	Data Owner	Refers to those responsible for the content, definition, and quality of the data, as well as consent provision to the sharing of data to other persons for any purpose.
8.	Data Steward	Refers to Legal Persons, Legal Entities, Public Administration Institutions, or Public Enterprises that oversee, research, monitor and promote the implementation of the agreed data governance framework.
9.	Enterprise Architecture	A framework and a roadmap for organizing and adjusting the functions and operational mechanisms of all relevant actors of the institution in a large and highly interactive digital ecosystem to effectively achieve the institution's objectives.
10.	Functional Requirement	A list of functions that the organization that owns and manages the IT system must define, which functions serve the core purpose of system development.
11.	Non-Functional Requirement	A list of functions that the organization owns and manages the IT system must comply with according to the guidance document in the application layer of the IT architecture framework.

12.	Security Operation Center	A group of IT security experts who protect IT systems from cyber threats by monitoring, analyzing, and investigating.
13.	User Experience	Focuses on designing the entire IT system based on user experience, aiming to create convenience, attractiveness, and user satisfaction with IT systems by incorporating key elements such as user needs and user habits.
14.	User Interface	Focuses on designing the parts that users can see and interact with, including buttons, icons, font type, font size, colors, and graphic design.

Annex 1: The Review of Current Situation Based on the Enterprise Architecture

To gain an understanding of the current situation and challenges of MEF IT Architecture, four aspects or layer include (1)-Business, (2)-Data, (3)-Application, and (4)-Technology will be reviewed and discussed as follows:

1.1. The Review of Business Layer Aspect

The MEF oversees 16 General Departments, two public administrative institutions, and 25 municipal and provincial departments of economy and finance (Figure 14). Additionally, the General Secretariat of the Non-Banking Financial Services Authority, which includes six regulators and several committees and councils, operates under the leadership and management of the Minister of Economy and Finance. Each General Department and entity is assigned specific roles and duties, as outlined in their respective sub-decrees regarding the organization and functioning of the institution. Furthermore, the General Departments and Units have established departments or offices under their supervision to fulfill their missions, each with varied functions and duties. Notably, 14 General Departments and Units within the MEF have set up IT departments to support, design, and develop IT systems that enhance their core and operational functions. Some departments have opted to establish only an IT office or technical team, staffed with professionals who coordinate related activities.

Figure 13: All Entities under the MEF or under Guardianship MEF's Minister



MEF is currently pursuing two main policy objectives, which are supported by five programs comprising a total of 32 sub-programs. The first policy objective focuses on managing the economic and financial sector, and includes two programs: **(1)-Economic Sector Management** and **(2)-Financial Sector Management**. The second policy objective centers on managing the public financial system and encompasses three programs: **(1)-Management of Public Revenue and State Assets**, **(2)-Management of Public Expenditure and the Public Finance System**, and **(3)-Administration and Institutional Development**.

(A) Defining Organizational Functions Within the COBIT 2019 Framework

Defining organizational functions will aid in reviewing the IT preparation proposals of each department or entity in accordance with its specific functions. This definition will also support decision-making regarding investments in the development of information systems. Data derived from the COBIT 2019 framework allows the categorization of the General Departments and subordinate Entities into four major groups: **(1)-Support Function:** This group consists of General Departments and Entities that utilize IT to enhance the institution's operations. However, their work can continue even without an IT system; **(2)-Factory Function:** These General Departments and Entities rely on IT for their core functions. While some processes do depend on these systems, work may slow or halt entirely if there are issues with the technology; **(3)-Turnaround Function:** This group includes the General Departments and Entities that use IT for specific tasks and to foster new innovations within the institution; **(4)-Strategic Function:** These are the General Departments and Entities that consider IT integral to the entire organizational process. If there are problems with the IT system, it can severely impact the organization's ability to function. According to the data, 11 General Departments and Entities fall into the Support group, seven into the Factory group, 13 into the Turnaround group, and four into the Strategic group, as illustrated in Figure 14 below. It is important to note that this classification does not imply that any entity performs better than another; rather, it categorizes the entities based on their specific functions.

Figure 14: Division of General Departments and Subordinate Entities by Functions



(B) Human Resource Situation

The Vision of the Ministry of Economy and Finance 2030 document outlines the key strategy one so-called the Human Capital Development System. This key strategy is based on four primary approaches: "selecting the right individuals, training them effectively, utilizing their skills appropriately, and retaining them." Currently, there are 7,495 officials and staff within the budget units. Of these, only 515 individuals, approximately 6.9% of the total staff, possess IT skills and work in the IT department or office. Among the IT officials and professional staff, about 41% focus on software development, 31% specialize in infrastructure management, 8% are dedicated to IT security, and 18% have diverse skills, including graphics and media management. The number of officials and staff remains insufficient to meet the workload demands of most General Departments and Entities. This has created complexities that management has struggled to address in the past, primarily due to a lack of a common framework that clearly outlines how General Departments and Entities should implement and comply with necessary protocols.

Based on the data provided and per the enterprise architecture, all General Departments and Entities can be categorized into three groups, namely: **(1)-Full Stack:** This group comprises general departments operating a complete IT system, managing their own infrastructure and data centers, and developing and implementing their own IT systems, of which four general departments are in this group; **(2)-Development:** This group includes General Departments and Entities with technical teams capable of developing and operating their own IT systems, with 16 General Departments and Entities in this group; **(3)-Operation Only:** This group comprises

General Departments and Entities that perform certain tasks by utilizing IT systems developed by other entities or acquired for operational use, with 16 General Departments and Entities in this group.

1.2. The Review of Data Layer Aspect

Data is a crucial component in the business operation and the functioning of any institutions. As institutions increasingly rely on IT systems for their daily activities and the use of artificial intelligence grows, the importance of data and data integrity becomes paramount. MEF manages a substantial amount of data, including revenue data (tax, customs, and non-tax revenue), expenditure data, state property data, debt data, state securities data, project and investment data, license data, and other relevant information. When this data is shared and interacts with one another, it transforms into Big Data, which can be utilized for various analyses and applications in artificial intelligence.

Currently, within the MEF framework, much of the data is cluttered and inconsistent, and data sharing remains limited. All Entities, whether they have IT systems or not, possess data that serves both their specific functions and the overall goals of the ministry. Most of this data is managed by the entities carrying out their work or by those overseeing the IT systems. Despite the abundance of data and technology to manage it, there is no precise mechanism for data sharing, which prevents different systems from interacting effectively. Consequently, many entities continue to request data from one another through formal letter submissions. Additionally, the types of data that can be shared have not yet been clearly defined, which complicates the use of this data as needed. Data inconsistency presents another challenge for data sharing and utilization. Currently, only data from a few systems, such as tax revenue, customs revenue, and non-tax revenue, have been integrated into the FMIS. These ongoing issues prevent all entities and MEF as a whole from using data effectively. Although the development of a Data Lake has been approved, it is still in the exploratory and early stages and will require more time to fully accomplish it. As a result, these issues continue to impede widespread data sharing and alignment with a clear framework.

Many General Departments and Entities have concerns about data ownership when data is shared. This issue arises from the lack of a clear framework for data governance, which should explicitly define the roles and ownership of data among all parties involved. Additionally, the Ministry has yet to decide on the appropriate architecture model for implementation. Best practices suggest implementing an ecosystem architecture model, as data is not collected in a single IT system. Instead, data needs to be exchanged between different IT systems to support the business of each institution. This approach allows technical and political leaders who require cross-organizational data to spend less time on coordination and makes it easier to generate regular reports based on that data.

1.3. The Review of Application Layer Aspect

In the context of "Digital Transformation," digital technology has played a significant role in helping General Departments and their subordinates implement their missions and achieve the vision of MEF. The adoption of digital technology for developing information systems in daily operations has become increasingly popular and is now a prominent trend among most General Departments. Thus far, these General Departments and Entities that prioritize IT systems have been actively developing and utilizing these systems through various mechanisms. They may either self-develop their systems, hire a technology service provider or purchase existing information technology systems, and use common systems created by other General Departments or Entities within the Ministry or the Royal Government as a whole. Some of these IT systems are tailored for officials and staff to support their daily work, while others are designed to serve diverse users, including enterprises, businesses, and the general public. Data collected in early 2024 indicates that all General Departments and Entities under MEF have a total of 200 IT systems. These systems can be categorized into three major groups:

- 1)- A core function system is an IT system designed to support the core operations of an institution. These core functions include revenue collection, expenditure management, state property management, debt management, macroeconomic forecasting, etc. Currently, there are a total of 83 systems that cater to the core functions of various General Departments and Entities. While these systems are intended to fulfill the institution's primary functions, they each have distinct characteristics and scopes.
- 2)- A common function system is an IT system designed to support the daily operations that are common or the same across different institutions. These common functions include personnel management, audit management, resource and document management, common data management, data exchange, etc. There are approximately 34 systems that perform these common functions across all general departments and units.
- 3)- An operating system is an IT system that supports an institution's daily operations. These operational functions encompass tasks such as administrative and financial work, division of duties, job automation, and promotion, among others. Currently, there are 82 IT systems in use across all General Departments and Entities.

So far, each General Department and entity has invested significant time and resources into developing, maintaining, and operating digital security mechanisms. However, the design of IT systems in some General Departments and Entities has not been approached holistically. Most of these systems lack essential features, such as digital security and interoperability. When systems cannot interact with one another, they may function independently but fail to complement or share data effectively. This

redundancy results in the same tasks being performed multiple times, wasting both time and resources—both human and financial—during the development and operation of the IT systems. Consequently, this leads to less efficient service for users.

The development of IT systems in the past has primarily focused on functional requirements, with each entity clearly defining the system's capabilities to fulfill its core responsibilities. In contrast, non-functional requirements have often been overlooked and inadequately defined. Some Entities have also attempted to incorporate non-functional requirements into their IT systems, which has positively impacted system-to-system interactions, security checks, and other areas. This highlights the importance of considering both functional and non-functional requirements, as well as the need for a standardized framework or set of principles for developing IT systems that all entities should follow.

The absence of common standardized principles for developing IT systems has led to challenges in system-to-system integration and future expansion of these systems. Different General Departments or Entities often create IT systems that serve the same or similar functions, resulting in wasted investment resources. Additionally, the effectiveness of cybersecurity becomes a challenge when individual IT systems do not adhere to proper security principles, especially for systems managed by low-resource institutions. Furthermore, this lack of common standardized principles contributes to significant expenses in developing IT systems.

1.4. The Review of Technology Layer Aspect

The technology layer outlines the infrastructure, hardware, and technology necessary to operate the IT system. It includes digital enablers that help standardize the system and utilize shared resources. This layer encompasses common computers, common networks, common data center and disaster recovery data center, common operational technologies, common digital enablers, and so on.

IT tools have become essential for staff and officials, with over 80% having access to computers. Smartphones have also become important for communication and various IT applications. For instance, staff and officials need to use a personnel management information system (MEF Profile) to track attendance. As the use of these technology tools increases, so do the associated risks to digital security. Many computers are freely accessible and are often used for personal tasks unrelated to institutional work, often without proper licensing for the systems or software. This situation has led to several problems, including computer infections, software crashes, and the loss or damage of files, which can disrupt daily work processes.

MEF has set up an internal IT network that includes both individual entity networks and an inter-entity network. Within the ministry's premises, a core network has been set up to provide common internet services, facilitate digital data sharing, enable internal communication through IP phones, and support IT for on-site entities. There are two types of network connections available: wired and Wi-Fi. Entities

outside the ministry's premises also have their own internal networks for local use and connections to the ministry's common intranet network. However, many local-level units under the ministry, such as municipal and provincial departments and treasuries, do not yet have access to the ministry's core network services. Currently, they can only connect to the network for the FMIS. Conversely, most tax branches and customs and excise branches/offices are already connected to the internal network, allowing them to utilize the IT systems necessary for managing tax revenue collection and customs and excise revenue.

Since 2020, MEF has installed a backbone network utilizing extensive fiber-optic cable infrastructure throughout the country. This network, known as the common intranet network of MEF, connects the Ministry to all data center locations, as well as the General Departments outside the Ministry. It also links municipal and provincial departments of Economy and Finance, Treasuries, Tax Branches, and Customs and Excise Branches located in various towns across the country. However, the use of IT services on this network remains limited. It is primarily dedicated to the internal services of respective organizations, with the exception of video conferencing systems that can commonly operate on this network. As for internet access, only the Ministry's premises have been utilizing the common internet service via both wired and wireless internal networks. Meanwhile, the General Departments and other local entities continue to use different internet service arrangements.

MEF has established four data centers, each managed and operated by different general departments. Three of these departments – the GDT, the GDCE, and the GDPFMIT – are responsible for their own data centers. Meanwhile, other General Departments and Entities utilize MEF's Common Data Center, which is managed by the IT Department of the General Secretariat. While the technology used across these data centers has some similarities, it also varies based on the specific requirements of each facility. Additionally, a common framework for design and management has yet to be developed.

Among the four data centers mentioned, two have disaster recovery data centers: **(1)**-The Disaster Recovery Data Center of the FMIS Project and **(2)**-The Disaster Recovery Data Center of the GDCE. However, the existing disaster recovery data centers do not fully comply with the necessary technical requirements, indicating a need for improvement based on technical standards. While the GDT has not established its own disaster recovery data center, it has implemented a reliable data recovery and backup system that prevents data loss and supports sustainable operations to some extent. Meanwhile, the common disaster recovery data center of MEF is under development, based on approved principles. Once completed, this common disaster recovery data center will be utilized commonly by all General Departments and Entities, adhering to those principles.

The current network connectivity infrastructures and data centers are not yet very efficient and effective. At present, four General Departments manage their own infrastructures independently. The General Secretariat is responsible for overseeing and coordinating the use of the infrastructures for the other General Departments and Entities under MEF. However, some General Departments have not transitioned to the common infrastructure due to insufficient resources for the change. Additionally, the General Secretariat's ability to provide services is limited by a lack of resources and a small staff.

Unofficial Translation

Annex 2: The Results from COBIT 2019 Framework

COBIT, which stands for Control Objectives for Information and Related Technology, is a tool developed by the Information Systems Audit and Control Association (ISACA) for the purpose of assessing and governing IT systems to ensure the quality, efficiency, and reliability of IT systems.

The COBIT 2019 framework has identified 40 objectives for the governance and management of IT systems. Analysis of data collected from 15 organizations showed that out of the 40 objectives, 11 major objectives are considered to be important objectives that departments and organizations must achieve to ensure the achievement of the organization's primary objectives. These goals include **(1)**-Ensuring governance framework setting and maintenance through the use of methods that meet the objectives of the organization and ensure the coherence between stakeholders, **(2)**-Ensuring resource optimization, **(3)**-Ensuring stakeholders engagement, **(4)**-Managing enterprise architecture through the creation of interactions between stakeholders, **(5)**-Managing relationships between stakeholders, **(6)**-Managing quality (IT solutions and services), **(7)**-Managing data through the effective and transparent use and sharing of data, **(8)**-Managing solutions identification & build, **(9)**-Managing service requests & incidents, **(10)**-Managing performance and conformance monitoring, and **(11)**-Managing system of internal control.

Through these 11 main goals, we can draw three preliminary conclusions, including **(1)**-The preparation of an IT architecture that requires interaction between the General Department and the Entities as necessary and must ensure that they have the right to decide and manage their internal IT system as well as their data. In short, the General Department and the Entities still maintain their sovereignty, rights, powers, and roles, while participating more actively in the ecosystem of the MEF, **(2)**-Transparent data sharing between the General Department and the Entities to increase the efficiency of the use of existing data, and **(3)**-The use of shared resources will solve the problems of the IT system effectively by using existing resources together and defining clear roles and responsibilities.

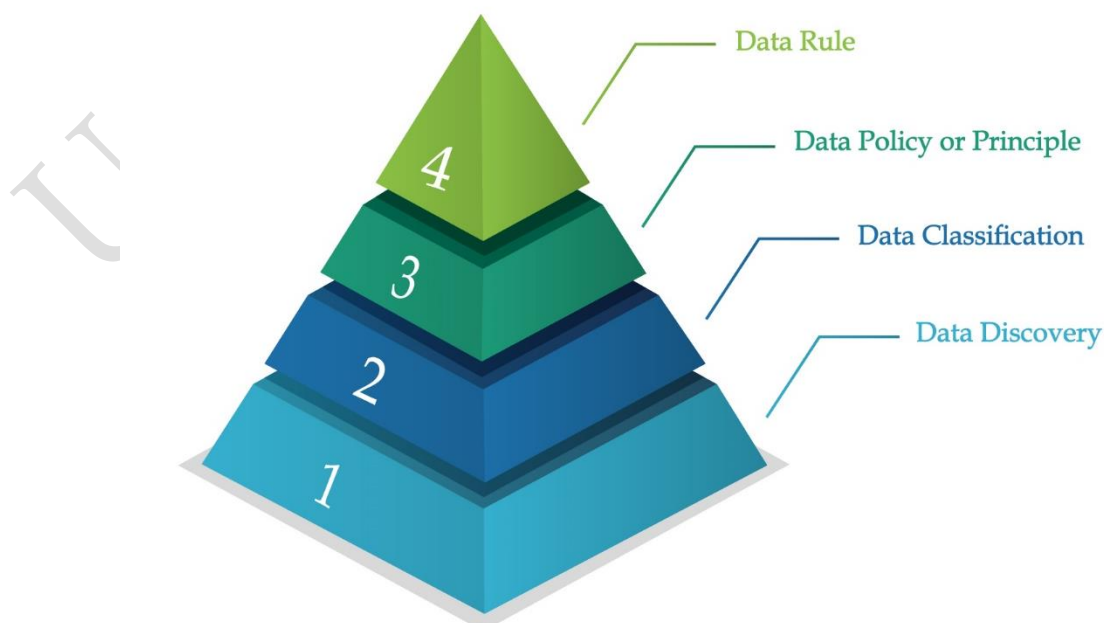
Among those questions, the Risk Profile related to IT systems was asked from each department and entity to determine the type, level, or magnitude of those risks to the overall process of the department and unit. The types of risks can be divided into three main categories, including **(1)**-Internal management (such as lack of commitment to technology investment by management and lack of program and project cycle management), **(2)**-Staff (such as knowledge and skills and professional ethics of staff), and **(3)**-External factors (such as hacking and supplier-related issues). The risk level was divided into five categories by multiplying the frequency with which such risks will occur and the level of relevance of those types of risks in each department and unit. The higher the risk level, the greater the attention that needs to be paid to manage, reduce, or avoid the impact of such types of risks.

Annex 3: Data Governance Framework

In general, data governance will follow three approaches: **(1)-People**, **(2)-Process**, and **(3)-Technology**. The **"People"** approach is fundamental to data governance because they create, collect, use, and manage data. Therefore, defining roles and responsibilities, including data owner, data consumer, data custodian, and data steward, is essential in data governance. In this framework, **"People"** refers to entities under the MEF and other relevant actors in the economy and finance ecosystem. In addition to defining roles and responsibilities, the **"People"** approach also refers to the importance of educating and training staff on the principles and practices of data governance. This will foster a data-literate culture within the institutions.

The **"Process"** approach is considered as a data management framework in data governance. **"Process"** refers to the structural development of data governance. Additionally, the **"Process"** defines the workflow and procedures for data management, including data quality checks, access control, data lineage tracking, and data retention. As part of the structural development of data governance, data discovery, data classification, data policy or principle, and data rule are essential. Data discovery will provide a comprehensive basis for understanding and identifying the data, for instance, each institution's data and the available data within each IT system. The data is then classified according to its type or sensitivity, as determined by institutional or national regulations. Based on data discovery and data classification, those data principles and sharing will be determined. Finally, the data governance approach will outline those specific data rules for sharing or managing data. Figure 15 below shows the four steps of data governance development.

Figure 15: Steps of Data Governance Development



All entities, regardless of their possession of IT systems, have data that serves the function of their entities and the ministry as a whole. Most of that data is managed by the responsible entity, or by the IT unit that manages the system. There are various types of data depending on the function of each unit; however, this data can be classified into six major categories, including **(1)**-Revenue Management, **(2)**-Revenue-expenditure Implementation and Financial and Accounting Operations of the State Budget, **(3)**-Public Investment, **(4)**-Financial Industries; **(5)**-Administration, Human Resources, Inventories and State Assets and Public Services, and **(6)**-Macroeconomics, Auditing, and Inspection. Despite the substantial volume of data, current practices within the Ministry of Economy and Finance indicate that much of the data is unstructured and inconsistent, and data sharing is limited. Data sharing still lacks a clear mechanism, hindering effective interaction between systems. Most practices involve a time-consuming and complicated process of submitting letters to make requests. Overall, the MEF lacks a clear data governance and interoperability framework for data sharing at the institutional level.

In implementing a decentralized ecosystem, data does not have to be concentrated in a single IT system; rather, it needs to be shared between IT systems to support the business functions of each institution. Moreover, each institution has full rights and responsibilities to manage and use its data, even when utilizing the IT systems of another institution. Currently, within the I-PFMIS, some IT systems, such as the IT management system of the GDT, the ASYCUDA system of the GDCE, and the IT system for non-tax revenue, are integrated with the FMIS, which serves as the core IT system for some critical data. However, the volume of synchronized data remains limited compared to the total data available within these IT systems. Furthermore, many other IT systems either have not yet synchronized data or still lack the capability to do so. Therefore, data sharing among entities remains problematic and hinders the optimal utilization of available data. In this regard, the MEF needs to establish a clear and precise data governance and interoperability framework that will serve as a common framework for the Ministry to promote a data-driven culture.

Based on these four steps of data classification, the primary variables of the entities under the Ministry of Economy and Finance are defined by key indicators such as data type, the function of the entities concerning data, the consistency of data sharing, the method of data sharing, and sensitivity of data sharing, as shown in the table below.

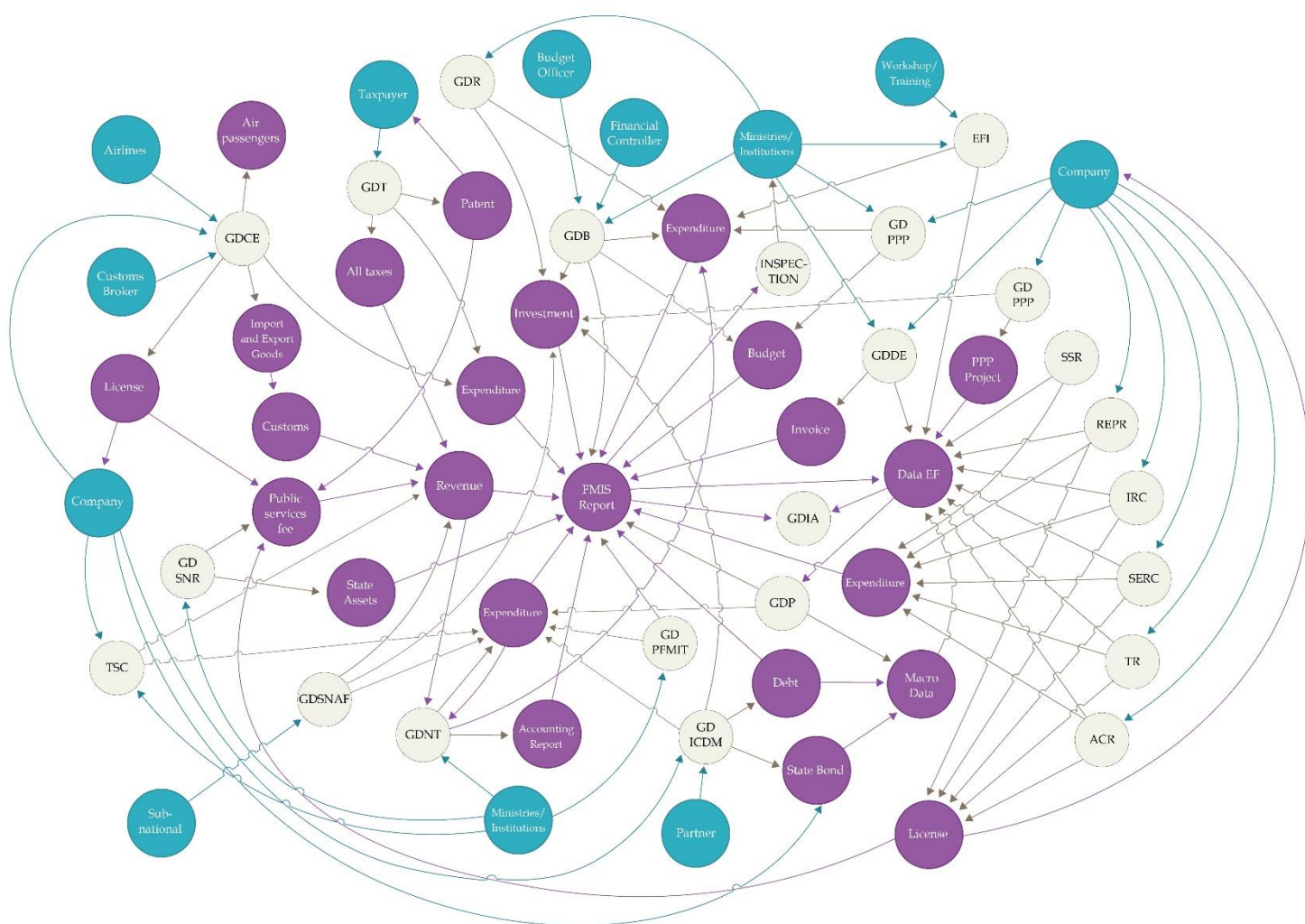
Table 1: Indicators and definitions for structural development of data governance

Classification	Type	Definition
Data type	Base registries	Details of the person or institution used for identification (e.g., details of the company applying for the license).
	Transactional	Data obtained from transactions, which may include time, location, price, ... (e.g., claim amount from daily insurance, shipping status).
	Statistical	Data derived from an analysis of the original data (e.g., the total number of licenses granted by a regulator in a month or year).
	Reporting	A report prepared in a timely manner for submission to relevant institutions (e.g., achievement reports, action plans).
Functions	Data Owner	Refers to those responsible for the content, definition, and quality of the data, as well as consent provision to the sharing of data with other persons for any purpose.
	Data Custodian	Refers to natural persons, legal entities, public administrative institutions, or public enterprises that determine the purpose and means of collecting, using or disclosing data.
	Data Consumer	Refers to natural persons, legal entities, public administrative institutions, or public enterprises that utilize the data owned by the data owners, acting as the data managers or public authorities.
	Data Steward	Refers to natural persons, legal entities, public administrative institutions, or public enterprises that monitor, search, review and reinforce the implementation of the agreed-upon data governance framework.
Consistency	Immediately	Data will be shared immediately after the transaction

	Hourly		Data will be shared hourly
	Daily		Data will be shared daily
	Monthly		Data will be shared monthly
	Quarterly		Data will be shared quarterly
	Semi-annually		Data will be shared semi-annually
	Annually		Data will be shared annually
Methods	Direct sharing	Paper	Data sharing in paper form
		Reporting (PDF, Word, PPT)	Data sharing in the form of PDF, Word, PowerPoint
		Excel	Data sharing in the form of Excel
		CSV	Data sharing in the form of CSV
	System to system	JSON	Data sharing in the form of JSON
		XML	Data sharing in the form of XML
Sensitivity	Public		Data that can be shared publicly
	Internal		Data for internal sharing and use within the Ministry only
	Confidential		Confidential data for institutions that can be shared and used only with the approval of the data owner.
	Restricted		Highly sensitive data, and it can affect the institution in the event of a leak.

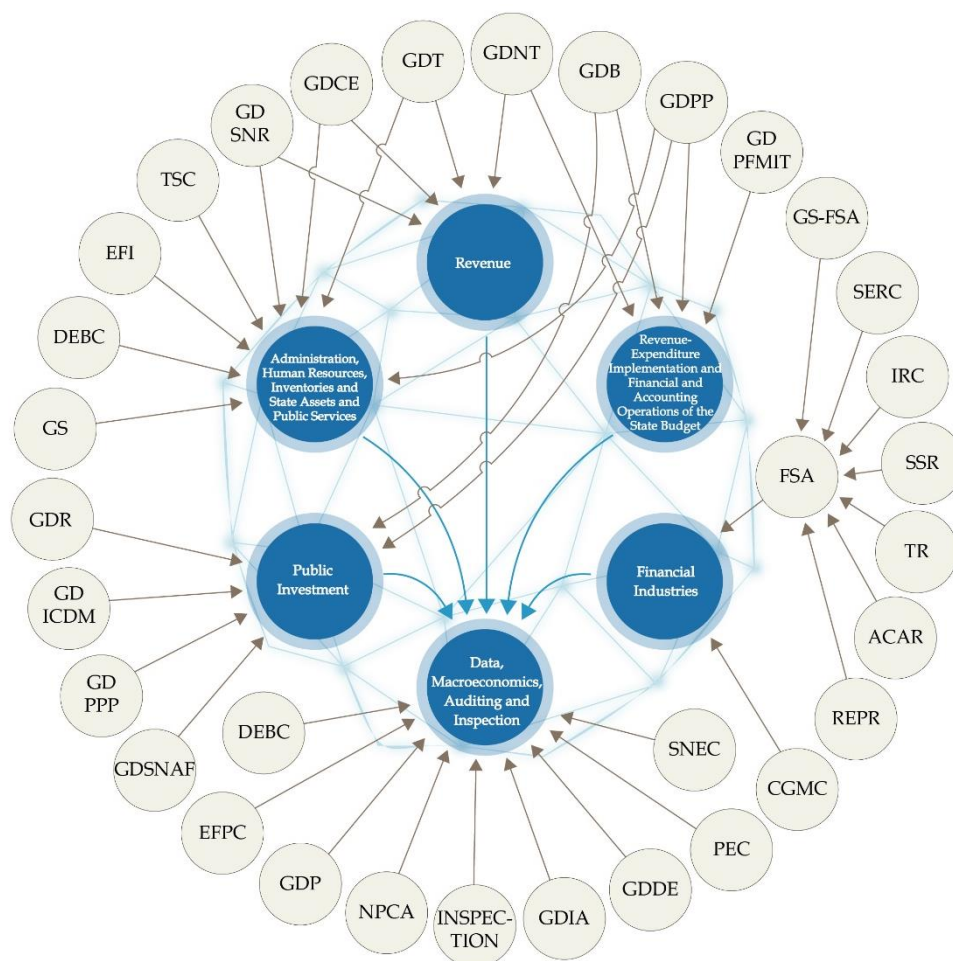
In the data discovery phase of the Ministry of Economy and Finance, there can be up to 18 types of data based on the function of the entities, including data on tax, customs, non-tax revenue, expenses, state assets, and liabilities, as shown in Figure 16 below.

Figure 16: Data discovery of the Ministry of Economy and Finance



In the data classification phase of the Ministry of Economy and Finance, data can be divided into six major categories (shown in Figure 17), including **(1)**-Revenue Management, **(2)**-Revenue-expenditure Implementation and Financial and Accounting Operations of the State Budget, **(3)**-Public Investment, **(4)**-Financial Industries; **(5)**-Administration, Human Resources, Inventories and State Assets and Public Services, and **(6)**-Macroeconomics, Auditing, and Inspection. This division is based on the five program functions of budget implementation of the MEF: **(1)**-Management of Public Revenue and State Assets, **(2)**-Management of Public Expenditure and the Public Finance System, and **(3)**-Administration and Institutional Development.

Figure 17: Data Classification in the MEF



In the third phase, which focuses on the phase of data policy or principle, the determination of instructions and authority of the data owner, data consumer, data custodian, and data steward will be established. Determining the data management approach or policy will enhance each stakeholder's understanding of their roles and responsibilities, leading to more effective and seamless practices in data governance.

In the fourth phase, which is the phase of data rules for data management, data rules will be developed based on some factors, including the type of activity (data analysis, reporting, or system integration) and the timeframe for achieving those activities (weekly, monthly, or immediately).

The "**technology**" approach is a key data governance driver. In general, "**technology**" refers to tools and software, IT systems for data quality monitoring and alerting systems, mechanisms for controlling data access, and data lineage tracking and metadata management.

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