How Does The Open Group Architecture Framework (TOGAF®) Realise Queensland's Digital Health Transformation?

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Abstract

The digital medical system in Queensland is currently facing a significant gap in digital technology. 'Queensland Digital Health Strategic Vision 2026' is a 10-year digital plan proposed by the Queensland Department of Health in 2017. It aims to establish a comprehensive consumer-centric system to involve all stakeholders effectively and provide them with convenient channels and services to access medical and health information. However, the strategic plan lacks an appropriate enterprise architecture framework (EAF) to ensure the complete realisation of the vision. As of 2020, under the influence of COVID-19, Queensland's digital medical system has not achieved the expected strategic goals.

This study aims to use the concept of EAF to reform Queensland's current digital health system. Specifically, it analyses three common architectural framework options, namely, a federal EAF (FEAF), the Zachman EAF© (ZEAF) and The Open Group Architecture Framework (TOGAF®). Whether these frameworks can be used to build Queensland's digital medical system is investigated.

To test the hypothesis that TOGAF® is the most suitable EAF under the current vision of the Queensland digital medical system, a literature review is conducted, a large number of documents related to EAF are consulted online, and different frameworks are reviewed. Documents related to EAF can be found in databases, such as Melbourne University Library, Science Direct, Informs and Google Scholar. The search engine function is used to search articles and journals by identifying the keywords of this report, such as Digital Health System, Queensland, EAF, TOGAF®, ZEAF and FEAF. Results show that TOGAF® will help Queensland's digital medical system achieve its goals and vision.

The results of the literature review suggest using TOGAF® to solve the aforementioned challenges and realise feasibility analysis of digital system optimisation. The eight phases of the architecture iterative cycle are clearly explained to enhance feasibility and guide the conversion process. The use of TOGAF® to improve digital health transformation is feasible within Queensland. On this basis, the Queensland digital medical system should use good information technology management, ensure data security and adopt a simple and easy way to operate.

This report also identifies limitations, including the lack of digital information, sufficient user feedback of the Queensland digital health system and professional analysis of the Queensland digital health system.

Keywords: Health care, digitalization, Queensland, health system, Federal Enterprise Architecture Framework (FEAF), Zachman Enterprise Architecture Framework© (ZEAF), The Open Group Architecture Framework (TOGAF®), enterprise architecture (EA), enterprise architecture framework (EAF).

1. Introduction

With the continuous development of digital technology, its adoption into everyday operations promises benefits for social well-being. The Queensland government intends to deliver advanced digital healthcare through disruptive innovation, which refers to a 10-year strategic plan proposed to achieve its goals gradually by building, optimising and transforming the current health system. However, varying requirements amongst government health systems can be a major challenge for the integration of business capabilities. The alignment between technology systems and business goals can also be a significant issue. These issues illustrate that applying appropriate enterprise architecture (EA) concepts and frameworks in digital transformation plans is critical.

The objectives of this report are to analyse the Queensland government's digital health plan and identify the current situation and advantages of the Queensland health plan. Then, it emphasises the key challenges and explains the adoption of The Open Group Architecture Framework (TOGAF®) to address these challenges.

2. Motivation

Since December 2019, countries worldwide have been affected by the COVID-19 pandemic. The World Health Organization calls on countries to establish digital health systems to support outbreak responses in the health sector (Fagherazzi et al., 2020). Digital medical technology protects patients, clinicians and communities from the risk of being exposed to the virus. Moreover, digital health systems are considered to provide patients with convenient remote medical treatments (Peek, Sujan & Scott, 2020). Therefore, the importance of medical systems is reflected in this epidemic. The medical systems of countries should be upgraded to achieve seamless service delivery. COVID-19 will be an important catalyst for the reform and upgrading of medical systems.

In accordance with the report of the Queensland Department of Health (Queensland Government, 2017), the current digital health system faces many challenges, such as growth in healthcare expenditure and the ageing population. Owing to the lack of seamless service delivery and effective system integration, the current digital health system cannot meet the increasing demand for medical services. Furthermore, COVID-19 has had a considerable effect on Australia.

Although the situation in Queensland is relatively better than that in other areas, the second outbreak of the epidemic in Victoria requires Queensland to prevent another outbreak of COVID-19. The digital health system is the most important support for the medical system, requiring efficient service delivery and data sharing. Thus, achieving the efficiency of the digital health system is a significant issue that the Queensland health department should consider.

3. EA and EA Framework (EAF)

3.1. Introduction to EA

EA is the practice of evaluating, creating, planning and executing enterprise-wide actions and strategies to achieve anticipated business value and objectives. It provides architectural principles and approaches to ensure the leading position of an organisation and the alignment between business strategies and digital and technological transformation (White, 2018). EA has already become a business priority in keeping up with the development and application of ever-accelerated updating of modern technology.

3.2. Introduction to EAF

EAF could be considered the foundation for building EA. That is, EAF refers to the framework, process and methodology that enable or guide an organisation to construct its EA (Watts, 2018). Four agreed categories of EAF, which are the Zachman EAF© (ZEAF), Federal EAF (FEAF), Treasury EAF (TEAF) and TOGAF®, are introduced in this report.

3.2.1. ZEAF

ZEAF is supposed to be the fundamental structure for EA. As depicted by Zachman (2008), it is typically 'a 6 × 6 "matrix" with the Communication Interrogatives as Columns and the Reification Transformations as Rows.' This framework provides an ontology instead of a methodology to establish an infrastructure which assists organisations during the processes of developing,

integrating, designing, governing and acquiring an information system (IS) (Sajid & Ahsan, 2016). However, ZEAF can be 'documentation-heavy' given 36 cells supported by countless models (Ambler, 2007).

3.2.2. FEAF

FEAF is a system of EA especially designed for federal governments, which is composed of five reference models. It highlights the importance of the shared improvement of general information and processes amongst various government departments and agencies. The architecture of FEAF is divided into four levels, namely, business, data, applications and technology (Leist & Zellner, 2006). Nevertheless, FEAF lacks specifications of metamodels. To a certain extent, this framework underestimates the contribution of technology to increasing business value.

3.2.3. TEAF

TEAF is an EAF that provides support to the Treasury's business processes. This EAF, which combines the interrelationships amongst organisations in a map to optimise the utilisation of information technology (IT) resources, is created by the Department of Treasury (Urbaczewski & Mrdalj, 2006). In the TEAF matrix, four views, which are functional, information, organisational and infrastructure views, are described as columns. Four perspectives, namely, planner, owner, designer and builder perspectives, are defined as rows. Therefore, 16 cells in the matrix represent work products, which shows that information from other views and perspectives should be considered once a work product is created. TEAF provides considerations that identify 'essential work products' from 'supporting work products' (Goethals, 2005).

3.2.4. TOGAF®

TOGAF® is an EAF developed by The Open Group, which supports a business to achieve its objectives (Opengroup.org, 2020). Seven main parts are considered in the TOGAF® document; they are Introduction, Architecture Development Method (ADM), ADM Guidelines and Techniques, Architecture Content Framework, Enterprise Continuum and Tools, TOGAF® Reference Models and Architecture Capability Models (The Open Group, 2018). Moreover, TOGAF® guides four types of architectures, including business, IS and technical architectures. TOGAF® can enable organisations to align their IT goals with business goals (White, 2018) and thus enhance businesses to capture their competitive advantages.

4. Significance of Using EA and EAF

As stated earlier, EA is the management blueprint for business–IT alignment improvement. Ahsan, Shah and Kingston (2009) concluded that the benefits of EA could be categorised into a hierarchy as the graph depicted in Figure 1 below, namely, IT and organisational benefits. EA provides IT system development with governance, which aligns IT principles, resource allocation and architecture. Moreover, EA makes it possible to evaluate the strategic goals of an IS holistically on the basis of corporate needs.

EA can optimise business processes and enhance the visibility and productivity of ISs. For companies which pursue a client-oriented innovation and efficient strategic decision making, reviewing and evaluating current EA can be beneficial (Ahsan, Shah & Kingston, 2009).

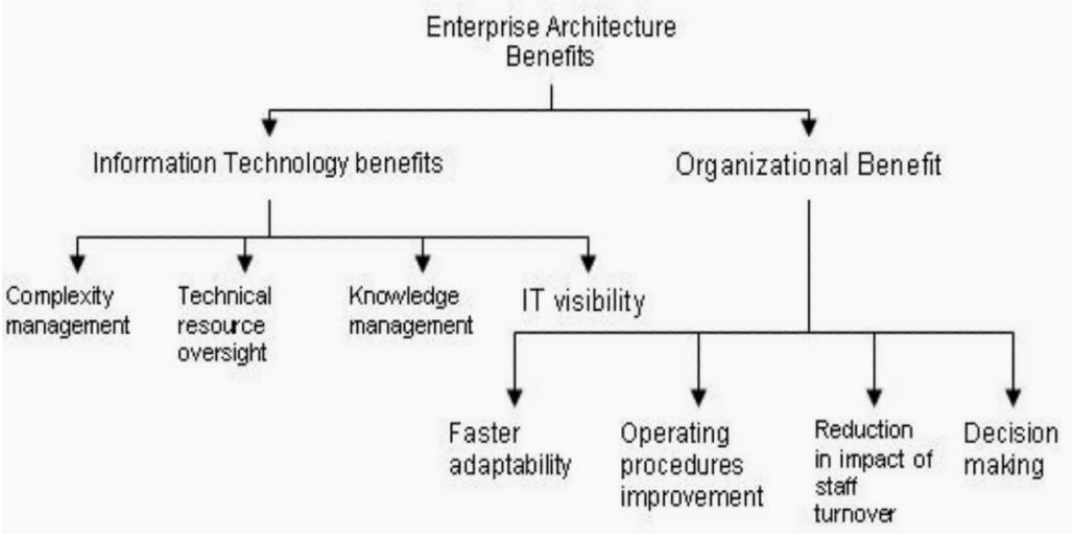

Figure 1. EA Benefit Hierarchy (Ahsan, Shah & Kingston, 2009)

Ahsan, Shah and Kingston (2010) held the view that EAF, as the actual practice framework for the EA approach, can provide instructive principles, standardised decision-making processes and means of implementation and integration of ISs. Urbaczewski and Mrdalj (2006) emphasised the importance of EAF selection for specific projects through comprehensive comparison.

5. Case Study - Digital Health Strategy Vision for Queensland 2026

5.1. Background

The Digital Health Strategic Vision for Queensland 2026 was published by Queensland Health in 2017, stating a 10-year goal in performing digital transformation and achieving innovation in the healthcare field. The primary objective of this strategic plan is to develop an integrated and consumer-centred system which involves health consumers, clinicians, health service providers and other relevant stakeholders, providing them with easy access to health data and acknowledgement. Various smart and modern technologies are adopted to facilitate targeted, professional, coordinated and systematic healthcare services.

5.2. Challenges

5.2.1. Inefficient and Insecure Data Sharing

Currently, massive and unstructured healthcare data possessed by different stakeholders is scattered across the Queensland health system, hindering the symmetrical provision of healthcare services. This problem could result in fragmented treatments and inconsistent medical care levels (Queensland Government, 2017). In reality, the Queensland healthcare system appears to be incapable of integrating diverse systems and databases of different locations and sectors, failing to realise effective and secure data sharing because healthcare customers, clinicians and relevant stakeholders have relevant accesses. To address the problems mentioned above, Queensland plans to implement wireless networks and bring your own devices in future decades (Queensland Government, 2017). Data confidentiality could be a key issue when dealing with mobile networks, mass data and system integration. According to OECD (2019), unrestricted data sharing may lead to unauthorised data access, critical information leakage and violation of intellectual property rights or agreed terms and conditions.

5.2.2. Poor IT Governance

In accordance with the Digital Health Strategic Vision for Queensland (Queensland Government, 2017), various stakeholders, sections and systems are involved in the digital health system. Therefore, instead of simply applying digital technology to current practices, Queensland should also change the way that it provides health services and establish an effective IT governance, ensuring efficient collaboration and high-quality service delivery. However, Queensland currently lacks a highly unified decision-making structure regarding the information-sharing priorities and employee management. Chaotic IT governance can lead to poor coordination between IT-oriented components and the broad management of business transformation plans. Poor IT governance may also increase expenditures and the possibility of violating data security and regulatory compliance. Most importantly, manpower and IT assets cannot be fully employed (McCue, 2007). Participants' contributions may not be precisely evaluated; thus, they have minimal incentives to adapt to the digital health system cooperatively.

5.2.3. Low Level of Digital Literacy

Various health-related technologies, including mobile applications, EMR and 3D printing, have been implemented in the Queensland digital health system. Meanwhile, smart and specialised systems are integrated into existing infrastructure (Queensland Government, 2017). The increasing adoption of digital technology requires improved levels of technical assistance and digital literacy across the workforce and system and the provision of readable and understandable clinical information for healthcare consumers. However, no indication shows that the current digital health system can support consumers to adapt to these changes. Training for healthcare professionals is also deficient. Kuek and Hakkennes (2020) demonstrated that low digital literacy will lead to staff's incompetence and lack of confidence in ICT, which could result in low engagement and self-efficacy. For example, poor computer skills and negative attitudes towards ISs hinders the adoption of electronic health records.

5.3. Why Choose TOGAF®

Mohamed et al. (2012) pioneered in comparing four EAFs from the perspectives of non-functional requirements and development issues under the circumstance of e-government implementation. Considering the remarkable similarity between the Queensland e-health system and e-government, this article compares ZEAF, FEAF, TEAF and TOGAF® on the basis of these two perspectives in accordance with Mohamed's work. The research method proposed by Urbaczewski and Mrdalj (2006) is a valuable reference for EAF comparison. Thus, in this section, four frameworks are thoroughly compared through the revision of their opinions.

5.3.1. Comparison by Non-functional Requirement Perspective

Criteria	ZEAF	TOGAF	FEAF	TEAF
Organizational Interoperability	1	2	2	1
Semantic Interoperability	1	1	1	1
Technical Interoperability	0	1	2	1
Agility	0	2	1	2
Integration	1	1	2	1
Reusability	0	1	2	1
Score	**3**	**8**	**10**	**7**

Figure 2. Comparison by Non-functional Requirements (Mohamed et al., 2012)

1) Organisational Interoperability

Organisational interoperability is defined as the coordination of business process and information architecture within and across enterprise boundaries, which enables methods and services to be commonly shared and pursues an efficient alignment (Mohamed et al., 2012). TOGAF® achieves a relatively high mark here, which indicates that decisions made by healthcare organisations can be highly accurate.

2) Agility

Someone argues that TOGAF® cannot be practically adopted due to its inability to provide a set of architectural principles. However, TOGAF® features agility, which explains the methodology of developing principles for supporting system implementation under various conditions (Mohamed et al., 2012).

5.3.2. Comparison by Development Issues

Criteria	ZEAF	TOGAF	FEAF	TEAF
Architecting Process	0	3	2	2
Service Orientation	0	2	2	1
Cloud Enablement	0	1	1	0
Architecture Modeling	1	3	2	1
Evaluation and Governance	0	2	3	3
Reference Models	1	2	3	1
Complexity Management	1	2	3	2
Documentation	2	2	3	2
Score	**5**	**17**	**19**	**12**

Figure 3. Comparison by Development Issues (Mohamed et al., 2012)

1) Architecting Process

TOGAF® is gauged for open system development, which provides high flexibility. Amongst the four frameworks, TOGAF® has a well-developed architectural process called ADM (Mohamed et al., 2012). ADM organises eight processes iteratively, which thus reduces the risks of errors.

2) Service Orientation

TOGAF® is service oriented, addressing individual and differentiated concerns. In the case of the state's e-health system, TOGAF® can facilitate developing a user-friendly information-sharing function which particularly caters for patients' demands.

5.3.3. Comparison by Stakeholders' Views

Urbaczewski and Mrdalj (2006) believed that TOGAF® manifests a distinct advantage in the business and technical architecture by comprehensively depicting owner, designer and builder views in terms of involvement in actual processes. By contrast, TEAF presents general views from project planner to system builder without detailed explanation.

Framework	Planner	Owner	Designer	Builder	Subcontractor	User
Zachman	Scope	Business Model	System Model	Technology Model	Detailed Representations	Functioning System
DoDAF	All View	Operational View	Systems View	Technical View		
FEAF	Objectives/Scope Planner's View	Enterprise Model Owner's View	Information Systems Model Designer's View	Technology Model Builder's View	Detailed Specifications Subcontractor's View	
TEAF	Planner	Owner	Designer	Builder		
TOGAF		Business Architecture View	Technical Architecture Views			

Figure 4. Comparison by Stakeholders' Views (Urbaczewski & Mrdalj, 2006)

5.3.4. Comparison by the Systems Development Life Cycle (SDLC)

SDLC consists of five phases, namely, planning, analysis, design, implementation and maintenance (Urbaczewski & Mrdalj, 2006). TOGAF® explains the principles which support initial analysis and implementation phases. It semantically executes these SDLC phases, which will promote the integrations when FEAF and TEAF perform the development life cycle segmentally.

SDLC Phase/ Framework	Planning	Analysis	Design	Implementation	Maintenance
Zachman	Yes	Yes	Yes	Yes	No
DoDAF	Yes	Yes	Yes	Describes final products	No
FEAF	Yes	Yes	Yes	Yes	Detailed Subcontractor's View
TEAF	Yes	Owner's Analysis	Yes	Yes	No
TOGAF		principles that support decision making across enterprise; provide guidance of IT resources; support architecture principles for design and implementation			

Figure 5. Comparison by SDLC (Urbaczewski & Mrdalj, 2006)

5.4. How TOGAF® Addresses the Challenges

The core of TOGAF® is the ADM, which provides a tested and repeatable process for translating requirements into operational architecture models (The Open Group, 2018). ADM provides support by establishing an architectural framework, developing architectural content, transitioning and governing the implementation of architectures. It is an iterative cycle with eight generic phases (A–H), namely, architecture vision, business architecture, IS architecture, technical architecture, opportunities and solutions, migration planning, implementation governance and architecture change management. Organisations can capture opportunities effectively and efficiently by adopting the ADM. The following sub-sections illustrate how each of these phases addresses the challenges faced by the Queensland government.

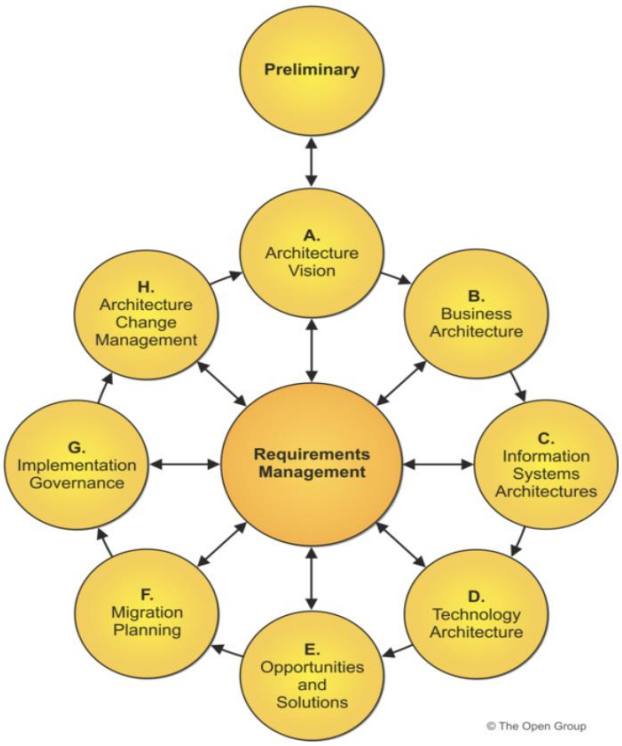

Figure 6. Architecture Iterative Cycle (The Open Group, 2018)

5.4.1. Preliminary Framework and Principles

The preliminary phase in TOGAF® determines the architectural capabilities required by an organisation and establishes architectural capabilities. In this phase, the enterprise structure and governance framework are established on the basis of the elements and resources of the organisation itself. The capability maturity target is established to evaluate the organisation's structural capabilities. TOGAF® records and preserves the strategic goals of the Queensland digital health system. Each phase is based on the goals in the preliminary phase. Such a framework prevents the future construction process from deviating from the strategic goal.

5.4.2. Architecture Vision - Phase A

The architecture vision aims to identify the stakeholders, develop a high-level architecture vision and obtain approval for the statement of architecture work. The Queensland digital health strategy provides new insights into developing new possibilities for healthcare accessibility and delivery. Meanwhile, changing the healthcare service delivery models from provider-focused to consumer-centric is the Queensland government's intention (Queensland Government, 2017). Applying the TOGAF® ADM iterative approach could help them have an enhanced understanding of stakeholders and an improved alignment with business goals and digital systems.

5.4.3. Business Architecture - Phase B

The business architecture phase develops the target business architecture, which can describe how to achieve business goals and respond to strategic drivers set out in phase A (The Open Group, 2018). The Queensland digital health strategy has presented the digital transformation plan in the next 10 years, whose objective is to provide scaled digital health with consistent and sustainable

capability. The business architecture phase in the ADM can help the Queensland government develop a business-driven architecture to promote phase A.

5.4.4. IS Architecture - Phase C

The IS architecture in the ADM iterative cycle makes an important contribution to the development of the target IS architecture. This phase describes how the IS can support the business architecture and architecture vision. The Queensland government has the business goals of promoting well-being, delivering healthcare and pursuing innovation. Phase C in the TOGAF® ADM is beneficial to establishing a business-driven IS, which aligns with business goals.

5.4.5. Technical Architecture - Phase D

The technical architecture phase is similar to the IS architecture phase. This phase aims to contribute to the development of the target technology architecture, which supports the architecture vision and business, data and application architectures. This phase can be delivered through technology components and services (The Open Group, 2018). The Queensland government digital health plan has mentioned pursuing innovation and enhanced accessibility of digital health; hence, the technical architecture phase can satisfy those requirements and improve the interoperability of the digital health system.

5.4.6. Opportunities and Solutions - Phase E

After the above architecture is developed (phases B, C, D), this phase generates the initial complete version of the architecture roadmap and determines the overall solution building blocks to finalise the target architecture. One of the challenges the Queensland government faces is the data security problem. Organisations could have guidelines to create a security architecture by adopting the TOGAF® ADM. In phase E, maximisation of business resources can be achieved. Existing security services available for reuse can also be identified through evaluating reusable security software and system resources.

5.4.7. Migration Planning - Phase F

This phase provides insights into finalising the architecture roadmap, supporting the implementation and ensuring the business value and cost of the work package and target architectures, which can be understood by the key stakeholders. As mentioned in the Queensland digital health plan, amongst their considerations for the digital health system are funding and regulation. The integration of healthcare would meet the requirement of funding and regulation (Queensland Government, 2017). Migration planning (phase F) can be a useful tool to address this consideration because it provides the architecture roadmap and lets stakeholders have a comprehensive understanding of the digital health plan.

5.4.8. Implementation Governance - Phase G

The objective of the implementation governance phase to ensure the target architecture is consistent with organisational requirements through implementing projects and providing architecture governance functions for solutions and architecture change requests. As mentioned in subsection 5.2, poor IT governance inside the Queensland digital plan is one of the issues that should be addressed. The implementation governance phase can help the Queensland government include the architecture contract, compliance assessments and other governance solutions to ensure that the digital health plan is consistent with their expectation.

5.4.9. Architecture Change Management - Phase H

The architecture change management is the last part of the ADM iterative cycle, which ensures that the architecture governance framework is executed and the EA capability meets the requirements (The Open Group, 2018). As the last part of the ADM iterative cycle, it can provide necessary governance and architecture updates to the holistic view of the Queensland digital health architecture. Furthermore, given that the Queensland government has fragmented network services, this phase can engage each phase listed above to work efficiently and accurately.

5.5. Advantages of Using TOGAF® to Address the Challenges

5.5.1. Reduction of Time and IT Operating Costs Involved in the Development of Enterprise Infrastructure

TOGAF® applied to Queensland's e-health system will provide customised EA. Each phase of TOGAF® is independent and has a specific purpose and guiding principles (The Open Group, 2018). For example, phase B helps the Queensland government develop a business-driven architecture. Phase C, based on the business-driven architecture in phase B, builds a business-driven IS. Although phase C is built on phase B, the guiding principle of phase B is to provide Queensland with scaled digital health with consistent and sustainable performance, whereas phase C is aimed at promoting well-being, delivering healthcare and pursuing innovation. Each phase of TOGAF® is both related and separate. If something goes wrong, a certain phase can be isolated and upgraded or changed. Thus, TOGAF® greatly reduces the cost and time required for system changes or upgrades. It can achieve the goal of fast time to market (The Open Group, 2020).

The Queensland Department of Digital Health has decided to implement a large number of health-related technologies, such as mobile applications. In the process of integrating intelligent dedicated systems into existing infrastructure, TOGAF® can achieve simple and fast integration. With the high efficiency and simplicity of TOGAF®, medical system-related personnel do not need excessively complicated training, which can greatly reduce the negative sentiment of medical system-related personnel. The use of TOGAF® greatly reduces the development, support and maintenance cost of the system and the training costs of related personnel.

5.5.2. Reduced IT and Business Complexity

TOGAF® is an architectural framework that guides the establishment of architecture in various areas, such as business, IS and technology architectures. The Queensland government could have an enhanced understanding of stakeholders' requirements and a clear direction of the development plan by using the TOGAF® ADM iterative approach. Thus, they could improve their business performance and satisfy stakeholders' expectations. The flexibility of the entire process is improved by optimising the business process without sacrificing architectural coherence, which will allow the Queensland government to achieve digital healthcare transformation and therefore improved business outcomes (The Open Group, 2020).

All available and relevant resources, such as IT infrastructure and human resources, are employed in the process of digital transformation to establish a business-driven IS. The IS will integrate IT units with business units and then provide an enhanced business–IS alignment whilst realising the business goals. That is, after adopting TOGAF®, the Queensland government could deliver seamless and real-time healthcare services that meet stakeholders' requirements.

Moreover, various technologies are adopted in existing IT architecture. Structural and strategic IT governance is required to coordinate and integrate the existing architecture and new technologies (Evernden, 2017). TOGAF® could coordinate all the resources in the architecture roadmap, improve the interoperability of the entire EA and enhance the capability of the Queensland government to make innovation to achieve digital healthcare transformation.

5.5.3. Reduction of Data Security Risk

The safety standards adopted in the TOGAF® ADM Architecture Requirement Management will be embodied as safety-related building blocks. Each of phases A–H will have relevant safety standards and regulations to protect and control data input and output strictly (Chmielewski, 2020).

For example, phase A adopts a list of applicable security policies and complete disaster recovery and business continuity plans to ensure the safety of input data. Phases B–E protect the safety of data input and output through terms and rules and specific risk analysis (Internet-Security-Scan.com, 2020).

In phase F, the effect of safety measures on other new components or existing legacy systems is evaluated (Internet-Security-Scan.com, 2020). In the operational phase, mechanisms are used to monitor the performance, safety and availability of various aspects of the system. The assessment and monitoring system of safety measures is important, considering that the Queensland medical system involves many stakeholders and needs to integrate medical information from various regions. The evaluation and monitoring system of security measures ensures the effectiveness and safety of data integration. This system is vital to the realisation of interoperability in the medical system.

In phase G, data security-related tests are run (Internet-Security-Scan.com, 2020). The test process simulates the operation of the medical system after it is promoted to the market. The security and privacy hazards in the data-sharing process of the medical system are discovered through testing and repaired in time.

In phase H, good security forensic practices, together with written and published security policies, can determine what went wrong (Internet-Security-Scan.com, 2020). Timely change management can effectively prevent network threats, thereby ensuring data security. Furthermore, the system is easy and safe to manage due to its reduced complexity. Compared with the security management of complex IT systems, the security management required by TOGAF® is easier to operate and implement.

Therefore, TOGAF® can guarantee data security in the areas of data processing or sharing.

5.5.4. Contribution to Defining a Clear Picture of IT Infrastructure and Architecture

Stakeholders' requirements are critical for the digital healthcare transformation in Queensland. In the digital health strategic vision (Queensland Government, 2017), stakeholders have shown their expectations with details on digital healthcare transformation in Queensland. TOGAF® allows the Queensland government to establish a sustainable technology architecture that can address stakeholders' concerns and achieve business goals. In TOGAF®, a stakeholder management section is included in the ADM tools, which provides the guideline to analyse and manage stakeholders' needs and requirements (The Open Group, 2018). After categorising stakeholders and their requirements, the Queensland government would have a clear picture of the implementation planning in various horizons. The entire digital healthcare transformation cannot be a one-time effort; therefore, the transformation should be realised step by step. The architecture roadmap can provide clear transformation procedures to the Queensland government. With a clear picture of the IT infrastructure and architecture, development and innovation opportunities will be recovered.

6. Conclusion and Recommendations

The Queensland government has issued relevant documents and expects to reform the digital health system to deliver flexible and efficient medical services by 2026. To solve the three problems of low data security, poor IT management and low level of digital literacy, the Queensland digital health system will use TOGAF® to reform. TOGAF® greatly reduces the time required for system development and IT costs to achieve the goal of short time to market. It reduces the system complexity, which means the complexity of operations and the difficulty of IT management decrease. For data security, the security framework of each phase of TOGAF® ensures the integrity of input and output data. TOGAF® provides a clear roadmap for the gradual realisation of the entire digital health system.

These findings lead to the conclusion that TOGAF® can be applied to the Queensland health system to achieve efficient delivery of medical services.

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