How the Federal Enterprise Architecture Framework (FEAF) Supports Government Digital Transformation

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Abstract

The Australian Government's digital transformation is currently service-oriented, which emphasises the implementation of digital public services through the application of innovative technologies. Many countries have actively participated in related electronic government (e-government) projects, with the aim of providing more advanced services to their citizens. Although current digitalisation has brought economic and cost benefits to countries and public administration, the studies show that technology-based transformation alone is clearly insufficient. In this case, the adoption of Enterprise Architecture (EA) offers solutions to the issues of integration and interoperability that commonly occur in all e-governments. The Federal Enterprise Architecture Framework (FEAF) is the focus of this report, because the framework provides functions that meet the needs of most governments. This report takes Australian Capital Territory Health as an example, to analyse its current situation and identify challenges that need to be addressed. The six reference models were utilised to further elaborate on how FEAF could support ACT Health to carry out its strategic plan and tackle challenges successfully. Using FEAF as the main guiding model can enable the government to improve its interoperability, agility, integration and reusability to support the development of digital transformation.

1. Introduction

With the development of technology, the Australian Government is gradually building Internet portals with integrated resources to transform into an e-government, providing a one stop shop for citizens' needs. E-government refers to the use of information and communications technologies to provide and improve services, transactions and interactions in the public sector, enabling government organisations to provide better services and improve efficiency and effectiveness (Silcock 2001, p. 88). However, with a vast transformation within government systems, the coordination of business processes and the integration of underlying information systems is a significant challenge. Integration and interoperability between e-government and service-delivery systems through the adoption of an appropriate EA is critical.

This report will identify the current situation of local governments and the importance of e-government and its advantages and challenges. The report will then use ACT Health's strategic plan as a case study to explore processes and systems integration challenges and highlight the opportunities for service improvement in the e-government implementation. After comparing pros and cons of three widely-used enterprise architecture frameworks (EAF), FEAF is adopted to examine how the government organisation could be supported, be benefitted, and how a better result of the digital transformation could be created.

The rest of the report is organised as follows. Section 2 reviews the current situation of governments. Section 3 discusses the importance of different EA. Section 4 introduces the ACT Health as a case study and presents how the adoption of FEAF could help to tackle challenges.

2. E-government current situation

E-government was introduced in the early 1990s (Andersen & Henriksen 2006, p. 236; Xiao-ke 2010, p. 228). Governments around the world started to deliver their core services such as community support, education, transport, and health and wellbeing services via the internet.

Currently, there is no widely accepted definition of e-government (Field 2003, p.13; Estevez & Janowski 2013, p. S94). The World Bank defines e-government as government-owned or operated systems that transform the relationships with citizens, private sectors or other government agencies through the usage of information and communication technologies, which enable a more transparent and efficient government and enhance the service to the communities. According to the Organisation for Economic Cooperation and Development (Field 2003, p. 13), e-government refers to "the use of information and communication technologies, and particularly the Internet, as a tool to achieve better government".

2.1. Advantages

The adoption of e-government could bring various advantages for governments. For example, e-government allows the public to better access governmental information which consequently improves service quality. Apart from that, e-government also improves policy effectiveness (Field 2003, p. 19). For instance, health information could be captured and delivered more efficiently across organisations that allow providing better care to individuals.

2.2. Challenges

Despite the claimed benefits, there are difficulties in practicing e-government. While some e-government initiatives are unmanageable, the development of online services is still in its infant stage (Layne & Lee 2001, p. 123). Also, as data was collected and shared through the internet across organisations, governments needed to tackle issues such as interoperability and security. The integration across organisations required high inter-organisational collaboration, which was often not supported by existing business processes and organisational structures (Luna-Reyes et al. 2007, p. 808).

3. The importance of EA to e-government

EA is seen as a "blueprint" that provides business with a holistic view from strategy, business, and technology perspectives to improve overall productivity (Bernard 2012, p. 31). By utilizing EA, organisations can operate efficiently with lower costs and flexible workforce to further achieve their goals. Specifically, EA aligns business and IT to deliver the value of effectiveness and efficiency that is to do the right things and do the things right within the organisations (Luftman 2000, p. 6). Therefore, EA can be regarded as a strategic management tool which helps to unify business process development, reduce complexity, deal with issues such as security, and achieve higher consistency and business-IT alignment.

It is undoubted that local governments usually include multiple independent e-government projects resulting in decentralised business processes, duplicated systems and technologies, and creating interoperability issues within the organisation. The main causes are limited consistency between projects and lack of coordination. With the causes, Ojo, Janowski, and Estevez (2012, p. 4261) argue that the three main reasons for EA adoption in e-government development are to:

- Enhance interoperability and provide technical and managerial standards

- Enable resources sharing across organisations and reduce IT cost and business operations by identifying duplications and opportunities for reuse

- Deliver seamless services and support the development of shared processes

Thus, having an integrated EA while adopting e-government can bridge the gap between information communication technology systems and business processes to address the inefficiencies. The appropriate EA that suits the government will be discussed further.

3.1. Introduction to EAF

EAF provides principles, standards, and defines how to achieve target EA which allow architects to gain insights into the domains, layers, and document each view for further business decision-making. With various organisation types, situations and specific needs, the common frameworks that are used in industries include Zachman Enterprise Architecture Framework™ (ZEAF), The Open Group Architecture Framework™ (TOGAF), and FEAF.

3.1.1 ZEAF™

ZEAF has been widely adopted to demonstrate the operations and resources of the enterprise and incorporated into other architectural frameworks. It is a matrix containing thirty-six cells that interprets the perspectives of stakeholders. This includes planners, owners, designers, builders, programmers, and users (Sowa & Zachman 1992, p. 591). Specifically, ZEAF provides a holistic view of the enterprise, shows the views that need to be addressed, and describes enterprise business requirements in IT. However, the framework does not reveal the relationship between single models and does not determine how the information is collected and managed.

3.1.2   TOGAF™

TOGAF™ is an architectural framework that provides a comprehensive approach to the design, planning, implementation, and governance of enterprise information architecture. The purpose is to help create a systematic way to simplify the development process and reduce the errors at each stage. By creating a common language and building a bridge between IT and business, it helps to bring clear information to all relevant people. Furthermore, TOGAF™ assists organisations to implement software technology in a structured manner with the focus on governance and business goals. As software development relies on collaboration between multiple departments and business units, TOGAF™ helps to solve problems and ensure key stakeholders are on the same page (White 2018). However, organisations considered other tools rather than TOGAF™ not only because of the vague internal repository structure but also lack of practical templates (WhiteCloud Software Ltd. 2020).

3.1.3   FEAF

FEAF is mainly applicable to federal governments. By providing a common framework and management tools for federal agencies, it ensures the integrated policies and consistency to share information among agencies and government entities. Shortly, FEAF covers different aspects of the organisation for improving performances. Adenuga and Kekwaletswe (2012, p. 31) claim that the FEAF prioritises certain architectural fragments and provides mechanisms for identification, development, and documentation. Additionally, it regulates the government's mission and vision which allows better operation efficiency. However, the fact that there are no templates or products for development for FEAF was seen as a drawback.

4. Case study-ACT Health

4.1. Current situation

ACT Health, an agency under the ACT Government, provides and manages healthcare services in various fields to citizens. The organisation has multiple systems in place to provide comprehensive health care, however, the current disjointed systems lead to inefficiency and errors. The digital health plan introduced in 2019, lasting ten years, is intended to improve the challenges faced by the organisation. One of the main investments includes implementing Digital Clinical Systems to provide integrated, trusted and real-time personal digital health records that can be accessed by all people within the organisation at any location and on any device. In addition to providing a tool to support clinical decision-

making, the digital health plan also provides a platform to support patient-centred care, preventive healthcare and inspire for the future of healthcare direction.

4.2. Challenges faced by government

According to the current situation described by ACT Health in "Digital Health Strategy 2019–2029 (2019)", it encountered the following two challenges during the process of digitalisation:

4.2.1   Decentralised systems and inconsistent data

Nowadays, ACT Health has more than 250 systems. Decentralised and large systems make the integration or modification more complicated. Due to the decentralised systems within ACT Health, data quality is a concern. People in the organisation would obtain duplicate or obsolete data which may lead to negative impacts on service delivery. According to Redman (1998, p. 80), the poor data quality influences an organisation's operations, tactics and strategy. For instance, non-integrated data increases the difficulties for decision-making, and organisational strategy execution and definition. Furthermore, more resources are required to modify errors which increases operational costs.

4.2.2   Paper based records

Paper records play an important role in the ACT Health system. ACT Health currently uses a hybrid model with paper and electronic recording systems. According to Holden's (2010, p. 78) study, paper records may affect physicians' clinical performance and the quality of patient care, such as time-consuming and higher degree of error. Moreover, paper medical records require physical storage and suffer from a lack of backup and security. Most importantly, paper-based medical records cannot achieve information transparency within the organisation and share information with external organisations, also increasing the difficulties for future data analytics projects.

4.3. Why FEAF suits e-government organisation

As it is important to select an appropriate framework to improve the operation of the organisation, the type of framework should be defined prior. Mohamed et al. (2012) compared different EAF in the case of government. The study evaluated EAF from both the non-functional requirements perspective and from the development perspective. As can be seen in the below tables, FEAF has the highest score among two

evaluations. Hence, FEAF is suggested as the best framework to be adopted by the e-government (Mohamed et al. 2012, p. 260). The following paragraphs will discuss five critical evaluation criteria in detail to justify the reasons.

Table 1. Evaluation according to non-functional requirements (Mohamed et al. 2012)

Criteria	ZEAF	TOGAF	FEAF
Organisational Interoperability	1	2	2
Semantic Interoperability	1	1	1
Technical Interoperability	0	1	2
Agility	0	2	1
Integration	1	1	2
Reusability	0	1	2
Score	3	8	10

0: Does not support, 1: Partially support, 2: Support explicitly

Table 2. Evaluation according to development issues (Mohamed et al. 2012)

Criteria	ZEAF	TOGAF	FEAF
Architecting Process	0	3	2
Service Orientation	0	2	2
Cloud Enablement	0	1	1
Architecture Modelling	1	3	2
Evaluation and Governance	0	2	3
Reference Models	1	2	3
Complexity Management	1	2	3
Documentation	2	2	3
Score	5	17	19

0: Poor, 1: Acceptable, 2: Good, 3: Very good

4.3.1   Architecture modelling

Architecture modelling considers the modelling tools and techniques of FEAF. The core of FEAF is the Consolidated Reference Model (CRM) which enables federal agencies with a common language and framework (Whitehouse 2013). CRM is composed of six interrelated reference models which provide standardised categorisation for strategic, business and technology models (Enterprise 2012).

The ACT digital health strategy plan identifies three major strategies to ensure digital transformation can be carried out seamlessly. The strategic plan also outlines possible future digital technology. However, there is a lack of overall architecture modelling specifying how the government handles the collaboration across different agencies. To achieve its objectives, the government needs to ensure a common and consistent way to manage digital transformation.

4.3.2   Service orientation

Service-Oriented Architecture (SOA) defines all functions as independent services with well-defined interfaces. The value of adopting SOA is that it allows organisations to leverage existing assets and can reduce costs to create new services (Channabasavaiah, Holley & Tuggle 2003).

As mentioned in the strategy plan, the ACT Government wants to promote system reusability and improve its agility regarding system integration. One of the first priority investments in the strategic plan is to build a digital clinical system to handle electronic medical records. This requires massive communication for health information exchange between systems. The SOA can be used in conjunction with FEAF reference models to identify the candidate services or applications. This aligns with the ACT Government's principle to seek a contemporary approach to minimise point-to-point interfaces.

4.3.3   Cloud enablement

Cloud computing is an emerging technology that creates revolution to e-government systems particularly because it offers cost-effective and easy-to-deploy solutions to help organisations to tackle their challenges (Mohamed 2012, p. 259; Mohammed et al. 2016, p. 304). Governments around the world introduced cloud computing technologies to improve the efficiency and effectiveness of existing services and reduce costs for public sectors (Kurdi et al. 2011, p. 406).

The ACT government would like to shift toward a cloud-first approach to meet future demands. In this regard, the FEAF Infrastructure Reference Model (IRM) which specifies cloud-related standards can be utilised to support the transformation. While IRM focuses on the platform, network and facility, it not only ensures a consolidated cloud infrastructure but also helps to manage service level agreements.

4.3.4   Evaluation, governance and management

As mentioned above, the ACT government can be seen as a nested organisation that incorporates many

agencies and hierarchy levels. To ensure IT investments are aligned with the ACT Government's business goals, it requires a comprehensive evaluation and governance approach. As depicted in the ACT strategy plan, the government wants to establish a good governance foundation to underpin the digital future technology as a whole. It also mentioned two ways to measure the performance of the implementation. However, there is not enough information to articulate how to govern and evaluate while implementing.

In this context, the governance element among eight basic elements within FEAF supports the organisation to measure the coherence, completeness and consistency for the entire planning process (Enterprise, 2012). The ACT Government can utilise the integrated governance model to ensure business and IT alignment during the implementation.

4.3.5 Documentation

Government is considered to be a complex organisation with levels of scope across various agencies. Meanwhile, policies and stakeholders change constantly in the case of e-government (Mohamed et al. 2012, p. 260). Hence, it is important for the ACT government to emphasise the documentation process because it provides a holistic view of the enterprise in detail.

While the ACT strategy plan identifies strategies and a high-level roadmap of the transformation, there is a lack of information in terms of the documentation process for the entire plan. In this regard, FEAF provides a documentation artifact with six sub-architecture domains to ensure information can be captured completely and fulfill stakeholders' requirements at the same time. The documentation artifact promotes a consistent view within and between organisations and ensures shareability among services, which consequently supports the robust infrastructure and facilitates the implementation process (Enterprise, 2012).

4.4. Benefits of adopting FEAF

The ACT Government is considered as a nested enterprise because it includes subunits and engages with the architecture. With that assumption, FEAF is the suggested nested framework that helps to support the federal organisation (Fatolahi & Shams 2003). By applying FEAF, the ACT Government will enhance the interoperability, agility, integration, and reusability to guide ACT Health for achieving digital transformation.

4.4.1 Interoperability

Interoperability is the ability of two or more systems, entities, and people to communicate and share information accurately. The three dimensions are organisational, semantic, and technical interoperability that assist the enterprise to evaluate the overall process and deliver cross-agency services efficiently. The table 3 below elaborates how FEAF helps the ACT Government to strengthen interoperability to further eliminate inconsistency across departments (Mohamed et al. 2012, p. 258).

Table 3. Benefit of interoperability for ACT Health

Interoperability	Benefits	How to benefit ACT Health
Organisational	Improve the services cost-effectively.	Achieve the desired future state to ensure the up-to-date data is accessible to clinicians, interrelated healthcare providers, and ACT Government entities effectively (Mohamed et al., 2012).
Semantic	Ensure the exchanged information has consistent and understandable meaning across departments.	Allow the clinicians and healthcare providers to access patients' details timely to offer accurate diagnosis effectively.
Technical	Offer features as open system interfaces, message exchange, accessibility and security services.	• Ensure the designated clinicians and staff have access to information anytime and anywhere from different technologies like tablets, mobiles, and laptops. • Improve security services to support e-government when investing in cloud platforms.

4.4.2 Agility

Agility refers to the enterprise's ability to act quickly to accommodate unpredictable changes. As the political, technological, and regulations change, it may cause problems in the systems and the processes. Thus, e-government must improve agility in the operations by considering the potential actions. For instance, the ACT Government should revisit the mission support systems utilised in the government and the interrelated subunits, ACT Health. This improves the flexibility to adapt to the new requirements and provides timely responses to patients. Also, adopting "time" as the critical criterion for evaluating the performances. Specifically, ACT

Health should set goals to reduce the time and provide high-quality services to the patients simultaneously. However, agility is the key to achieve efficiency and eliminate costs (Kamensky 2017). With the feature of agility in FEAF, ACT Health can manage the changes properly.

4.4.3   Integration

According to the strategic plan for ACT Health, it is undeniable that there are various systems across departments to deal with up-to-date patients' data. Integration is to combine the subsystems and ensure the functions are compatible within a particular system. Without integrating the subunits properly, the outcome of the services will affect the time, costs, and quality. By considering FEAF, integration offers a method to enable the consistency between the system and the scope of ACT Health (Mohamed et al. 2012).

centric services efficiently. Also, the plan shows how digital transformation benefits the participants in ACT Health. By having interchangeable data across systems, it is suggested that the common components should be reused to enable the staff and healthcare providers to access patients' data accurately and promptly. Therefore, reusability helps ACT Health to reduce time and costs for implementing systems and provide high-quality services to the patients.

4.5. Addressing challenges in ACT Health

The core of the FEAF is the Consolidated Reference Model which consists of six reference models. The following paragraphs describe how the six reference models address the challenges faced by ACT Health. Figure 1 gives a holistic view of the possible improvement of adoption.
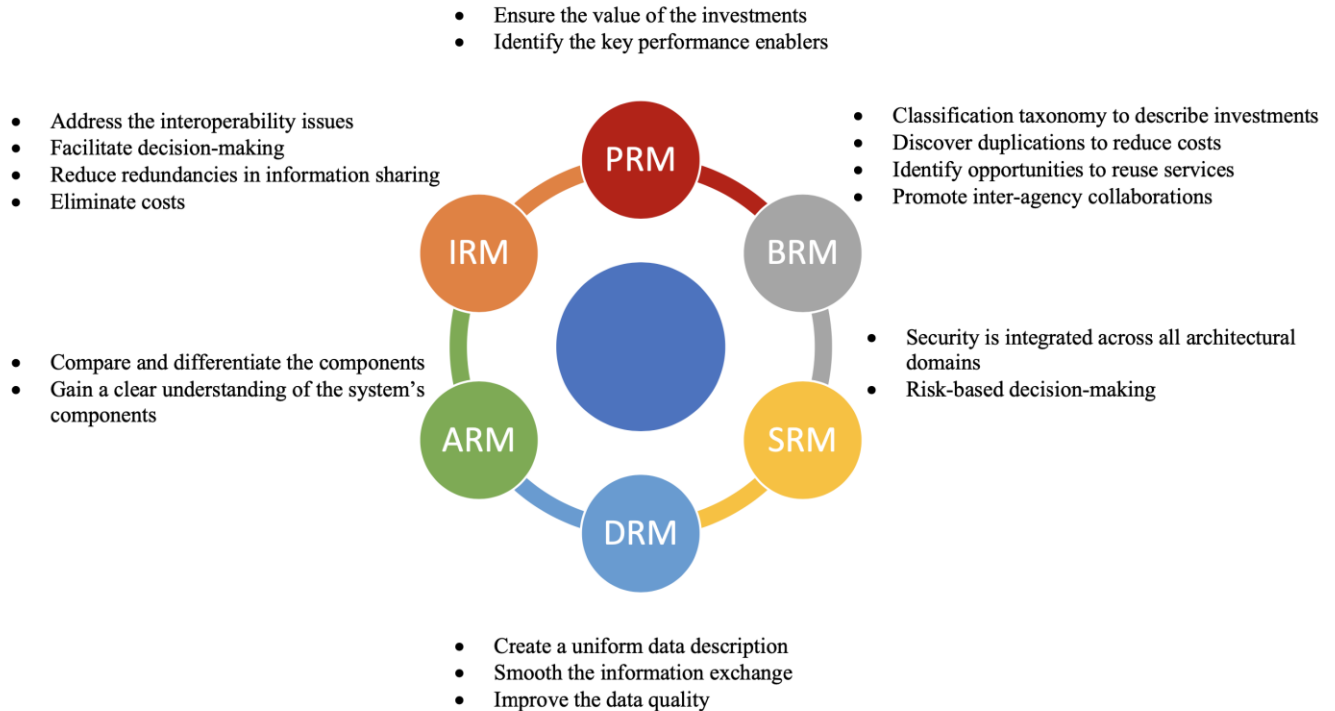

- Ensure the value of the investments
- Identify the key performance enablers

- Address the interoperability issues
- Facilitate decision-making
- Reduce redundancies in information sharing
- Eliminate costs

- Classification taxonomy to describe investments
- Discover duplications to reduce costs
- Identify opportunities to reuse services
- Promote inter-agency collaborations

- Compare and differentiate the components
- Gain a clear understanding of the system's components

- Security is integrated across all architectural domains
- Risk-based decision-making

- Create a uniform data description
- Smooth the information exchange
- Improve the data quality

Figure 1. Six Reference Models

4.4.4   Reusability

Reusability refers to the components that can be applied and used in more than one system. E-government should consider reusability because the services provided by different authorities use common parts. According to the strategic plan, ACT Health has shown the importance of investing in cloud platforms to manage the massive data needed to provide patient-

4.5.1   Performance Reference Model (PRM)

PRM aims to link investments to the enterprise vision. As ACT Health planned to focus on the areas of investments like digital clinical systems, diagnostic and medication services, digital corporate and operational systems, and collaboration and communication, it is critical to know whether the investments are valuable.

Specifically, to ensure the value of the investments, the input, output, and outcome in ACT Health should be identified along with the key performance enablers. This helps to understand how the multiple investments support the strategic outcomes that will provide patient-centric services to suit patients' needs ('Federal Enterprise Architecture Framework' 2013).

4.5.2 Business Reference Model (BRM)

BRM is a standard taxonomy used to describe services provided by the government which is composed of three layers, including the mission sector, business function and service. While the ACT Health strategic plan presents a guide for digital transformation for the next ten years, it involves tremendous capital investments in technology initiatives. Further, as it plans to implement digital clinical systems that provide a single health record for patients, this requires strong collaboration in both public and private health sectors. By using a classification taxonomy to describe investments, business functions and services, it enables the ACT Government to discover duplications within the organisation to reduce costs; identify opportunities to reuse services and promote inter-agency collaboration ('Federal Enterprise Architecture Framework' 2013).

4.5.3 Security Reference Model (SRM)

SRM links security and privacy within the EA of government, including organisational strategic goals, business processes, data flows, applications, and infrastructure technologies, to ensure that every aspect of the organisation is covered with appropriate security and privacy ('Federal Enterprise Architecture Framework' 2013). ACT Health is committed to investing in multiple integrated systems in different service areas to provide services with efficiency and good quality. With SRM, ACT Health could ensure that security is integrated across all architectural domains and at all levels within the organisation. To be more specific, SRM is ubiquitous and provides a common language and method for risk-based decision-making to ensure that security is considered in IT systems from the beginning to the end.

4.5.4 Data Reference Model (DRM)

The purpose of DRM is to promote a standard description that facilitates information data sharing and reuse across systems or agencies ('Federal Enterprise Architecture Framework' 2013). As the ACT Health strategic plan intends to build a single-source digital clinical system, it involves massive health data exchange across patients, clinics, hospitals and public health sectors. In this context, DRM is able to create a uniform data description that not only smooths the information exchange but also improves the data quality as well. Moreover, DRM can be used in conjunction with BRM to classify data sources to support shared services, which allows the ACT Government to leverage its existing data sets.

4.5.5 Application Reference Model (ARM)

The purpose of ARM is to provide a basis for the classification of applications and their components ('Federal Enterprise Architecture Framework' 2013, p. 42). More and more organisations are introducing diverse applications in their systems, and ACT Health is one of them. FEAF has set relevant principles and models for this trend. Among the models provided by FEAF, ARM categorises technologies related to systems and applications that support the delivery of service ('Federal Enterprise Architecture Framework' 2013, p. 42). If the organisation compares the components in the system with the ARM standards, it will find the differences. This will help the organisation reintegrate system applications in a standardised manner and achieve economies of scale. As mentioned in section2, the challenges faced by ACT Health, ACT Health has problems caused by decentralised systems. New systems planned to be added may be hindered by complexity as well. Therefore, the use of the ARM structure will help ACT Health understand the system's components more clearly.

4.5.6 Infrastructure Reference Model (IRM)

IRM consists of three domains, platform, network, and facility that help to promote benefits across digital implementation and transformation. According to the ACT Health strategic plan, the shift to the cloud approach is considered one of the most important parts of the digital investment. IRM helps to create IT asset management and evaluate the feasibility of moving the infrastructure to the cloud. Moreover, the duplicate components that were utilised can be identified. By applying the reference model, ACT Health can address the interoperability issues and benefit the business by facilitating decision-making, reducing redundancies in information sharing, and eliminating costs ('Federal Enterprise Architecture Framework' 2013).

5. Conclusion

Under the recent trend of digitalisation of government institutions, it is necessary to provide citizens with easier-to-use services and improve the connection between organisations and the public

through technology. Therefore, the method of evaluating the system through the EA and finding key issues is particularly important for conducting e-government. According to the analysis of this study, FEAF is a framework which provides standardised principles of sharing reusable information technology resources within government agencies. Six reference models form a set of frameworks whereby departments can describe the important constituent elements of an organisation's systems in a uniform manner. The agility, integration, interoperability and reusability within government agencies will be improved after adopting it widely. What's more, the benefits of FEAF will further improve the operational performance of the EA. Hence, it is recommended that government agencies apply the FEAF while developing innovative functions of e-government in the future.

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