

## Towards an E-Government Enterprise Architecture Framework for Developing Economies

Flavia Namagembe<sup>1</sup>, Agnes Nakakawa<sup>1\*</sup>, Fiona P. Tulinayo<sup>1</sup>,  
Henderik A. Proper<sup>2</sup>, and Sietse Overbeek<sup>3</sup>

<sup>1</sup> School of Computing and Informatics Technology, Makerere University, P. O. Box 7062, Kampala, Uganda

<sup>2</sup> Institute of Information Systems Engineering, TU Wien, 1040 Vienna, Austria

<sup>3</sup> Faculty of Science, Utrecht University, Princetonplein 5, 3584 CC Utrecht, The Netherlands

[flavia.namagembe@mak.ac.ug](mailto:flavia.namagembe@mak.ac.ug), [anakakawa@cit.ac.ug](mailto:anakakawa@cit.ac.ug), [fturinayo@cit.ac.ug](mailto:fturinayo@cit.ac.ug),  
[e.proper@acm.org](mailto:e.proper@acm.org), [s.j.overbeek@uu.nl](mailto:s.j.overbeek@uu.nl)

**Abstract.** The growth and uptake of e-government in developing economies is still affected by the interoperability challenge, which can be perceived as an orchestration of several issues that imply the existence of gaps in methods used for e-government planning and implementation. To a great extent, various counterparts in developed economies have succeeded in addressing the method-related gaps by developing e-government enterprise architectures, as blueprints for guiding e-government initiatives in a holistic and manageable way. However, existing e-government enterprise architectures are country-specific to appropriately serve their intended purpose, while enterprise architecture frameworks or methods are generic to accommodate several enterprise contexts. The latter do not directly accommodate the unique peculiarities of e-government efforts. Thus, a detailed method is lacking that can be adapted by developing economies to develop e-government enterprise architectures that fit their contexts. To address the gap, this article presents research that adopted a Design Science approach to develop an e-Government Enterprise Architecture Framework (EGEAF), as an explicit method for guiding the design of e-government enterprise architectures in a developing economy. EGEAF was designed by extending the Architecture Development Method of The Open Group Architecture Framework (TOGAF ADM) to address requirements for developing interoperable e-government solutions in a developing economy. EGEAF was evaluated using two scenarios in the Ugandan context, and findings indicate that it is feasible; its design is understandable to enable its adoption and extension to accommodate requirements for developing interoperable e-government solutions in other developing economies.

**Keywords:** e-Government, Enterprise Architecture, Developing Economies, e-Government Interoperability.

\* Corresponding author

© 2023 Flavia Namagembe, Agnes Nakakawa, Fiona P. Tulinayo, Henderik A. Proper, and Sietse Overbeek. This is an open access article licensed under the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>).

Reference: F. Namagembe, A. Nakakawa, F. P. Tulinayo, H. A. Proper, and S. Overbeek, "Towards an E-Government Enterprise Architecture Framework for Developing Economies," *Complex Systems Informatics and Modeling Quarterly*, CSIMQ, no. 35, pp. 30–66, 2023. Available: <https://doi.org/10.7250/csimq.2023-35.02>

Additional information. Author ORCID iD: F. Namagembe – <https://orcid.org/0000-0003-3642-801X>, A. Nakakawa – <https://orcid.org/0000-0003-0891-4707>, F. P. Tulinayo – <https://orcid.org/0000-0003-0922-6172>, H. A. Proper – <https://orcid.org/0000-0002-7318-2496>, and S. Overbeek – <https://orcid.org/0000-0003-3975-200X>. PII S225599222300193X. Received: 25 March 2023. Revised: 12 July 2023. Accepted: 14 July 2023. Available online: 31 July 2023.

# 1 Introduction

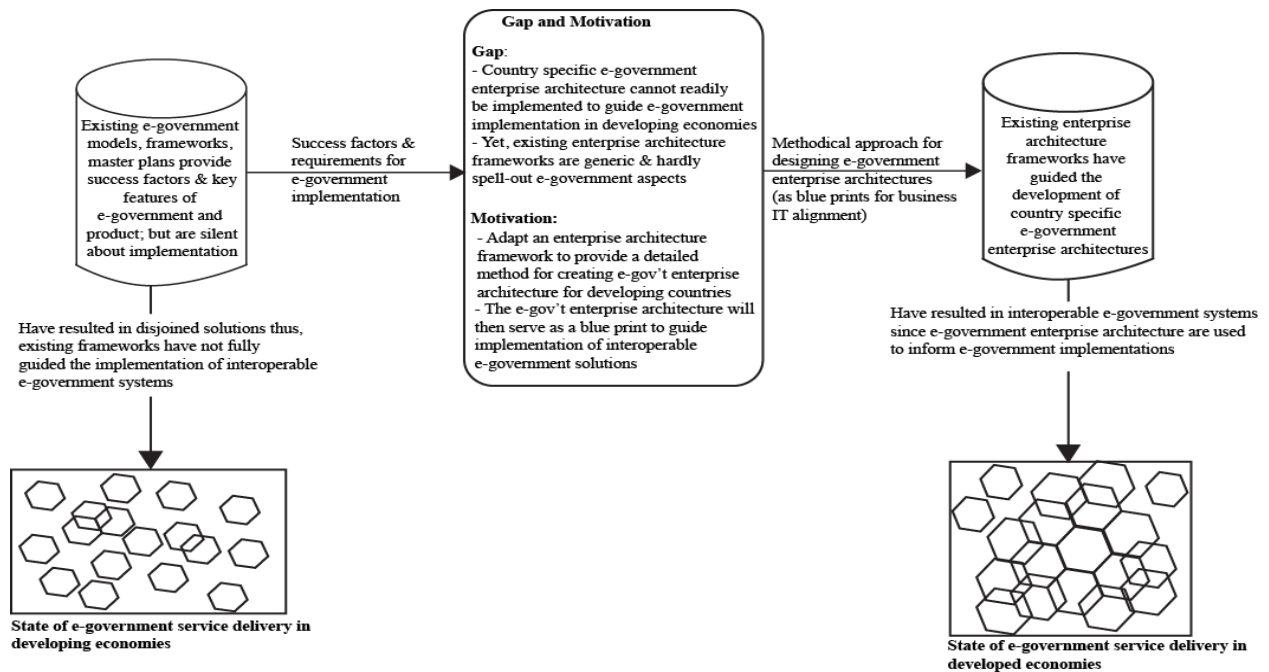
E-government development is measured by several e-government maturity models (e.g., [1]–[6]). A comparative assessment of existing e-government maturity models also exists [7]–[9]. Such models provide a phased approach to developing e-government solutions and measuring progress towards attaining a citizen-centric and responsive government [10]–[12]. Despite the existence of several e-government maturity models, developing economies are still in the low or middle indices of e-government development while most of the developed economies are in the (very) high indices [13], [14]. Literature (e.g., [10], [15]–[18]) reveals that steady growth of e-government initiatives in developing economies is hindered by an orchestration of several situational issues. These include: weak technology or digital infrastructure with unreliable internet connectivity, digital divide, financial/economic constraints, cultural-socio-behavioral constraints, unreliable political climate, handicapping policies or legal frameworks, donor-reliant programmes, lack of unified standards for public services and their corresponding electronic services, fragmented e-government solutions, and fragmented regulatory practices [13], [14], [19], [20]. Such challenges contribute to 35% total failure rate and 50% as partial failure rate of e-government implementations in developing countries [21], [22]. An analytical reflection on these issues reveals two critical gaps that are prevalent in developing economies. One, is the frequent mismatch between the baseline and target perspectives of e-government [23], [24], which causes an unrealistically large *design-to-reality gap* and a higher risk of e-government failure [9], [22]. Two, is the *lack of holistic and systemic approaches* to guide e-government implementations [25]–[29] in a coherent way. For instance, the success of information technology investments in Africa is still affected by the lack of adequate skills in designing, implementing, and maintaining technology infrastructure, in a way that can enable services to accelerate growth in various sectors [30].

Thus, developing countries or countries with low indices of e-government development need to prioritize adoption of practices towards: a whole-of-government approach to e-government implementation; establishment of unified technical and legal standards for e-government solutions; enhancing competition on quality of service among public entities; effective coordination of e-government investments within and across public entities; and full interoperability within and across public entities [13], [31], [32]. Since the practice towards full e-government interoperability seems to be the underlying pre-requisite that can facilitate the realization of other recommended practices, this article concentrates on exploring its realization in a developing economy.

However, prior to assessing and devising means of realizing full e-government interoperability, it is vital to specify the scope of interoperability in the context of this research. ISO/IEC indicate that two or more systems are considered interoperable if they can “*exchange information and mutually use the information that has been exchanged*” [33]. This is achieved if: (a) the participating systems understand the type and size of data to be exchanged (*technical interoperability*), the formats of the exchanged information (*syntactic interoperability*), and the exchanged data and interpret in the same way (*semantic interoperability*); (b) the data exchange complies with the contextual, legal, organizational, and policy frameworks (*policy interoperability*); and (c) all stakeholders mutually understand the subsequent actions on the data after the exchange (*organizational interoperability*) [33]–[35]. In the context of e-government, the seamless transfer of data within and across public entities requires a country to prioritize the achievement of data and systems interoperability [32]. However, basing on the above definitions, organizational interoperability facilitates the realization of data and systems interoperability. This implies that achieving full e-government interoperability involves considering interoperability within all domains of a public entity and across public entities. The domains include: the business/process domain, data/information domain, application systems domain, and technology infrastructure domain [36], [37]. This shows the scope and complexity of the full e-government interoperability need.

In a bid to manage the wide scope and complexity of aspects in e-government interoperability, two courses of action have been undertaken by different countries: a) Developing e-government

master plans and standards for Information and Communication Technologies (ICTs) as well as policy guidelines that are based on e-government models and frameworks, to enable harmonized implementation of e-government [38]–[40]; and b) Adopting an enterprise architecture approach to e-government implementations [41]–[48]. Details of these two courses of action are discussed in Section 3, while their major drawbacks are highlighted in Figure 1.



**Figure 1.** Gap Analysis and Research Motivation

Figure 1 depicts the gap analysis and motivation for this research. Figure 1 was derived by synthesizing insights from existing work on e-government interoperability [25], [34], [49]–[52] and e-government enterprise architectures [45], [53]–[58]. Existing e-government models and frameworks in developing economies [59]–[71] mainly provide success factors and emphasize some aspects of the desired e-government end product. They hardly offer a detailed procedure towards a holistic and controlled approach to e-government implementations. As a result, various disjointed e-government applications still exist [72], [73]. Although the issue of disjointed e-government solutions is also reported in developed economies [74]–[76], it is prevalent in developing economies.

On the other hand, the use of e-government enterprise architectures has yielded interoperable e-government solutions to a large extent in economies that have adopted them [45], [53]–[56], [77]. In general, enterprise architectures help organizations to achieve several goals such as: streamlining and managing technical complexity in digital transformations; integration of application systems; reduction in operational costs; effective support for business-IT alignment; support for the design and implementation of business and IT strategies; support for interoperability [78]–[80]. Although enterprise architecture concerns several goals, the motivation to consider it as potential solution in this study is its support for interoperability. This is mainly due to two reasons. First, interoperability can be perceived as an enabling factor or goal, because its prioritization and realization helps to indirectly achieve the other goals or benefits of enterprise architecture. Second, since the e-government challenge in this study is full interoperability, the motivation for adopting enterprise architecture into e-government is its support for realizing interoperability in countries that have prioritized it.

Unfortunately, e-government enterprise architectures that are developed and used to streamline e-government in developed countries are country-specific, and designed to suit specific contexts. Solutions in developed countries cannot just be transferred to developing countries without

assessing mismatches in contexts [24]. Thus, e-government enterprise architectures for developed countries cannot just be transferred and implemented or used to guide e-government implementations in developing economies without a comprehensive adaptation. Developing countries or low income countries are characterized by: inadequate and unreliable technological or infrastructure landscapes; significantly low average incomes; high poverty levels; significantly high inequalities in income distribution; low level of physical capital and human capital development; inadequate investments and very low productivity levels; inability to fully utilize natural resources; high level of unemployment and under-utilized human resources; low levels of education and inadequately skilled labor force; inability to leverage or adopt production technologies for advancing industrialization; inadequate and unreliable health care systems; and limited access to quality and diverse education systems [81]–[83]. Thus, the variations in the economic, technical, socio-cultural, and regulatory contexts of developed and developing economies cannot permit the trivial adoption of an e-government enterprise architecture for a developed economy. This implies that a developing economy that needs to adopt an enterprise architecture approach to e-government implementation can either re-design the domain architectures of an existing e-government enterprise architecture, or develop its own e-government enterprise architecture. Yet, existing enterprise architecture development frameworks (or methods for developing enterprise architectures) are generic and hardly provide specific guidelines tailored to address e-government concerns in the developing economies. There is a need for an e-government enterprise architecture framework, that is specifically tailored to provide a thinking pattern that helps to address e-government challenges in developing economies [84], [85]. As indicated in Figure 1, this can be achieved by adapting an existing enterprise architecture framework with respect to e-government concerns in a developing economy like Uganda, so as to initiate a research effort that is envisioned to yield an e-Government Enterprise Architecture Framework for Developing Economies (EGEAF).

EGEAF can be perceived as a method for supporting the development of e-government enterprise architectures, which are blueprints for implementing coherent and interoperable e-government solutions. Thus, this article answers the question: *How can the design of e-government enterprise architectures be methodologically supported? In other words, what should constitute EGEAF, or how should EGEAF be structured?* In terms of scope, although this concept can be applied in a developed economy, this article first instantiates it in Uganda as a case of a developing economy. This is because the details associated with the ‘methodological support’ tend to vary with respect to a country’s e-government maturity level and ability to deliver its contextual e-government demands. Section 2 presents the research approach used, Section 3 gives an overview of related work, Section 4 presents the design of EGEAF, Section 5 highlights evaluation findings, and Section 6 concludes the article.

## 2 Research Approach

Design Science supports development of feasible artifacts that address significant enterprise problems and opportunities [86]. Figure 2 illustrates how Design Science was adopted to guide the development of EGEAF. Figure 2 shows that, from the problem context, specific challenges and requirements of developing interoperable e-government solutions were identified and presented in our earlier work [84]. Herein, the challenges and insights from existing literature (on enterprise architecture and e-government) are used to inform the design of EGEAF. Thereafter, an analytical method and a field demo are used to evaluate the designed EGEAF to determine the extent to which it addresses aspects in the problem context. Findings from the evaluation are used to refine the design of EGEAF and the resultant artifact is added to the knowledge base. Since Design Science research involves three cycles [86], this research comprises three cycles: (1) Relevance cycle, is depicted by the consideration of challenges from the problem environment and by the evaluation of EGEAF in its intended application context. (2) Design cycle, is depicted by the design of EGEAF and its continuous refinement based on evaluation feedback. (3) Rigor cycle, is

depicted by the re-use of insights from the knowledge base to inform the design and evaluation of EGEEAF. These cycles are elaborated in Sections 3 to 5.

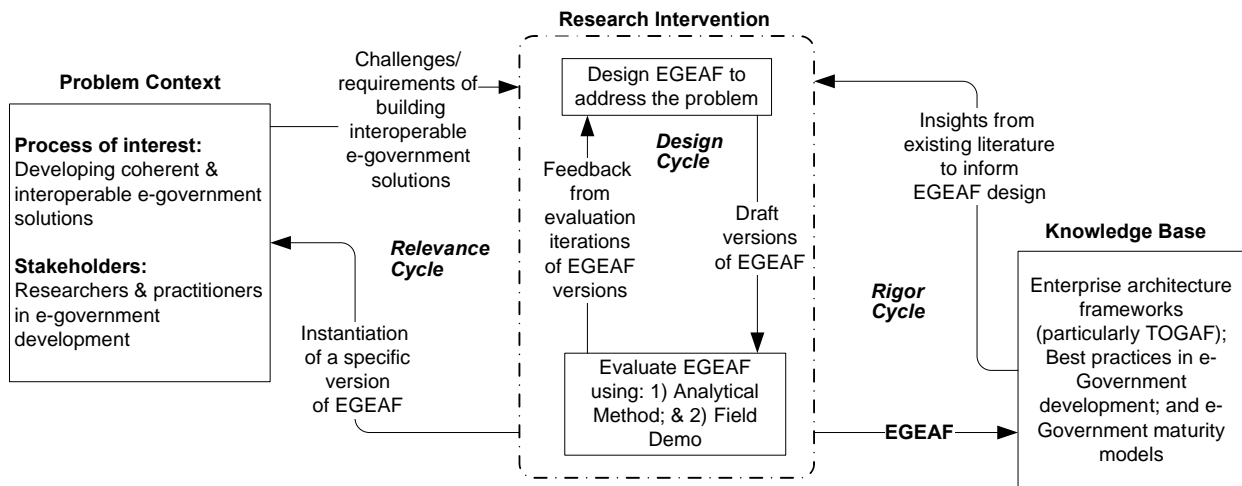


Figure 2. Adoption of Design Science to Develop EGEEAF

### 3 Related Work, Gaps, and Possible Solutions

Section 3.1 categorizes existing work on e-government and highlights the strategic role of enterprise architecture in realizing e-government interoperability. Section 3.2 discusses how enterprise architecture frameworks can be extended to address the research gap.

#### 3.1. Gaps in e-Government Efforts and Role of Enterprise Architecture

Using an unsystematic narrative review approach [87] coupled with a snowball literature review approach [88], instances of existing efforts on e-government development were synthesized as indicated in Table 1. Systematic literature reviews require researchers to use and specify *'reproducible'* steps for methodically searching all existing articles or studies on particular phenomena of interest, evaluating them, summarizing, and condensing their findings to yield new results [87]. In this research, the purpose of the review was to identify reported gaps in existing approaches for e-government development, but not to synthesize content of these approaches. Thus, the review herein did not require use of a systematic review approach, but rather a narrative review and snowball review approach. Unsystematic narrative reviews focus on describing and assessing findings in articles on a given subject so as to give general observations in the subject of interest, without prioritizing the reproducibility of the search and assessment process of the articles [87]. A snowball review approach involves using the bibliography of an article on a given subject to find other articles on the subject that were cited in that article or other articles that cite the article in question [88]. Thus, unsystematic narrative review and snowball review approaches were mutually used. Table 1 classifies existing approaches for e-government development into categories A to F, and highlights the gap in each category.

Table 1 indicates that several developing countries have undertaken efforts in categories A to E, but their e-government landscapes still suffer disintegration and duplication. Other economies (e.g., those in category F in Table 1) have overcome disintegration, to a great extent, by developing e-Government Enterprise Architectures. Enterprise architecture is a significant pillar for e-government success [103] and most countries with mature e-government programmes have an effective enterprise architecture programme [101], [105]. Enterprise architecture standardizes and aligns e-government initiatives by providing standard principles and guidelines for project planning, technical development, and operations [106]. Enterprise architecture enhances e-government coherence by specifying policies, standards, design decisions, and constraints that

yield an e-government landscape that holistically links business and technology services [101], [103].

**Table 1.** Categories of Existing e-Government Approaches and Identified Gaps

Category	Overview of a category and research gap
A. e-Government Adoption Models and Studies	<p>Articles in this category [59]–[62], [65], [66], [89]–[91] principally focus on factors affecting e-government or ICT adoption and mechanisms for enhancing adoption of already developed e-government solutions by citizens/ stakeholders.</p> <p>– <i>However, these papers remain silent about means towards attaining interoperability of e-government solutions, since this is not their principal focus.</i></p>
B. e-Government Maturity Models	<p>Efforts in this category [1]–[6], [9], [92]–[95] specify stages for determining progress of e-government development, and give insight into specific features or growth indicators and expected e-government solutions at each stage of e-government advancement.</p> <p>– Although some existing studies [7], [8], [66], [93,] [96], [97] profile and discuss e-government maturity models, attempts hardly exist <i>towards providing guidance on: (a) how to align efforts to achieve specific stages of e-government growth; and (b) designing blueprints for each stage of e-government growth.</i></p>
C. e-Government Interoperability Frameworks (eGIFs)/Models	<p>An eGIF clearly defines standards and guidelines or technical structures that provide a common language for ensuring coherent information flow and exchange across systems to achieve e-government interoperability [25], [34], [49]–[52]. Examples of efforts in this category include the European Interoperability Framework [98] and other several country-specific eGIFs that are profiled by Lallana [49].</p> <p>– <i>eGIFs provide insight into critical interoperability aspects that can be adequately addressed through adopting specific standards. Section 4.3 shows when and how eGIFs are adopted herein to address the overall research gap.</i></p>
D. e-Government Challenges, Success Factors, Implementation Models	<p>Articles in this category [63], [64], [67]–[71], [99] provide insight into possible interventions or measures for addressing factors that influence the failure or success of e-government implementations.</p> <p>– <i>However, these studies hardly provide details of how the interventions or measures can be realized in a coordinated way.</i></p>
E. e-Government Master Plans	<p>These are country-specific plans or roadmaps that specify the baseline situations of e-government adoption and possible e-government projects that can be implemented to enable a given country to reach a desired state.</p> <p>– Examples of countries with e-government master plans include: Philippines [100], Singapore [101], Bangladesh [102], Uganda [38].</p> <p>– <i>However, e-government master plans hardly delve into the details on the coherence of: (a) planned and ongoing projects; (b) potential outputs from these projects; and (c) implementation plans of each of the prescribed e-government solutions or projects.</i></p>
F. e-Government Enterprise Architectures/ Models or Reference Architectures	<p>These are blueprints for specific countries that provide a comprehensive roadmap for realizing coherent e-government implementations.</p> <p>– Efforts towards developing country-specific e-government enterprise architectures have been reported for: European countries [77], Korea [53], South Africa [54], Singapore [55], UK [45], China [103], Lebanon [56], Ghana [57], Egypt [58], and India [104] among others.</p> <p>– Due to design-to-reality issues highlighted in Section 1 of this article, country-specific e-government enterprise architectures cannot be merely ‘transplanted’ for implementation in another country.</p> <p>– <i>Thus, this research was motivated to devise a method or procedure for guiding the development of an e-government enterprise architecture.</i></p>

To effectively utilize resources, it is vital to first create realistic baseline and target architectures that show the structure and dynamics of an enterprise, with respect to the overall e-government objective [47]. However, the adoption of enterprise architecture in e-government is not a trivial effort, which justifies the limited efforts towards developing country-specific e-government enterprise architectures [55]. The last row of Table 1 highlights that it is not feasible to simply adopt and implement existing e-government enterprise architectures for developed economies, because of differences in historical, geographical, economic, demographic, and political contexts. Differences also exist in working cultures, skill sets, access to technology and infrastructure setup across countries. Such differences make it difficult to simply implement existing e-government enterprise architectures or frameworks, without tailoring them to specific issues in developing economies and contexts. This underlines the importance of a common method that government agencies can follow to develop their own e-government enterprise architectures [53]. Such a method can be achieved by adapting existing enterprise architecture frameworks to suit contextual factors and e-government demands of developing countries.

### **3.2 Enterprise Architecture Approaches and Gaps**

Amidst the fragmented techniques for business-IT alignment, enterprise architecture frameworks can support the development of standard guidelines for aligning public sector business processes with ICT to enable e-government efficiency [105]. An enterprise architecture framework specifies the process for developing properly scoped and detailed blueprints of business-IT alignment, and deliverables of such a process [37], [80]. Examples include: The Open Group Architecture Framework [36], [37]. Zachman [107] Federal Enterprise Architecture Framework [108], and Integrated Architecture Framework [109] among others.

While other frameworks being less elaborated regarding the architecting procedure, TOGAF includes an Architecture Development Method (ADM) that details generalized guidelines for developing architectures, that can be instantiated and implemented in various enterprise contexts [36]. Hence the adoption of TOGAF in this research. Prior to applying TOGAF ADM, it is vital to review the extent to which its components suit a specific enterprise, and to customize it to derive an enterprise-specific architecture framework [36]. However, instantiating or adapting the ADM to provide a detailed procedure for realizing interoperable e-government implementations is not an obvious endeavor. Since TOGAF ADM comprises at least 10 phases or broad thematic areas, it was not possible to adapt all these phases to accommodate e-government aspects at once in this research. Thus, to make the scope of the adaptation manageable, this research adapted the first two (out of the 10) phases of TOGAF ADM – the preliminary phase and architecture vision phase. The adaptation was done by underpinning TOGAF ADM guidelines with e-government aspects in Uganda, so as to derive an e-Government Enterprise Architecture Framework (EGEAF). EGEAF specifies guidelines for creating an e-government enterprise architecture, as a blueprint of the baseline and target e-government solutions and their corresponding synergies or interoperability instances.

## **4 Design of EGEAF**

To design EGEAF, there was need to first investigate requirements for e-government interoperability and then orchestrate possible solutions into a synthesis that can support their implementation in a mutual and holistic way. Accordingly, as reported in our earlier work [84], requirements were investigated by conducting an exploratory survey among ICT managers or focal persons in Ugandan public entities. The survey mainly investigated challenges hindering the realization of e-government interoperability and e-government implementations in general; and possible solutions to the hindrances. The list of strategic requirements is summarized in Table 2 (columns 1 and 2), and a detailed account of how they were derived is given in Nakakawa and Namagembe [84]. In Table 2, requirements are coded as Rx (R1.1 to R3.5) to represent three

clusters of strategic needs associated with e-government implementations, i.e.: regulation and governance aspects (R1.1 to R1.7), policy aspects (R2.1 to R2.4), and socio-cultural or contextual aspects (R3.1 to R3.5). To address the requirements, column 3 of Table 2 summarizes ‘*design tasks*’ that had to be executed to build EGEAF, to ensure that its structural composition enables it to fulfill its intended purpose. These design tasks are perceived and treated as ‘*design decisions*’ made to address specific requirements, because they yield outputs in form of ‘components or modules’ that are synthesized to constitute EGEAF. The design tasks are coded as Dx (D1.1 to D3.5), so that they can be easily traced back to the requirements they address.

In Table 2, design decision D3.2 (in the grey-shaded row) is the pivotal design decision or task that serves as a hinge for all other design decisions or tasks. This implies that achieving requirement R3.2 (through realizing D3.2) is a prerequisite for logically addressing all other requirements in column 2, since D3.2 yields a schema for synthesizing all other design decisions in column 3 in a coherent way. To achieve D3.2, the procedure shown in Figure 3 was used. Figure 3 shows that there was a need to:

- a) First specify the structural composition of a government enterprise, such that its features are used to guide the adaptation of TOGAF ADM.
- b) Adapt the two initial phases of TOGAF ADM, so as to derive key steps for creating an enterprise architecture vision for the government enterprise. To manage complexity, the scope of adaptation was limited to the first two phases of the ADM (preliminary and architecture vision phases). This provides a basis for adapting other ADM phases, whereby insights from adapting the first two phases will inform the adaptation of other phases of the ADM in future work.
- c) Extend or underpin steps in the adapted 11-Step model for creating and e-government architecture vision, with specific components that address requirements or aspects of e-government interoperability in either a developing or developed economy. As indicated at the bottom of Figure 3, aspects for developed economies are beyond the scope of this article. Thus, the adapted 11-Step model was extended with components derived from executing design decisions D1.1 to D3.1 and D3.3 to D3.5 in Table 2.

**Table 2.** Requirements for e-Government Interoperability vs. Design Decisions executed to address them

<b>Code Rx</b>	<b>Requirements for e-government interoperability [84]</b>	<b>Design Decision taken in building EGEAF to ensure that it addresses each requirement</b>	<b>Code Dx</b>
R1.1	Develop standard guidelines for acquiring or developing ICT solutions in public entities	Guide the selection of methods for acquiring & developing e-government solutions <i>by providing insights for stakeholder deliberation based on existing modes of acquiring ICT solutions</i>	D1.1
R1.2	Develop standard guidelines for assessing e-government readiness of agencies/entities	Guide the creation of a catalog for e-government readiness assessment & change management <i>by adapting insights for stakeholder deliberation from existing readiness assessment &amp; change management approaches</i>	D1.2
R1.3	Develop standard guidelines for the evaluation, selection, and adoption of open standards/systems	Guide the definition of criteria for evaluating and adopting open standards/systems/solutions <i>by providing insights into aspects for stakeholder deliberation</i>	D1.3
R1.4	Develop operational guidelines for sharing, re-using, and archiving information	Guide the formulation of guidelines for information sharing, reuse, & archival <i>by providing insights into how existing frameworks can be adapted to streamline information management in public entities</i>	D1.4
R1.5	Develop an e-government regulatory framework for coordinating e-government implementations	Guide the formulation of quality & legal guidelines for e-government implementations <i>by providing insights into how to adapt existing legal frameworks &amp; quality models</i>	D1.5



Table 2 continued

Code Rx	Requirements for e-government interoperability [84]	Design Decision taken in building EGEAF to ensure that it addresses each requirement	Code Dx
R1.6	Establish an advocacy programme for approved ICT standards and e-government regulations to increase their awareness among top managers of public entities	Guide the acquisition of management support for e-government regulation <i>by providing insights into the kind of information that can be used to create awareness (on ICT standards and best practices) among managers of public entities</i>	D1.6
R1.7	Develop an governance structure for overseeing e-government & business-ICT investments in public entities	Guide the definition of governance mechanisms for e-government architecture effort <i>by adapting TOGAF ADM guidelines on establishing an architecture governance framework</i>	D1.7
R2.1	Develop a collaboration framework with universities to build human resource capacity for e-government implementations	Guide the standardization of efforts on human resource capacity building for e-government <i>by providing insights into aspects for stakeholder deliberation</i>	D2.1
R2.2	Develop an e-government strategic management and sustainability framework for aligning e-government priorities of public entities and their development partners	Guide formulation of strategic drivers for e-government <i>by adapting a project management perspective on defining the enterprise vision, mission, &amp; strategic objectives</i>	D.2.2.1
		Guide the creation of a catalog on strategies for sustaining donor-driven e-government projects <i>by guiding on how to synthesize &amp; adopt existing success factors for donors/beneficiaries of e-government</i>	D.2.2.2
R2.3	Develop a risk and mitigation management framework for e-government	Guide the creation of a catalog of e-government risks and mitigations <i>by providing insights into aspects for stakeholder deliberation</i>	D2.3
R2.4	Establish a Public Private Partnerships (PPPs) programme for the shared development of e-government infrastructure	Guide the creation of a catalog on success factors for establishing PPPs for e-government infrastructure <i>by providing insights into aspects for stakeholder deliberation</i>	D2.4
R3.1	Develop guidelines for adopting existing e-government interoperability standards and principles	Guide the formulation of criteria/guidelines for choosing e-government interoperability standards <i>by providing insights into how to adapt existing e-government interoperability frameworks</i>	D3.1
R3.2	<i>Adapt an enterprise architecture framework or approach to guide planning and implementation of coherent e-government solutions</i>	<i>Adapt the phases of TOGAF ADM (preliminary phase and architecture vision phase) by underpinning/extending their steps and guidelines with e-government aspects associated with addressing requirements in column 2</i>	D3.2
R3.3	Develop a public participatory approach for e- enhancing stakeholder participation in planning, implementing, and evaluating e-government efforts	Guide the formulation of a taxonomy on e-government stakeholder groups & involvement strategies & techniques <i>by adapting: the project management guide on identifying &amp; prioritizing key stakeholders; forms of e-government; &amp; group support techniques</i>	D3.3
R3.4	Specify technologies that can be adopted to enable interoperability among existing heterogeneous e-government solutions	Guide the formulation of criteria for evaluating and selecting appropriate middleware systems for enabling the integration of heterogeneous data sources <i>by providing insights into aspects for stakeholder deliberation</i>	D3.4
R3.5	Develop an approach for monitoring and evaluating e-government efforts	Guide the formulation of criteria & measures for monitoring & evaluating e-government <i>by providing insights into aspects for deliberation</i>	D3.5

**Scoping the design, applicability, and adaptation contexts of EGEAF:** the EGEAF concept can be adopted in both developing and developed economies. However, this article first contextualizes it to the context of Uganda, as an instance of a developing economy. This is because e-government aspects or activities that underlie steps in the two adapted phases of the TOGAF ADM were derived from strategic requirements that should be fulfilled to address challenges

hindering e-government interoperability in developing economies like Uganda (step 3A in Figure 3). This specifies a situational dimension in EGEEAF’s design, whereby e-government activities that underlie adapted steps in TOGAF ADM are expected to differ when adapting EGEEAF to support e-government advancement in a developed economy. Although some e-government aspects are similar and cut across developed and developing economies, there are some that contextually apply to only developing economies. Sections 4.1 to 4.3 discuss details and outputs of the three stages in Figure 3.

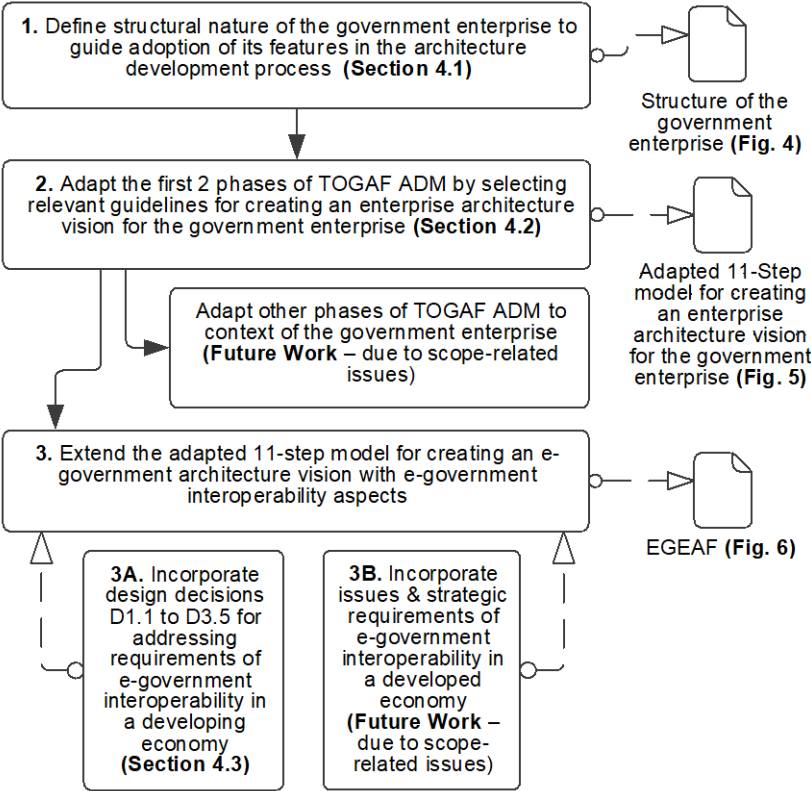


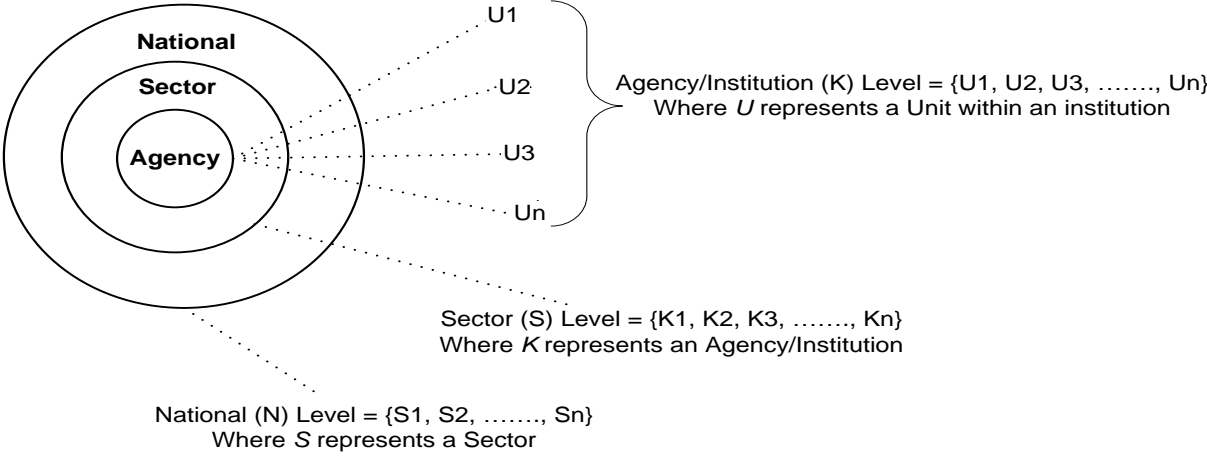
Figure 3. Procedure followed to realize Design Decision D3.2 (as a pivot of other design tasks/decisions)

4.1. Structural Composition of Government Enterprise

An enterprise is a collection of organizations or organizational units that work together towards a mutual goal [36]. On the other hand, a governmental organization is a complex venture comprising traditional and interconnected sectors [101] that are made up of several agencies mandated to deliver specific public services. Thus, an *enterprise in the context of e-government* refers to a government agency or institution, or collection of government agencies or institutions in a specific sector or in all sectors of a country. This definition points to three levels of complexity in the government enterprise – Agency or Institution, Sector, and National levels as depicted in Figure 4. Various countries comprise at least 3 levels of government complexity, which are named differently depending on their governance needs [110]. Although the setting considered herein is one comprising three main levels of the government enterprise, the concept can be adapted to accommodate other levels of government.

In Figure 4, *national level* comprises the entity mandated to regulate all e-government implementations in a country, such as the Ministry of ICT in Uganda’s context. *Sector level* comprises specific sectors or ministries responsible for delivering specific categories of services such as education services (Ministry of Education) and health services (Ministry of Health). *Institution or agency level* comprises departments and units that offer specific services in a particular sector or ministry. Institutions or agencies directly interact with other institutions,

businesses, or citizens to provide Government to Government (G2G) services, Government to Business (G2B) services, or Government to Citizen (G2C) services. These services need to be supported by e-government implementations, where those managed at institution or agency level are regulated at sector level and those managed at sector level are regulated by the national level. These three levels are crucial when determining which guidelines of TOGAF ADM are relevant for creating an architecture vision of the government enterprise. This is elaborated in Section 4.2.



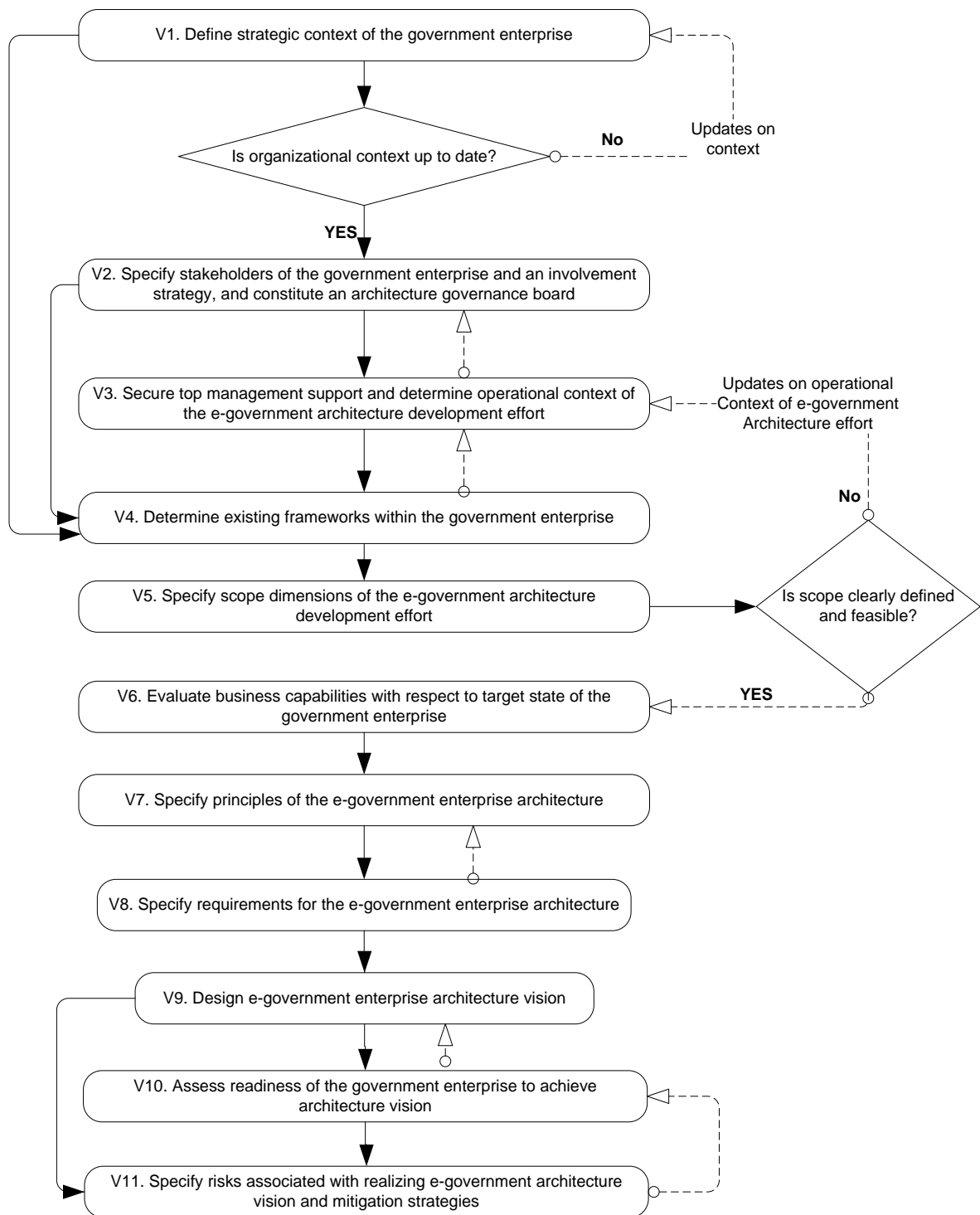
**Figure 4.** Three Levels/Tiers of Complexity in the e-Government Enterprise

**4.2. Adapt TOGAF ADM to Government Enterprise**

The first two phases of TOGAF ADM – preliminary and architecture vision – were adapted with respect to the structural composition of the e-government enterprise that is described in Section 4.1. This was achieved by: reviewing steps in the two phases to identify those relevant to the e-government enterprise, re-ordering steps, and merging replicated steps to derive a summarized model of 11 steps for creating an enterprise architecture vision for the e-government enterprise. Thus, the customized 11-Step model (shown in Figure 5) is based on TOGAF [36], [37]. The adapted steps in Figure 5 are coded as V1 to V11. Thick arrows represent the adopted order of executing steps. Dotted lines with white arrow heads show information exchange or information-related dependencies between steps. Each step in Figure 5 (V1 to V11) should be extended or underpinned with e-government related aspects, so as to address the requirements for e-government interoperability. Section 4.3 discusses how this was done.

**4.3. Constituting EGEAF**

To ensure that EGEAF addresses requirements for e-government interoperability, the 11-Step model in Figure 5 was extended by invoking or executing design decisions D1.1 to D3.1 and D3.3 to D3.5 (in Table 2). This involved adopting insights from other techniques or approaches (as indicated in Table 2 and Sections 4.3.1 to 4.3.11). However, details of how the adoption of other techniques is done are beyond the scope of this article. Executing design decisions D1.1 to D3.1 and D3.3 to D3.5 yielded ‘e-government development activities’ coded A1.1 to A3.5 (for traceability), and D3.2 was decomposed into D3.2.1 to D3.2.3 (as indicated in Table 3). The e-government development activities are perceived as components or modules that elaborate steps V1 to V11, and are to be executed by target users of EGEAF. Thus, Table 3 shows which design decisions are aligned with steps V1 to V11, and the resultant e-government development activities.

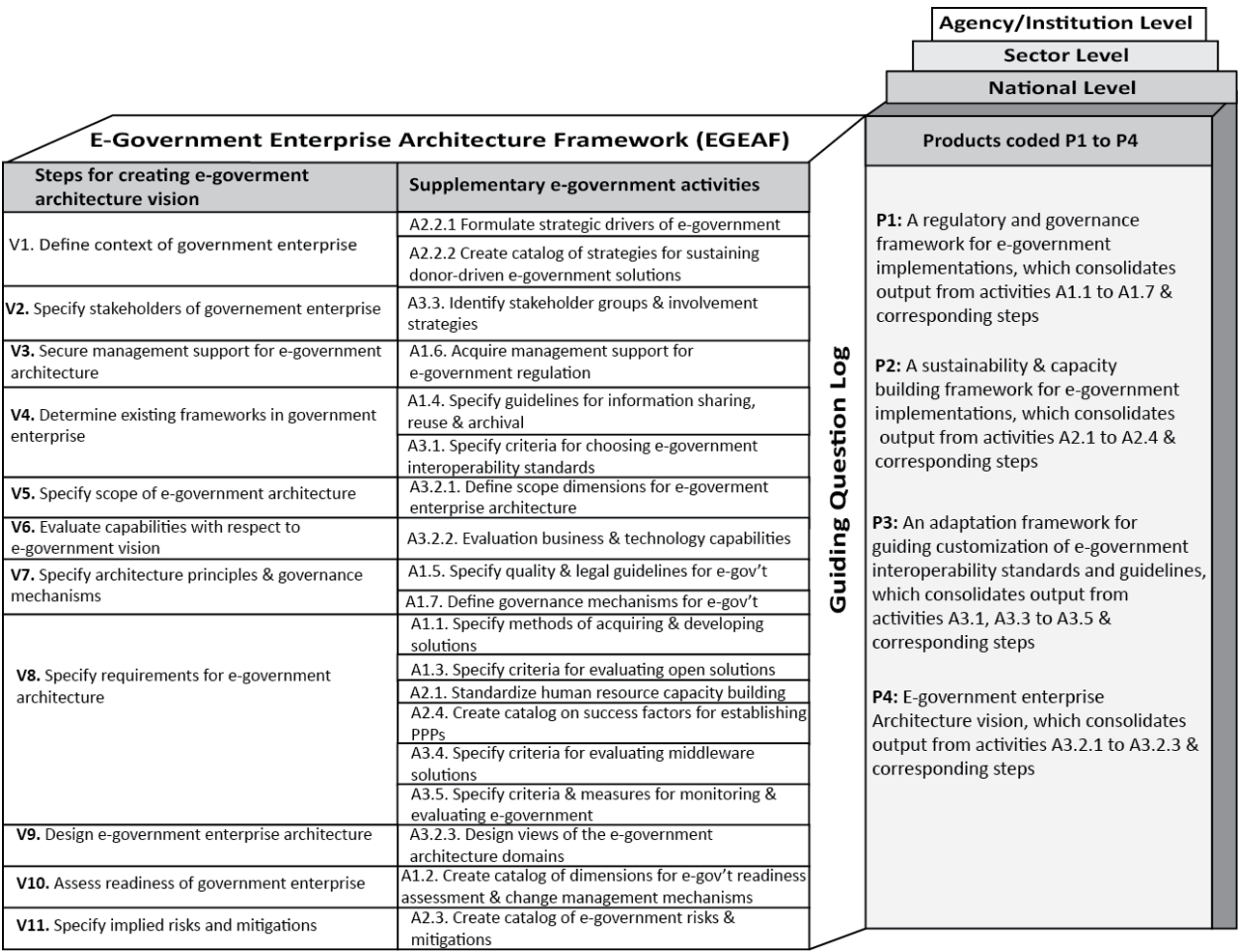


**Figure 5.** Adapted 11-Step Model for creating an Enterprise Architecture Vision for a Government Enterprise

**Table 3.** Aligning the adapted 11 steps for creating e-government architecture vision with e-Government Activities

<b>Steps for creating e-government enterprise architecture (in Figure 5)</b>	<b>Design Decisions taken (as presented in Table 2)</b>	<b>Resultant e-Government Activities</b>
V1. Define strategic context of the government enterprise	D2.2.1	A.2.2.1. Formulate strategic drivers of e-government
	D2.2.2	A.2.2.2. Create catalog of strategies for sustaining donor-driven e-government solutions
V2. Specify key stakeholders of the government enterprise, involvement strategies, and architecture governance mechanisms	D3.3	A3.3. Identify stakeholder groups & involvement strategies
V3. Secure management support on regulation of e-government implementations through e-government architecture	D1.6	A1.6. Acquire management support for e-government regulation
V4. Determine existing frameworks in the government enterprise	D1.4	A1.4. Specify guidelines for information sharing, reuse, & archival
	D3.1	A3.1. Specify criteria for choosing e-government interoperability standards
V5. Specify scope of e-government architecture development effort	D3.2.1. Guide the process of scoping e-government enterprise architecture <i>by adapting TOGAF ADM guidelines on scope</i>	A3.2.1. Define scope dimensions for e-government enterprise architecture
V6. Evaluate business capabilities with respect to realizing the e-government vision	D3.2.2. Guide the process of evaluating business and technology capabilities <i>by providing insights into key aspects to be assessed</i>	A3.2.2. Evaluate business & technology capabilities
V7. Specify architecture principles & governance mechanisms for e-government implementations	D1.5	A1.5. Specify regulatory & legal guidelines for e-government
	D1.7	A1.7. Define governance mechanisms for e-government
V8. Specify requirements for e-government architecture	D1.1	A1.1. Specify methods of acquiring & developing solutions
	D1.3	A1.3. Specify criteria for evaluating open solutions
	D2.1	A2.1. Standardize human resource capacity building
	D2.4	A2.4. Create catalog on success factors for establishing PPPs
	D3.4	A3.4. Specify criteria for evaluating middleware solutions
	D3.5	A3.5. Specify criteria & measures for monitoring & evaluating e-government
V9. Design e-government enterprise architecture	<i>D3.2.3. Guide designing e-government architecture views by adapting TOGAF ADM guidelines</i>	A3.2.3. Design views of the e-government architecture domains
V10. Assess readiness of the government enterprise to undergo architecture-driven transformation	D1.2	A1.2. Create catalog of dimensions for e-government readiness assessment & change management mechanisms
V11. Specify implied risks and mitigations associated with the e-government architecture	D2.3	A2.3. Create catalog of e-government risks and mitigations

To derive a coherent design of EGEAF, steps V1 to V11 and e-government development activities A1.1 to A3.5 (as aligned in Table 3) were synthesized or orchestrated into a holistic view depicted in Figure 6.



**Figure 6.** Design of the E-Government Enterprise Architecture Framework (EGEAF)

Figure 6 shows EGEAF as a process (based on TOGAF ADM) for guiding the development of e-government enterprise architectures – blueprints for informing and ensuring the development of interoperable e-government solutions. EGEAF has the following two core views:

- a) **Method View** – the left side is the procedure for creating an e-government enterprise architecture vision. It is derived by integrating the adapted steps of TOGAF ADM (V1 to V11) in pane 1 of Figure 6 with design decisions D1.1 to D3.1 and D3.3 to D3.5, so as to obtain e-government development activities A1.1 to A3.5 (in pane 2 of Figure 6). The unshaded height pane of Figure 6 presents the question log of EGEAF – a set of questions that need to be answered when executing each e-government development activity, to ensure that stakeholder deliberations yield desired outputs and products. Regarding the situational applicability of EGEAF, e-government activities in pane 2 are tailored to strategic constraints and requirements of e-government in Uganda as an instance of a developing economy. Also, the set of questions in the question log is tailored to strategic issues or requirements in a developing economy (that appear in Table 2). Thus, applying EGEAF in a developed economy requires one to adapt activities in pane 2 and questions in the question log, so that they accommodate strategic constraints or requirements of e-government in a developed economy. The method view is elaborated in Sections 4.3.1 to 4.3.11.
- b) **Product View** – the right side shows products expected from executing EGEAF steps and activities in the method view. The synthesis of V1 to V11 and A1.1 to A3.5 yields four products coded P1 to P4 as indicated in Figure 6. The products are defined with respect to the

structural composition of the government enterprise. Thus, the top right of Figure 6 shows that EGAEF products comprise three levels of granularity – Institution or agency, Sector, and National levels. The three levels depict a hierarchical reasoning pattern that needs to be adopted to achieve interoperability in implementing e-government solutions. This implies the need to instantiate each EGAEF step and activity at these three levels. The product view is elaborated in Section 4.4.

Sections 4.3.1 to 4.3.11 discuss the following: motivation of each step in EGAEF; corresponding e-government development activities; a set of questions (discretely presented using text boxes) that guide execution of each activity, by providing stakeholders with a semi-structured thinking pattern for brainstorming and deliberating; and expected outputs and products.

#### 4.3.1. Specify Strategic Context of the Government Enterprise [V1, A2.2.1, A2.2.2]

Defining organizational context involves specifying the enterprise vision, mission, business goals, culture, and enterprise-wide and project-specific resource constraints [36]. The government enterprise involves various types of specializations that are cascaded in at least three levels of complexity (as depicted in Figure 4). Thus, stakeholders at the three levels need to agree on the strategic direction of e-government (mission, vision, goals, objectives, and strategies) at each level. To achieve this, activities A2.2.1 and A2.2.2 were defined to elaborate step V1 in EGAEF (Figure 6). This yields a shared framework for strategic management of e-government, which enables entities at a given level and their partners to mutually specify strategic drivers, actions, and sustainability mechanisms of e-government initiatives. Basing on strategic planning insights in [79], [111]–[113], A2.2.1 prompts stakeholders to deliberate towards defining clear agency/institution level strategic drivers for e-government, that are aligned with sector and national level drivers for e-government. This alignment informs the design of coherent views of the e-government architecture at agency/institution, sector, and national levels. To execute A2.2.1, guiding questions that need to be deliberated are presented in the text box coded V1:A2.2.1.

[V1:A2.2.1] Prompts for formulating strategic drivers of e-government
Q1) What is the mission, vision, goals, and objectives of implementing e-government at [ <i>institution/ sector/ national</i> ] level?
Q2) To what extent do the e-government strategic drivers at agency or institution level align with those at sector level, and those at national level? To what extent do the drivers at sector level align with those at national level?

Furthermore, developing economies use their limited resources on several development priorities [114], and rely on donor support to facilitate e-government efforts [19]. However, most donor funded e-government projects are implemented without conducting comprehensive needs analysis with respect to context, and thus collapse when donor funding ends [21], [115]. To prevent this, activity A2.2.2 prompts stakeholders at agency or institution/ sector/ national levels of the government enterprise to create a catalogue of possible sustainability strategies that can be adopted to give assurance of long-term support for donor-driven e-government efforts. With such a catalogue, stakeholders can choose suitable sustainability strategies that can be adopted and contextualized or amended to specific settings at institution/ sector/ national levels. To achieve this, guiding questions are presented in the text box coded V1:A2.2.2. Sustainability aspects are elaborated in Section 4.3.7 and 4.3.8 (under A1.7 and A2.4).

**[V1:A2.2.2] Prompts for creating a catalog of strategies for sustaining donor-driven e-government solutions**

- Q1) Which e-government projects are currently donor-driven at *[institution/ sector/ national]* level?
- Q2) How do specific donor-driven projects contribute to the achievement of e-government strategic drivers at *[institution/ sector/ national]* level?
- Q3) Which activities of a donor-driven project support achievement of goals of existing/planned e-government projects at *[institution/ sector/ country]* level?
- Q4) How can a specific donor-driven project be sustained at *[institution/ sector/ national]* level, once donor funding is terminated or expired?
- Q5) Which strategies can donors and/or beneficiaries of donor funding adopt/adapt to sustain donor-driven projects at *[institution/ sector/ national]* level?

**4.3.2. Specify Stakeholders of the Government Enterprise [V2, A3.3]**

To determine relevant views for an enterprise architecture, there is need to create a stakeholder map that specifies key actors to be affected by (or to influence) a transformation; their concerns; and levels of involvement [36], [37]. Adequate stakeholder involvement helps to secure their support; leads to solution designs that match contextual needs; and is a critical success factor in complex efforts [116]–[118], such as e-government implementations. This implies the need to develop a cascaded stakeholder map of key internal and external actors of e-government at institution, sector, and national levels. Thus, activity A3.3 details step V2 in EGEAF (Figure 6) by prompting for the formulation of a stakeholder map and engagement strategy for the e-government architecture development effort. With the stakeholder map, it is possible to determine the relevant views of the e-government enterprise architecture. Executing A3.3 yields a comprehensive stakeholder map/register and communication roadmap for e-government at institution, sector, and national levels. Drawing from insights on stakeholder identification and prioritization in [36], [37], [117], [119], the execution of A3.3 involves defining existing and planned governance structures and stakeholder groupings; and specifying contextual factors that influence the timing and prioritization of stakeholder involvement, and selection of appropriate involvement strategies. To achieve this, guiding questions are presented in the text box coded V2:A3.3.

**[V2:A3.3] Prompts for identifying stakeholder groups & their involvement strategies**

- Q1) Who will be involved in and/or benefit from e-government implementations at *[institution/ sector/ national]* level?
- Q2) Which of the stakeholder groups in Q1 can be classified as internal/external stakeholders at *[institution/ sector/ national]* level?
- Q3) Which stakeholder groups participate in government-to-government (G2G) transactions, government-to-consumer (G2C) transactions, or government-to-business (G2B) transactions (including vendors, contractors, suppliers) at *[institution/ sector/ national]* level?
- Q4) What are the specific roles, levels of interest, and influence of each stakeholder group in Q1 to Q3 at *[institution/ sector/ national]* level?
- Q5) Which techniques can be used to appropriately involve each stakeholder group in Q1 to Q3, to elicit their concerns and needs during planning, implementation, and evaluation of e-government implementations at *[institution/ sector/ national]* level?

**4.3.3. Secure Management Support for e-Government Architecture [V3, A1.6]**

It is vital to conduct context-specific procedures to ensure that all internal and external stakeholders of the enterprise recognize the architecture development initiative and corporate management authorizes and supports it [37]. Top management support is among the critical success factors in ICT project management [120]–[123]. This is because in e-government initiatives, top managers will ensure that the project is resourced appropriately and will provide relevant political support for its success [70]. Thus, activity A1.6 in step V3 of EGEAF (Figure 6) focuses on adopting existing enterprise-specific strategies to: (a) create awareness on e-government regulation and standards among top managers at each level in the government enterprise, and (b) to secure their support in advancing e-government maturity by making informed



decisions on the coherency of e-government implementations. Coupling step V3 and A1.6 in EGAEF yields an awareness and advocacy programme (for top managers at the 3 levels of the government enterprise) on acceptable standards and best practices in e-government regulation. Such a programme would help to: a) regulate adoption, development, and maintenance of ICT solutions in public entities and b) continuously monitor adherence to e-government implementation standards. The programme would also provide strategies that can be contextualized to secure top management commitment for e-government regulation at each level of the government enterprise. Guiding questions for executing A1.6 are presented in the text box coded V3:A1.6.

<b>[V3:A1.6] Prompts for acquiring management support for e-government regulation</b>
Q1) What is the architecture maturity score of entities at <i>[institution/ sector/ national]</i> level of the government enterprise?
Q2) What are the challenges/factors hindering advancement of the maturity score of entities at <i>[institution/ sector/ national]</i> level?
Q3) Which challenges in Q2 can be addressed through adopting/adapting ICT standards and regulatory best practices?
Q4) Who are the top managers and sponsors influencing e-government implementations at <i>[institution/ sector/ national]</i> level?
Q5) Which measures can be used to increase awareness of findings on Q1 to Q3 among managers in Q4?
Q6) Which strategies can be used by managers in Q4 to enforce adoption of standards and best practices at <i>[institution/ sector/ national]</i> level?
Q7) Which techniques are appropriate for seeking and gaining the support and commitment of managers in Q4?

#### **4.3.4. Define Existing Management Frameworks [V4, A1.4, A3.1]**

It is vital to identify and specify relationships or inter-linkages between the enterprise architecture development effort and existing management/operational and governance frameworks, models, and projects in an enterprise [37]. In the context of the government enterprise, frameworks that can inform or can be affected by the development of the e-government enterprise architecture include operating models of units that constitute the e-government enterprise, e-government interoperability frameworks, and legal frameworks. Thus, activities A1.4 and A3.1 in step V4 of EGAEF (Figure 6) focus on prompting stakeholders to adopt these frameworks and explore or demonstrate the extent to which they directly and indirectly relate with the e-government enterprise architecture effort. Output from these activities is used to refine or complete outputs of steps V1 to V3 in the preceding sections. **Activity A1.4** focuses on adapting existing frameworks to define guidelines for streamlining or standardizing information management (including sharing, re-use, and archival) in the government enterprise. This yields a framework for data and information management across e-government implementations. The text box coded V4:A1.4 provides guiding questions for this task.

<b>[V4:A1.4]. Prompts for specifying guidelines for information sharing, reuse, &amp; archival</b>
Q1) What are the operational issues/implications of information sharing, re-use, and archival at <i>[institution/ sector/ national]</i> level?
Q2) Which existing data management frameworks/standards can be adapted to address issues in Q1?
Q3) Which data management mechanisms/principles/guidelines can be adapted from frameworks in Q2 to address issues in Q1?
Q4) Which data management mechanisms/principles/guidelines can address issues that are not addressed in Q3?
Q5) What are the implications of findings in Q3 and Q4 on operations at <i>[institution/ sector/ national]</i> level?

Activity A3.1 further enriches step V4 of EGAEF by prompting stakeholders to adapt existing interoperability standards to define appropriate minimum principles/guidelines for e-government interoperability across levels of the government enterprise. Interoperability is the ability of systems and devices to exchange data and interpret the shared data [34]. e-Government interoperability is the ability of two or more digital solutions (that support government operations) to interconnect

and exchange data in a seamless way [54], [124]. Thus, e-government interoperability frameworks define minimum standards and principles or policies that government entities must adhere to when developing their digital solutions, so as to enable seamless information flow across all entities that constitute the public sector [54]. Interoperability of electronic systems is defined in 3 levels: technical level – specifying the type and size of data to be exchanged; semantic level – ensuring that data to be exchanged is interpreted by all actors in the same way; organizational interoperability – ensuring that expected actions on the exchanged data are mutually understood by all actors [34]. These insights are adopted to formulate questions (in the text box coded V4:A3.1) for guiding stakeholder deliberations on key contextual inputs and constraints for realizing interoperability across all levels of the government enterprise. **Activity A3.1** yields a catalogue of e-government interoperability frameworks/standards, criteria for guiding the selection of their components to address particular types of interoperability needs, and measures of enforcing adherence to interoperability principles or guidelines in public entities.

<b>[V4:A3.1]. Prompts for specifying criteria for choosing e-government interoperability standards and frameworks</b>
Q1) What are the data and information needs of entities at <i>[institution/ sector/ national]</i> level of the government enterprise?
Q2) Which entity at <i>[institution/ sector/ national]</i> level is mandated to generate data sets that address specific data and information needs in Q1?
Q3) Which data sets must be exchanged between or among which entities at <i>[institution/ sector/ national]</i> levels? <i>This yields requirements for achieving technical interoperability in e-government.</i>
Q4) What should be the standard format for specific data sets in Q3, so that all stakeholders involved in the exchange interpret the data set in the same way? <i>This yields requirements for achieving semantic interoperability in e-government.</i>
Q5) For each data set to be exchanged, what is the expected action of each entity involved in the exchange? <i>This will yield requirements for achieving organizational interoperability in e-government.</i>
Q6) Which existing (e-government) interoperability frameworks/standards can be adapted to address the needs and constraints of data exchange in Q1 to Q5?
Q7) Which interoperability principles and guidelines can be adopted/adapted from the existing frameworks in Q6 to address contextual aspects in Q1 to Q5?
Q8) Which e-government interoperability principles/guidelines can address aspects in Q1 to Q5 that are not addressed in Q7?
Q9) Which strategies should be executed to ensure that adapted e-government interoperability principles and guidelines are adhered to at <i>[institution/ sector/ national]</i> level?

#### **4.3.5. Define Scope of e-Government Architecture Effort [V5, A.3.2.1]**

Due to limited resources and the nature and context of an enterprise, it is vital to specify the scope of its architecture development effort by articulating: all its internal and extended units that are to be included and excluded in the effort, architecture domains to be designed, and expected level of detail for the architecture views [37]. Since the government enterprise has a complex structure of at least 3 levels/tiers, it is imperative to specify the scope of the e-government architecture at each level with respect to resources and context of specific entities. To achieve this, step V5 in EGAEAF (Figure 6) is enriched with activity A3.2.1 (which was initiated in Table 3). A3.2.1 involves specifying key aspects that shape the scope dimensions of e-government architecture development across all levels of the government enterprise. This is because the extent of e-government growth or maturity of each entity at any level is planned depending on the specific laws and unique concerns associated with exercising the mandate of that entity. Thus, the synthesis of V5 and A3.2.1 yields the scope specification for e-government implementations at institution, sector, and national levels. To achieve this, questions that should be explored and deliberated by stakeholders are presented in the text box coded V5:A3.2.1. Each question in the text box V5:A3.2.1 encapsulates other questions at institution, sector, and national levels. Thus, a comprehensive guide on scoping e-government architecture efforts is provided in earlier work by Nakakawa et al [125].

**[V5:A3.2.1]. Prompts for defining scope dimensions for e-government enterprise architecture**

- Q1) What are the available resources for the e-government architecture development effort at *[institution/ sector/ national]* level?
- Q2) Which existing and planned business processes or capabilities at *[institution/ sector/ national]* level are to be supported by e-government implementations?
- Q3) Which architecture domains (i.e., business, data, applications, technology, and security) are to be designed to guide e-government implementations at *[institution/ sector/ national]* level?
- Q4) What is the appropriate level of detail for architecture domains in Q3 at *[institution/ sector/ national]* level?

**4.3.6. Evaluate Business Capabilities [V6, A3.2.2]**

Evaluating business capabilities helps to investigate and specify which capabilities are relevant to achieve strategic drivers and business requirements for the target state of the enterprise, and their implications on the technology capabilities [37]. In the government enterprise, it is vital for stakeholders to assess which business capabilities at institution, sector, and national levels will support the realization of the e-government strategic drivers at each level. To achieve this, step V6 of EGEAF (Figure 6) involves executing activity A3.2.2 (which was initiated in Table 3). In A3.2.2 business capabilities that are relevant in the e-government architecture effort are identified and evaluated at institution, sector, and national levels. The synthesis of V6 and A3.2.2 yields a catalog of business capabilities for realizing e-government strategic drivers at institution, sector, and national levels; and a catalog of technology capabilities required to support the target e-government enterprise architecture vision. To achieve this, questions that have to be deliberated by stakeholders are presented in the text box coded V6:A3.2.2.

**[V6:A3.2.2]. Prompts for evaluating business capabilities and technology capabilities**

- Q1) What are the existing and planned business capabilities, data management capabilities, and information technology capabilities at *[institution/ sector/ national]* level?
- Q2) How will each capability in Q1 directly or indirectly contribute to the achievement of the e-government strategic drivers at *[institution/ sector/ national]* level?
- Q3) What are the relationships or interactions between and among capabilities in Q1 and Q2 at *[institution/ sector/ national]* level?
- Q4) From findings in Q1 to Q3, which capabilities need to be integrated/merged, outsourced, improved, or phased out at *[institution/ sector/ national]* level?
- Q5) Which business capabilities, data management capabilities, and information technology capabilities need to be established at *[institution/ sector/ national]* level, so as to achieve the desired e-government state?

**4.3.7. Specify Architecture Principles and Governance Mechanisms [V7, A1.5, A1.7]**

Architecture principles are rules and guidelines that specify constraints and inform decision making in the architecture development effort, and the architecture governance board helps to ensure that the constraints are addressed by the architecture products and resolves conflicting issues [36], [37]. Thus, step V7 of EGEAF (Figure 6) indicates the need for stakeholders to define architecture principles and an explicit governance mechanism for e-government implementations. This is elaborated by activities A1.5 and A1.7 which focus on developing a regulatory and governance framework for e-government implementations, as elaborated below. **Activity A1.5** involves establishing a regulatory and legal framework for e-government, by formulating quality and legal guidelines for directing and controlling the development and coordination of e-government implementations. Since step 3 and activity A1.6 of EGEAF (Figure 6) focus on securing management support for regulation of e-government efforts, activity A1.5 is concerned with the actual formulation and establishment of the regulatory and legal guidelines for e-government implementations. Thus, A1.5 yields regulatory and legal guidelines and architecture principles for ensuring that e-government efforts at institution, sector, national levels are synchronized to realize the e-government vision. Guiding questions that have to be deliberated to achieve this are presented in the text box coded V7:A1.5.

**[V7:A1.5] Prompts for specifying regulatory and legal guidelines for e-government**

- Q1) What are the quality issues or implications of implementing the business, data, application, technology, and security solutions that are required to achieve the e-government vision or target state at *[institution/ sector/ national]* level?
- Q2) Which existing best practices, standards, and quality guidelines can be adopted/adapted to address aspects in Q1?
- Q3) Which additional guidelines can address aspects in Q1 that are not addressed in Q2?
- Q4) From findings in Q2 and Q3, which business, data, application, technology, and security architecture principles are relevant to address aspects in Q1 at *[institution/ sector/ national]* level?
- Q5) What are the legal issues or implications associated with implementing e-government at *[institution/ sector/ national]* level?
- Q6) Which existing legal frameworks can be adapted to address the legal aspects in Q5?
- Q7) Which legal principles/guidelines can be adapted from frameworks in Q6 to address legal issues in Q5?
- Q8) Which additional legal principles/guidelines can address legal issues that are not addressed in Q7?
- Q9) What are the (quality) implications of legal aspects in Q7 and Q8 on routine and periodic operations at *[institution/ sector/ national]* level?
- Q10) Which measures can be used to ensure compliance to the quality and legal guidelines in Q7 to Q9?

**Activity A1.7** involves designing a governance framework for coordinating and controlling quality of e-government implementations, which: (a) provides a cascaded management and approval structure for e-government initiatives; and (b) specifies roles of (and criteria for selecting) members of the governance board, quality assurance teams, and technical working groups for supporting development of the e-government enterprise architecture. This yields a cascaded e-government governance and quality assurance board that is responsible for overseeing, monitoring, evaluating, and continuously maintaining e-government enterprise architecture at institution, sector, and national levels. To achieve this, questions that have to be deliberated are presented in the text box coded V7:A1.7. Other roles of the governance and quality assurance boards are readiness and change management (see step V10), risk and mitigation assessment (see step V11), and sustainability assessment (see step V1 under A2.2.2 and step V8 under A2.4).

**[V7:A1.7] Prompts for defining governance mechanisms for e-government architecture**

- Q1) Which mechanisms can be used to identify and select representatives of all key stakeholder groups (at strategic, operational, political, and community levels) of e-government implementations at *[institution/ sector/ national]* level?
- Q2) Which of the representatives in Q1 should constitute the architecture governance and quality assurance board of the e-government enterprise architecture at *[institution/ sector/ national]* level?
- Q3) Which of the representatives in Q1 should constitute the technical working group or task force of the e-government enterprise architecture at *[institution/ sector/ national]* level?
- Q4) Which of the representatives in Q1 should constitute the steering and advocacy committee of the e-government enterprise architecture at *[institution/ sector/ national]* level?
- Q5) What are the specific routine and periodic roles of the control boards and groups in Q2 to Q4?
- Q6) What are the criteria for assessing quality, sustainability, and regulatory-legal compliance of e-government implementations at *[institution/ sector/ national]* level?
- Q7) Which criteria in Q6 are considered at the governance and quality assurance board, at the technical working group or task force, and at the steering and advocacy committee at *[institution/ sector/ national]* level?

#### 4.3.8. Define Requirements for e-Government Architecture [V8]

To satisfy stakeholders' concerns, there is a need to comprehensively define requirements for the architecture development effort and to articulate their implications on resources required to achieve particular business outcomes [37]. Thus, step V8 of EGEAF (Figure 6) coupled with activities A1.1, A1.3, A2.1, A2.4, A3.4, and D3.5 focuses on engaging stakeholders to specify requirements for the e-government architecture. **Activity A1.1** involves specifying guidelines for acquiring ICT solutions in public entities and standard frameworks and methods for developing e-government solutions. Approaches of software acquisition can be broadly categorized into: open source, custom-made, in-house development, and commercial-off-the-shelf [126]. Basing on this, guiding questions for stakeholder deliberation are presented in the text box coded V8:A1.1. Thus,

activity A1.1 yields a catalog of standardized quality criteria for acquiring e-government solutions and accessories.

<b>[V8:A1.1] Prompts for specifying methods of acquiring/ developing e-government solutions</b>
Q1) What are the strengths and weaknesses of using open source avenues, custom-made avenues, in-house development avenues, & commercial-off-the-shelf avenues to acquire e-government solutions & their accessories <i>[institution/ sector/ national]</i> level?
Q2) From Q1, which acquisition avenues are acceptable for use at <i>[institution/ sector/ national]</i> level?
Q3) Which measures can be established at <i>[institution/ sector/ national]</i> level to guard against the weaknesses of the acquisition avenues specified in Q1?

**Activity A1.3** involves specifying criteria and methods for evaluating and adopting open standards/solutions for the government enterprise. Government ICT solutions must be open to the people, organizations that use them, and any provider [45]. Thus, public entities need to create a shared secure ICT infrastructure based on a suite of agreed upon open standards, that can be adopted and maintained to enable interoperability between solutions [15]; and to build consistent, standardized, and reliable e-government implementations [127]. Basing on these, guiding questions for guiding stakeholder deliberations are presented in the text box coded V8:A1.3. The output of A1.3 is a catalog of open standards that can be selected, blended, and adopted for specific e-government implementations.

<b>[V8:A1.3] Prompts for specifying criteria for evaluating open standards and solutions</b>
Q1) Which open (ICT) standards can be adopted/adapted to support interoperability and standardization of data sets at <i>[institution/ sector/ national]</i> level?
Q2) What are the strengths and weaknesses of standards in Q1 with respect to addressing needs and constraints of service delivery at <i>[institution/ sector/ national]</i> level?
Q3) Basing on findings in Q2, which criteria can be used to evaluate open (ICT) standards for e-government implementations at <i>[institution/ sector/ national]</i> level?
Q4) Which measures should be implemented to enforce adoption of suitable open standards at <i>[institution/ sector/ national]</i> level?

**Activity A2.1** focuses on establishing a standard process for recruitment, selection, hiring, and continuous professional development of ICT personnel for e-government growth; and specifying guidelines for collaborating with academia to standardize continuous capacity building of ICT personnel for e-government success. Qualified staff and reliable training schemes are necessary pre-requisites for e-government success [21], [70], [128], [129]. Yet in developing economies, personnel tasked to implement e-government do not often have the required skillset, while people with the desired skillset are not availed the opportunity [129]. Thus, it is vital to have a recruitment and selection policy which can inform the recruitment process [130]. Basing on these insights, stakeholders have to deliberate questions provided in the text box coded V8:A2.1. Output of A2.1 is a standard human resource capacity building process for e-government implementations at all levels.

<b>[V8:A2.1] Prompts for standardizing human resource capacity building</b>
Q1) Which skill sets are necessary for successful implementation of e-government at <i>[institution/ sector/ national]</i> level?
Q2) Which academic institutions can offer continuous human resource capacity building to address the skill sets in Q1?
Q3) How should entities at <i>[institution/ sector/ national]</i> level collaborate with academic institutions to address the skill sets in Q1?
Q4) What partnerships and knowledge transfer forums should be created to ensure that the skill sets in Q1 are addressed at <i>[institution/ sector/ national]</i> level?
Q5) How can the measures in Q4 be operationalized at <i>[institution/ sector/ national]</i> level?
Q6) Which measures can be taken to ensure retention of competent personnel for e-government success at <i>[institution/ sector/ national]</i> level?

**Activity A2.4** involves adapting critical success factors for establishing or strengthening PPPs to enable joint development and maintenance of a shared ICT infrastructure for supporting interoperable e-government implementations. PPPs can help to overcome limitations of financial resources and technical capacity in e-government implementations; and increase growth opportunities for the private sector [131]. The output of A2.4 is a catalog of critical elements in establishing PPPs for building capacity for sustainable e-government implementations, through enhancing skillsets and infrastructure at all levels/tiers. To achieve this, stakeholders need to deliberate questions in the text box coded V8:A2.4.

<b>[V8:A2.4] Prompts for creating a catalog on success factors for establishing Public Private Partnerships (PPPs)</b>
Q1) Which e-government projects at <i>[institution/ sector/ national]</i> level require high capital investment or vast financial resources and high technical capacity or skillsets?
Q2) What forms of PPPs can be created for projects in Q1, and which form of PPP is the most appropriate at <i>[institution/ sector/ national]</i> level?
Q3) Which critical success factors/strategies can be used to establish/strengthen PPPs in Q2 at <i>[institution/ sector/ national]</i> level?

**Activity A3.4** involves defining criteria for evaluating and selecting appropriate middleware systems for enabling integration of heterogeneous data sources in already existing e-government implementations. Achieving e-government interoperability requires public entities in a given context to collaborate and use middleware solutions to integrate heterogeneous data sources in existing systems [132]. Thus, output of A3.4 is a catalog of possible and selected middleware solutions for integrating isolated e-government implementations. Achieving this requires stakeholders to deliberate questions in the text box coded V8:A3.4.

<b>[V8:A3.4] Prompts for specifying criteria for evaluating middleware solutions</b>
Q1) Which legacy e-government systems at <i>[institution/ sector/ national]</i> level require integration with other systems through the use of middleware?
Q2) Which criteria can be used to evaluate and select the different types of middleware for system integration?
Q3) Using criteria in Q2, which middleware is appropriate to support integration of systems in Q1?
Q4) Which Electronic Data Interchange (EDI) technologies are appropriate for systems in Q1, or in delivering e-government strategic drivers at <i>[institution/ sector/ national]</i> level?

**Activity A3.5** involves adapting best practices in monitoring and evaluation to address quality issues in e-government efforts. Various e-government initiatives in developing countries are constrained by the absence of proper monitoring and evaluation structures [131]. To address this, activity A3.5 prompts stakeholders to deliberate questions provided in the text box coded V8:A3.5. This yields a monitoring and evaluation framework for e-government solutions at all levels.

<b>[V8:A3.5] Prompts for specifying criteria &amp; measures for monitoring &amp; evaluating e-government</b>
Q1) What are the key performance indicators associated with achieving e-government strategic drivers and goals at <i>[institution/ sector/ national]</i> level?
Q2) What are the sources of data for indicators in Q1 at <i>[institution/ sector/ national]</i> level?
Q3) Which measures or approaches can be used to enable stakeholders to collaboratively and effectively assess e-government performance at <i>[institution/ sector/ national]</i> level?

#### 4.3.9. Design e-Government Architecture Vision [V9, A3.2.3]

Stakeholder perspectives on baseline and target contexts of an enterprise are synthesized into a high level composition of elements that accommodate stakeholder concerns, requirements, constraints, and principles – the enterprise architecture vision [37]. Thus, step V9 of EGEAF (Figure 6) involves using output from steps V1 to V8 to design an e-government architecture vision for each level. Activity A3.2.3 supplements steps V9 by engaging stakeholders into deliberations that validate and align different views of the e-government architecture vision across levels. The

output of V9 coupled with A3.2.3 is a contextualized integrated e-government architecture vision for institution, sector, and national levels of government. To achieve this, the text box coded V9:A3.2.3 provides questions for stakeholder deliberations.

<b>[V9: A3.2.3] Prompts for designing views of e-government architecture domains</b>
Q1) What are the business, data, application, and technology elements that will support realization of the target e-government context at <i>[institution/ sector/ national]</i> level?
Q2) What are the information exchanges between and among the business elements in Q1 at <i>[institution/ sector/ national]</i> level?
Q3) Which views of the target e-government business architecture vision appropriately accommodate stakeholder concerns and requirements at <i>[institution/ sector/ national]</i> level?
Q4) Which views of the target e-government data architecture vision appropriately support the target e-government business architecture vision in Q3 at <i>[institution/ sector/ national]</i> level?
Q5) Which views of the target e-government application architecture vision appropriately support the data architecture vision in Q4 and business architecture vision in Q3 at <i>[institution/ sector/ national]</i> level?
Q6) Which views of the target e-government technology architecture vision appropriately support the application architecture vision in Q5, data architecture vision in Q4, and business architecture vision in Q3 at <i>[institution/ sector/ national]</i> level?
Q7) Which architecture building blocks from Q3 to Q6 are needed to acquire the web presence stage, interaction stage, transaction stage, and transformation stage of e-government maturity at <i>[institution/ sector/ national]</i> level?
Q8) To what extent do the architecture views in Q3 to Q6 accommodate stakeholder concerns, requirements, and constraints?

#### **4.3.10. Assess Transformation Readiness of the Government Enterprise [V10, A1.2]**

Enterprise architecture development entails considerable changes, which implies the need to devise cohesive change management strategies towards realizing the target business value [36], [37]. In addition, e-government implementations entails utilization digital technologies to enable rational changes that improve public service delivery through reforming the public sector structure, values, culture and ways of conducting business [133]. If changes resulting from e-government implementations and enterprise architecture in public service delivery are not effectively managed, resistance may be faced [134]. Thus, it is vital to assess readiness of the extent to which an enterprise is ready to undergo the desired transformation, by realistically analyzing and rating the enterprise against various readiness factors with respect to the enterprise architecture vision [36], [37].

Step V10 of EGEAF (Figure 6) is concerned with assessing the extent to which each level of the government enterprise is ready to undergo changes associated with achieving the architecture vision, that will realize the e-government strategic drivers. Activity A1.2 supplements V10 by prompting stakeholders to: (a) specify which dimensions of the government enterprise are to be assessed for readiness; and (b) devise change management strategies that are needed to realize the target e-government context. e-Government readiness and change management is one of the critical functions of the governance boards in step V7. The synthesis of V10 and A1.2 yields three outputs, i.e.: a catalog of factors or dimensions for assessing e-government readiness of internal and external entities at each level of the government enterprise; a catalog of change management practices or techniques that can be adopted in internal and external entities at each level of the government enterprise; a report on e-government readiness at institution, sector, and national levels of the government enterprise; and a corresponding change management report for institution, sector, and national levels. To achieve this, questions for guiding stakeholder deliberation are provided in the text box coded V10:A1.2.

**[V10:A1.2] (a) Prompts for creating a catalog of dimensions for e-government readiness assessment**

To achieve the desired state of e-government, what is the current/baseline status and readiness score for each entity at *[institution/ sector/ national]* level in terms of:

- Q1) People/human factors (i.e., end user ICT skills, HR training and development, and technical support)?
- Q2) ICT infrastructure factors (i.e., hardware and software, LAN and WAN, security)?
- Q3) Legal factors (i.e., privacy, confidential)?
- Q4) User access channels (i.e., usability, availability, accessibility)?
- Q5) e-Government programme establishment (i.e., single-sign-on portal, government service bus, government secure network)?
- Q6) Business process and information systems (i.e., business process reengineering, knowledge and change management)?
- Q7) Apart from factors in Q1 to Q6, which additional dimensions should be considered to assess the e-government readiness of public entities, private entities, and communities at all levels?
- Q8) For public enterprises (as beneficiaries of G2G/G2G transactions), what is the general readiness score/context in dimensions Q1 to Q7 above?
- Q9) For private enterprises (as beneficiaries of G2B/B2G transactions), what is the general readiness score/context in dimensions Q1 to Q7 above?
- Q10) For citizens and various communities (as beneficiaries of G2C/C2G transactions), what is the general readiness score/context in adopting e-government solutions to realize the e-government strategic drivers?

**[V10:A1.2] (b) Prompts for creating a catalog of mechanisms for e-government change management**

To achieve the e-government strategic drivers and goals:

- Q11) Which technology-related changes need to be managed at *[institution/ sector/ national]* level?
- Q12) Which process-related changes need to be managed at *[institution/ sector/ national]* level?
- Q13) Which people-related changes need to be managed at *[institution/ sector/ national]* level?
- Q14) Which organization culture-related changes need to be managed at *[institution/ sector/ national]* level?
- Q15) What organization structure-related changes need to be managed at *[institution/ sector/ national]* level?
- Q16) Which context-specific measures should be adopted in public entities to implement changes in Q11 to Q15?
- Q17) In private enterprises and at community level, which context-specific change management measures should be adopted?

#### **4.3.11. Identify Implied Risks and Mitigations [V11, A2.3]**

Most e-government projects in developing countries are deemed as partial failures if they fail to deliver the expected technical performance, functionality, and business benefits within budget and schedule; and as complete failures if they are abandoned [135]. Failures mainly arise from critical problems that governments encounter when implementing large ICT projects [136]. These problems are regarded as a ‘hidden threat to e-government’, and unless governments devise means of managing the hidden threats as risks, e-government projects will continue to fail [137]. However, in adopting an architecture-driven approach to e-government implementations, guidance is needed on how risks or threats can be managed. Basing on the enterprise readiness status/capacity and change management capabilities, it is vital to: identify risks associated with realizing the architecture vision; assess their magnitude; and devise implied mitigation strategies [36], [37]. Thus, step V11 of EGEAF (Figure 6) prompts stakeholders to identify risks and mitigation strategies that are associated with achieving the desired e-government state at institution, sector, and national levels.

In addition, activity A2.3 supplements step V11 by prompting stakeholders to create a catalog of risk factors in e-government implementation across entities at institution, sector, and national levels; and adapting existing risk assessment and cost benefit analysis approaches to the e-government context. Risk and mitigation management is a key role of the governance boards specified in step V7. The synthesis of V11 and A2.3 yields a catalog of potential risks and mitigation strategies for implementing the e-government enterprise architecture vision at all levels of the government enterprise and achieving e-government strategic drivers. Adoption of such a catalogue across all levels of the government enterprise yields a cascaded and integrated readiness assessment and risk mitigation framework for e-government implementations. To achieve this, questions for stakeholder deliberation are provided in the text box coded V11:A2.3.



**[V11: A2.3] Prompts for creating catalog of e-government risks and mitigations**

Q1) Which risks arise when implementing e-government enterprise architecture vision at *[institution/ sector/ national]* level?

Q2) Which risks are associated with the B2G/G2B, C2G/G2C, and G2G transactions at *[institution/ sector/ national]* level?

Q3) Which strategies can be implemented to mitigate risks in Q1 and Q2 at *[institution/ sector/ national]* level?

#### 4.4. The Question Log and Products of EGEAF

EGEAF comprises two views – method view and product view (see Figure 6). The method view is a combined representation of steps for designing an e-government architecture vision, supplementary e-government activities, and a question log. The **question log** in EGEAF is a consolidation of critical questions that prompt and guide stakeholder deliberations during the execution of steps V1 to V11 and their supplementary e-government activities coded A1.1 to A3.5. Sets of logically related questions are provided in text boxes that are discretely presented in Sections 4.3.1 to 4.3.11. Questions in each text box guide the execution of a specific step and its supplementary activities. Each set of questions yields specific outputs, which are consolidated into products of EGEAF.

**Products of EGEAF** are presented in the right part of Figure 6 with codes P1 to P4. Since EGEAF comprises several steps and corresponding e-government activities, the specific outputs from its activities and steps are grouped into 4 broad classifications (coded as P1 to P4). The classifications are based on the expected outputs of implementing the strategic requirements for e-government interoperability that are summarized in Section 4 (Table 2), and discussed in [84]. These include:

- [P1] *A regulatory and governance framework for e-government*, which comprises outputs from activities A1.1 to A1.7 and the corresponding steps in EGEAF.
- [P2] *A sustainability and capacity building framework for e-government*, which comprises outputs from activities A2.1 to A2.4 and the corresponding steps in EGEAF.
- [P3] *An adaptation framework for guiding customization of e-government interoperability standards and guidelines*, which comprises outputs from activities A3.1, A3.3 to A3.5. and the corresponding steps in EGEAF.
- [P4] *e-Government Enterprise Architecture Vision*, which comprises outputs from activities A3.2.1 to A3.2.3 and the corresponding steps in EGEAF.

Since EGEAF steps and activities are executed at institution, sector, and national levels of the government enterprise, the corresponding outputs and products need to be consolidated as follows:

- **First, outputs from each level** are consolidated to constitute products of each level of the government enterprise. This implies that products P1 to P4 are expected or obtained at 3 levels, as indicated in the following text box.

- Institution/Agency Level Products (KP) = {KP<sub>1</sub>, KP<sub>2</sub>, KP<sub>3</sub>, KP<sub>4</sub>}
- Sector Level Products (SP) = {SP<sub>1</sub>, SP<sub>2</sub>, SP<sub>3</sub>, SP<sub>4</sub>}
- National Level Products (NP) = {NP<sub>1</sub>, NP<sub>2</sub>, NP<sub>3</sub>, NP<sub>4</sub>}

Where:

- {KP<sub>1</sub>, SP<sub>1</sub>, NP<sub>1</sub>} = outputs of activities A1.1 to A1.7 executed in steps V3, V4, V7, V8, V9
- {KP<sub>2</sub>, SP<sub>2</sub>, NP<sub>2</sub>} = outputs of activities A2.1 to A2.4 executed in steps V1, V8, V9
- {KP<sub>3</sub>, SP<sub>3</sub>, NP<sub>3</sub>} = outputs of activities A3.1, A3.3 to A3.5 executed in steps V2, V4, V8
- {KP<sub>4</sub>, SP<sub>4</sub>, NP<sub>4</sub>} = outputs of activities A3.2.1 to A3.2.3 executed in steps V5, V6, V9

Therefore, the full set of EGEAF Products {P1, P2, P3, P4} = {KP<sub>1-4</sub> + SP<sub>1-4</sub> + NP<sub>1-4</sub>}

- **Second, products from each level** are aligned with products of other levels to ensure coherency. Specifically, institution level products are aligned with sector level products, and sector level products are aligned with national level products. Thus, the full product set of EGEAF (that is illustrated in Figure 6) is a consolidation of institution, sector, and national level products as indicated in the text box above.

## 5 Evaluation of the Design of EGEAF

Evaluation of an artifact involves assessing its ability to address the requirements and purpose that motivated its development [138]. The ‘ability’ is often interpreted in terms of attributes such as functionality, completeness, understandability, consistency, accuracy, traceability, performance, reliability, feasibility, and usability [138]–[140]. Design Science artifacts can be evaluated using analytical, experimental, observational, or descriptive methods [86]. Depending on available resources and the purpose of an artifact, these methods can all be used to gradually improve the quality of an artifact. The purpose of EGEAF is to guide the development of an e-government enterprise architecture, that serves as a coherent blueprint for supporting the planning and implementation of interoperable e-government solutions in developing economies. Thus, prior to using other evaluation methods, it was vital to first evaluate EGEAF using analytical evaluation methods. Analytical evaluation is achieved through: (a) static analysis – assessing static attributes of the structure of an artifact such as understandability and complexity; and (b) dynamic analysis – assessing dynamic attributes of an artifact in use such as response time and performance [86]. Given the limited resources of the study, it was cost effective to first use static analysis to evaluate the design and feasibility of EGEAF. This section presents findings on the static attributes of EGEAF. Static analysis of EGEAF was done using two iterations that were conducted in Uganda. The first iteration involved using a field demo (as elaborated in Section 5.1). The second iteration involved using a group structured walkthrough (as elaborated in Section 5.2). Findings from these iterations are discussed in Section 5.3.

### 5.1. Setup of the field demo on EGEAF – 1st Iteration of Validation

In a field demo, a researcher demonstrates the practical usability of an artifact by using it in a real life setting [141]. In this study, the field demo was first chosen to ensure that the relevance of specific steps and activities of EGEAF is assessed. Achieving this required that EGEAF steps and activities are executed in a setting with a limited scope, and the corresponding outputs generated. Thus, the field demo was setup as follows:

- *Aim of demo:* to determine whether EGEAF can be followed to guide the design of an e-government enterprise architecture (as a blueprint for enabling planning and implementation of interoperable e-government solutions) in an agency/institution level entity in Uganda.
- *Type of entity considered:* An institution level public entity, that is mandate to manage the planning and delivery of quality services in one of Uganda’s urban cities. In the city’s area of jurisdiction, the entity oversees the delivery of services such as physical planning, construction, public health, environment preservation, waste management, education, social welfare, youth and community development, and revenue collection for city maintenance.
- *Key participant(s) involved and context:* The tasks involved in the validation required the validator to have a general understanding of two concepts – enterprise architecture and e-government interoperability. At the time the validation was done in the entity indicated above, only one person (i.e., Project Manager or Task Leader of Business Process Reengineering, who also served as the enterprise architect of the entity) understood the concept of enterprise architecture and would comfortably participate in the validation sessions of EGEAF.
- *Duration and agenda of the validation sessions:* Four (4) discrete sessions were conducted in a period of three months. The 1st and 2nd sessions involved walkthrough discussions of

EGEAF design and its question log (that is discretely presented using the various text boxes in Section 4.3.1 to 4.3.11). The 3rd session involved using output from the first two sessions to design the e-government architecture vision of one of the core programmes of the entity indicated above. The programme's architecture vision was then discussed in the 4th session.

- *Inputs:* EGEAF model (in Figure 6), EGEAF question log (see text boxes discretely presented in Section 4.3.1 to 4.3.11), and a design evaluation instrument. The evaluation instrument comprised questions that prompted for the validator's opinion on the design and feasibility of EGEAF.
- *Output:* e-government architecture vision of one of the core programmes of the entity indicated above; and feedback on EGEAF design and feasibility (presented in Table 4).

## 5.2. Setup of the group walkthrough on EGEAF – 2nd Iteration of Validation

A field demo could only be conducted in one enterprise setting at a given time, and it requires a lot of time to be conducted to completion. Thus, the second iteration sought a cost effective way that could be used to obtain feedback on the design and understandability of EGEAF from target users in different organization settings. This implied that a sample of target users had to be engaged to evaluate EGEAF design by not executing its steps and activities, but by assessing its structural composition or design orchestration. Thus, a group walkthrough was considered to be the most appropriate form of static analysis and validation in iteration 2. Walkthroughs are used to engage experts in a specific field to analytically assess an artifact by chronologically reviewing its design, so as to identify possible usage problems, errors, omissions, violations, inconsistencies, and vagueness [142], [143]. Accordingly, procedures recommended by Sharp et al [142] and Jody [143] were adapted to derive the setup of the group walkthrough that was used as follows:

- *Aim of the group walkthrough validation:* to further determine whether the design and purpose of EGEAF was understandable to target users from different enterprise settings.
- *Key participant(s) involved:* Six (6) ICT professionals working in public entities in Uganda. Three participants worked in public entities at institution level of the government enterprise, and three worked in entities at sector level. The kind of work that they did involve tasks that are associated with the planning, implementing, and maintaining software and hardware solutions for e-government realization in their respective entities. Participants had a general understanding of the concepts of enterprise architecture and e-government interoperability.
- *Agenda/context, supporting tools, and duration:* Two discrete sessions were conducted. Session 1 involved walkthrough discussions of EGEAF design, its question log, and expected outputs and products. This was a virtual session supported by Zoom. Thereafter, participants were given two weeks to independently review EGEAF design documents. Session 2 involved eliciting feedback from participants on the design of EGEAF. Session 2 was also virtual session supported by both Zoom and MeetingWizard. Zoom was used to enable dialog between participants; and MeetingWizard was used as the Group Support System, to enable systematic elicitation and consolidation of views from participants.
- *Inputs:* EGEAF model (in Figure 6), the question log (in text boxes that are discretely presented in Sections 4.3.1 to 4.3.11), and a design evaluation tool that was used in iteration 1 to prompt validators to comment on the design of EGEAF.
- *Output:* Feedback on the design and composition of EGEAF (presented in Table 4).

**Table 4.** Feedback from the two validation iterations of EGEEAF

<i>Comments on the design &amp; feasibility of EGEEAF, &amp; insights on how to improve its design to simplify its understandability</i>
<ul style="list-style-type: none"> <li>• <b>Aim &amp; Relevance:</b> The aim or purpose of EGEEAF is clear, the steps and supplementary e-government activities are understandable to a large extent, are logically sequenced, and can be followed or executed in the context of a developing economy. However, the steps and activities are not necessarily very easy to follow if one has no background in enterprise architectures, e-government, or information systems development. EGEEAF steps (V1 to V11) comprise architecture concepts, and this makes it hard for someone without any basic understanding or background in enterprise architecture to understand the steps. Also, someone without basic understanding of e-government may fail to understand the supplementary e-government activities (A1.1. to A3.5) and how they fit within particular steps (V1 to V11).</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Question Log:</b> Although most questions in the log are clear and understandable, they are too many. They may require the users to spend a lot of time to find suitable answers to them. It is not clear how the answers to the questions are to be synthesized. Also, some questions in the log require additional explanations for them to be properly understood. Aspects raised in most of the questions can be traced back to specific issues faced during e-government planning and implementation.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>EGEEAF Products:</b> these are understandable, but it is not clear how the outputs should be assembled or synthesized or aligned to obtain a specific product. Also, someone without any background in problems faced in e-government implementations may find it hard to understand activities that lead to the outputs and products, and the relevance of specific outputs or products.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Visual Layout of EGEEAF:</b> The general composition and outlook of EGEEAF is okay and understandable to a great extent. However, it requires considerable effort from the user to understand its general logical structure, because it is not interactive or very engaging for individuals or target users without any background on enterprise architecture and e-government (or those who have limited time to concentrate and follow the logic). An individual without basic understanding of the enterprise architecture concept and issues faced in e-government implementation in a developing context, is likely to find it hard to understand the relationship between the supplementary e-government activities, outputs, and products of activities. Training of target users would help to address this limitation.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>e-Government Activities vs. Levels of the government enterprise vs. Outputs vs. Products:</b> The relationship between products at institution, sector, and national levels is understandable. However, a person without a basic understanding of e-government issues and implementation contexts would find it hard to understand the nature of relationships between the specific outputs of e-government activities and products across the 3 levels of the government enterprise.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Applicability:</b> EGEEAF is applicable to the structure of many government institutions. However, it will require an entity to dedicate time and a team of people to use EGEEAF. Most target users or managers may find it complex to use during deployment, if they have no background in architecture or e-government development issues. This would require EGEEAF designers or users with an understanding of architecture to provide training and preliminary support to target users.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Lack of Templates:</b> Providing templates for capturing/documenting findings on topics in the question log would greatly improve the understandability of various questions and the general use of the question log. Templates need to be prioritized to improve the understanding of how EGEEAF outputs are presented and aligned. Most users often respond well to questions if they are provided with a guiding template that shows key parameters that are expected to be specified in their responses. Such a template would help to contextualize and clarify particular aspects of some unclear questions in the question log of EGEEAF. Templates would help to simplify the question log and would bridge the gap between some terminologies of architecture and e-government development to the target users who have limited understanding of these two concepts.</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Missing aspects:</b> EGEEAF seems unclear on ways of addressing issues such as: a) Digital divide or unequal access to internet and computers across government entities and the various sub groups that constitute the general public; and b) Corruption when contracting vendors to develop the e-government enterprise architecture or implement specific e-government solutions.</li> </ul>

### 5.3. Discussion of Validation Findings

Validation findings point to three issues that are elaborated below:

*First, background knowledge that target users need to have prior to using EGEEAF.* From the design of EGEEAF, it was observed that target users of EGEEAF need to have basic understanding of: a) issues hindering e-government growth in developing economies; and b) enterprise architecture. This guided the selection of participants in the two iterations. Validation findings justify our choice of only engaging validators who had some background understanding of e-

government and enterprise architecture. In various public entities in developing economies like Uganda, most personnel have a good understanding of e-government, but limited understanding of enterprise architecture. Thus, further validation of EGEAF will ensure that training of participants or target users on basic concepts of enterprise architecture, is prioritized as one of the initial activities in the evaluation protocol of EGEAF. Unfortunately, this would increase the time for using or evaluating the artifact in a given setting.

*Second, qualitative feedback on the design and understandability of EGEAF.* Given the aim of validation in both iterations, it was considered appropriate to first elicit qualitative views from validators, so as to obtain specific insights on how to improve the design of EGEAF. As indicated in Table 4, issues were highlighted on the question log, outputs, products, and missing aspects in the EGEAF design. The revised design of EGEAF (that is presented in Section 4) has addressed the issue on specifying the relationship between the outputs and products of EGEAF. The issues on missing aspects and templates will be addressed in future versions of EGEAF design. The issue on too many questions in the question log could hardly be addressed, because the questions help stakeholders to deliberate on the critical issues on architecture-driven e-government development. However, the proposed addition of templates for capturing and assessing responses to the questions could reduce the number of questions.

*Third, the need for templates that elaborate how responses to questions should be recorded and synthesized.* Efforts are ongoing to address this need in future versions of EGEAF design. The templates will also address the issue on how specific outputs of EGEAF activities are consolidated into a specific product. The templates will also show how a team of EGEAF users in an enterprise can collaboratively manage the various questions that stakeholders need to deliberate when creating an e-government architecture.

## 6 Conclusion and Ongoing Work

Our earlier research efforts yielded a taxonomy of requirements for achieving e-government interoperability in developing economies. This article extends that effort by adopting a Design Science approach to derive a framework of fundamental elements to address the requirements of realizing e-government interoperability. To derive the framework, the elements are synthesized and orchestrated by adapting steps in two phases of TOGAF ADM – preliminary phase and architecture vision phase. The synthesis and orchestration yielded a TOGAF based 11-Step model for creating an e-government enterprise architecture, that was blended with e-government activities or guidelines that exist in literature. This whole process yielded what can be perceived as an initial version of an E-Government Enterprise Architecture Framework (EGEAF) for Uganda as an instance of a developing economy, which is the key output of this article.

EGEAF comprises two views – method view and product view. The method view provides a detailed procedure for creating an e-government enterprise architecture, that accommodates e-government needs at institution, sector, national levels of a government enterprise in a developing economy. The method view shows steps and activities to be executed, a comprehensive question log to guide the execution of activities and expected outputs. The product view shows specific outputs that are synthesized into e-government products at institution, sector, and national levels of the e-government enterprise. EGEAF was evaluated using two iterations. The first iteration involved a field demo that was conducted in a public entity in Uganda, and the second iteration involved a group walkthrough with ICT professionals who worked in public entities in Uganda. Validation findings indicate that EGEAF is feasible and its design is understandable to a large extent, and highlighted considerations that had to be made to improve the design of EGEAF. Some recommendations have been addressed in the current version of EGEAF that is presented herein, while others are to be addressed in future work as indicated below.

**Ongoing and future work.** First, ongoing work on EGEAF entails developing visual templates that can be used along with the question log of EGEAF to guide stakeholder deliberations and document findings. The templates will also serve as an additional user guide for operationalizing

EGEAF elements at institution, sector and national levels of the government enterprise. Second, plans are underway to instantiate EGEAF in real settings (with unrestricted scope) of e-government implementation efforts at institution, sector, and national levels. This will provide more insights into ways of further improving the design and usability of EGEAF. Third, the scope and level of detail in EGEAF will be extended using an incremental approach, by adapting other phases of TOGAF ADM (besides the preliminary and architecture vision phase which have been considered in this article). Fourth, EGEAF will be extended to guide architecture-driven e-government implementations in other developing economies and in developed economies. However, these extensions require one to first derive taxonomies of issues affecting full growth of e-government in other developing economies and in developed economies. These issues will then be used as a basis to define e-government activities that are relevant for architecture-driven e-government in other developing economies and in a developed economy.

## Acknowledgement

We appreciate everyone who participated in the validation sessions of this research. We also appreciate reviewers of the earlier version of this article.

## References

- [1] J. S. Hiller and F. Belanger, "Privacy strategies for electronic government," The PricewaterhouseCoopers Endowment for The Business of Government, Report, 2001. Available: <https://www.businessofgovernment.org/sites/default/files/PrivacyStrategies.pdf>
- [2] K. Layne and J. Lee, "Developing fully functional e-government: A four stage model," *Government Information Quarterly*, vol. 18, no. 2, pp. 122–136, 2001. Available: [https://doi.org/10.1016/S0740-624X\(01\)00066-1](https://doi.org/10.1016/S0740-624X(01)00066-1)
- [3] M. Moon, "The Evolution of E-Government Among Municipalities: Rhetoric or Reality," *Public Administration Review*, vol. 62, no. 4, pp. 424–433, 2002. Available: <https://doi.org/10.1111/0033-3352.00196>
- [4] C. Baum and A. Di Maio, "Gartner's four phases of e-government model," Gartner Group, 12, 2000.
- [5] Deloitte Research, "At the Dawn of E-Government: The Citizen as Customer – State Government Approaches to Customer Service", 2000.
- [6] United Nations Division for Public Economics and Public Administration (UNDPEPA) and American Society for Public Administration (ASPA), "Benchmarking e-Government: A Global Perspective – Assessing the Progress of the UN Member States," 2002. Available: <https://publicadministration.un.org/egovkb/portals/egovkb/documents/un/english.pdf>. Accessed on Jan. 15, 2018.
- [7] A. Fath-Allah, L. Cheikhi, R. E. Al-Qutaish, and A. Idri, "E-government maturity models: A comparative study," *International Journal of Software Engineering & Applications*, vol. 5, no. 3, pp. 71–91, 2014.
- [8] H. Almuftah, V. Weerakkody, and U. Sivarajah, "Comparing and contrasting e-government maturity models: A qualitative-meta synthesis," *Electronic Government and Electronic Participation: Joint Proceedings of Ongoing Research and Projects of IFIP WG*, vol 23, pp. 69–79, 2016. Available: <https://doi.org/10.3233/978-1-61499-670-5-69>
- [9] P. Joshi and S. Islam, "E-Government Maturity Model for Sustainable E-Government Services from the Perspective of Developing Countries," *Sustainability*, vol. 10, no. 6, article 1882, 2018. Available: <https://doi.org/10.3390/su10061882>
- [10] G. Karokola, and L. Yngström, "Discussing E-Government Maturity Models for the Developing World," *Proceedings ISSA 2009*, pp. 81–98, 2009. Available: [https://digifors.cs.up.ac.za/issa/2009/Proceedings/Full/30\\_Paper.pdf](https://digifors.cs.up.ac.za/issa/2009/Proceedings/Full/30_Paper.pdf)
- [11] D. Coursey, and D. F. Norris, "Models of e-government: Are they correct? An empirical assessment," *Public Administration Review*, vol. 68, no. 3, pp. 523–536, 2008. Available: <https://doi.org/10.1111/j.1540-6210.2008.00888.x>

- [12] V. Ndou, “E-Government for developing countries: opportunities and challenges,” *The Electronic Journal of Information Systems in Developing Countries*, vol. 18, no. 1, pp. 1–24, 2004. Available: <https://doi.org/10.1002/j.1681-4835.2004.tb00117.x>
- [13] United Nations, “E-Government Survey 2022: The Future of Digital Government,” 2022. Available: <https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2022>. Accessed on July 5, 2023.
- [14] United Nations, “E-Government Survey 2020: Digital Government in the Decade of Action for Sustainable Development (With addendum on COVID-19 Response),” 2020. Available: [https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20\(Full%20Report\).pdf](https://publicadministration.un.org/egovkb/Portals/egovkb/Documents/un/2020-Survey/2020%20UN%20E-Government%20Survey%20(Full%20Report).pdf). Accessed on July 6, 2021.
- [15] International Telecommunication Union “Confronting the Crisis: ICT Stimulus Plans for Economic Growth”, 2nd ed., Geneva. 2009. Available: [https://www.itu.int/dms\\_pub/itu-s/opb/gen/S-GEN-CRISIS\\_2-2009-PDF-E.pdf](https://www.itu.int/dms_pub/itu-s/opb/gen/S-GEN-CRISIS_2-2009-PDF-E.pdf)
- [16] J. R., Gil-García and T. A. Pardo, “E-government success factors: Mapping practical tools to theoretical foundations,” *Government Information Quarterly*, vol. 22, no. 2, pp. 187–216, 2005. Available: <https://doi.org/10.1016/j.giq.2005.02.001>
- [17] R. Matavire, W. Chigona, D. Roode, E. Sewchurran, Z. Davids, A. Mukudu, and C. Boamah-Abu, “Challenges of eGovernment project implementation in a South African context,” *The Electronic Journal Information Systems Evaluation*, vol. 13, no. 2, pp. 153–164, 2010. Available: <https://academic-publishing.org/index.php/ejise/article/view/272/235>
- [18] K. Pederson, “e-Government in Local Government: Challenges and Capabilities,” *The Electronic Journal of e-Government*, vol. 14, no. 1, pp. 99–116, 2016.
- [19] E. Lau, “Challenges for E-government Development,” OECD, 5th Global Forum on reinventing Government, Mexico City, 2003. Available: [https://static.aminer.org/pdf/PDF/000/326/994/factors\\_impacting\\_e\\_government\\_development.pdf](https://static.aminer.org/pdf/PDF/000/326/994/factors_impacting_e_government_development.pdf)
- [20] I. Oplatka, “The principalship in developing countries: Context, characteristics and reality,” *Comparative Education*, vol. 40, no. 3, pp. 427–448, 2004. Available: <https://doi.org/10.1080/0305006042000274872>
- [21] D. Dada, “The failure of e-government in developing countries: a literature review,” *The Electronic Journal of Information Systems in Developing Countries*, vol. 26, no. 1, pp. 1–10, 2006. Available: <https://doi.org/10.1002/j.1681-4835.2006.tb00176.x>
- [22] R. Heeks, “Most eGovernment for Development Projects Fail: How Can Risks be Reduced?” *SSRN*, iGovernment Working Paper no. 14, 2003. Available: <https://doi.org/10.2139/ssrn.3540052>
- [23] B. Bellman and F. Rausch, “Enterprise architecture for e-government,” *Electronic Government, EGOV 2004. Lecture Notes in Computer Science*, vol. 3183, Springer, pp. 48–56, 2004. Available: [https://doi.org/10.1007/978-3-540-30078-6\\_9](https://doi.org/10.1007/978-3-540-30078-6_9)
- [24] R. Heeks, “Information systems and developing countries: Failure, success, and local improvisations,” *The Information Society*, vol. 18, no. 2, pp. 101–112, 2002. Available: <https://doi.org/10.1080/01972240290075039>
- [25] L. Guijarro, “Interoperability frameworks and enterprise architectures in e-government initiatives in Europe and the United States,” *Government Information Quarterly*, vol. 24, no. 1, pp. 89–101, 2007. Available: <https://doi.org/10.1016/j.giq.2006.05.003>
- [26] J. Osah and C. Pade-Khene, “E-government strategy formulation in resource-constrained local government in South Africa,” *Journal of Information Technology & Politics*, vol. 17, no. 4, pp. 426–451, 2020. Available: <https://doi.org/10.1080/19331681.2020.1715907>
- [27] S. Mukamurenzi, “E-Government Service Evaluation in Rwanda: A Design Perspective,” Ph.D. dissertation, Örebro University, Sweden, 2019. Available: [http://dr.ur.ac.rw/bitstream/handle/123456789/1145/Thesis%20Solange\\_Mukamurenzi%20%20\(1\).pdf](http://dr.ur.ac.rw/bitstream/handle/123456789/1145/Thesis%20Solange_Mukamurenzi%20%20(1).pdf)
- [28] S. K. Sharma and J. N. Gupta, “Building blocks of an e-government: A framework,” *Journal of Electronic Commerce in Organizations (JECO)*, vol. 1, no. 4, pp. 34–48, 2003. Available: <https://doi.org/10.4018/jeco.2003100103>
- [29] T. Schuppan, “E-Government in developing countries: Experiences from Sub-Saharan Africa,” *Government Information Quarterly*, vol. 26, no. 1, pp. 118–127, 2009. Available: <https://doi.org/10.1016/j.giq.2008.01.006>

- [30] Joburg Centre for Software Engineering. “JCSE ICT Skills Survey”, 2016. Available: <https://www.wits.ac.za/media/wits-university/news-and-events/images/documents/JCSE%20Skills%20Survey.pdf>. Accessed on July 7, 2021.
- [31] World Bank, “World Development Report 2016: Digital Dividends,” Washington, DC: World Bank, 2016. Available: <https://doi.org/10.1596/978-1-4648-0671-1>
- [32] World Bank, “World Development Report 2021: Data for Better Lives,” Washington, DC: World Bank, 2021. <https://doi.org/10.1596/978-1-4648-1600-0>
- [33] International Organization for Standardization and International Electrotechnical Commission, “ISO/IEC 17788:2014, Information Technology – Cloud computing – Overview & vocabulary.” Online Browsing Platform, ISO, Geneva, 2014. Available: <https://www.iso.org/obp/ui/#iso:std:iso-iec:17788:ed-1:v1:en>
- [34] M. Novakouski and G. A. Lewis, “Interoperability in the e-Government Context,” Carnegie-Mellon University Pittsburgh, PA, Software Engineering Institute, 2012. Available: [https://resources.sei.cmu.edu/asset\\_files/TechnicalNote/2012\\_004\\_001\\_15365.pdf](https://resources.sei.cmu.edu/asset_files/TechnicalNote/2012_004_001_15365.pdf)
- [35] International Organization for Standardization and International Electrotechnical Commission, “ISO/IEC 19941:2017, Information Technology, Cloud Computing, Interoperability, and Portability,” Online Browsing Platform, ISO, Geneva. 2017. Available: <https://www.iso.org/obp/ui/#iso:std:iso-iec:19941:ed-1:v1:en>
- [36] TOGAF. The Open Group Architecture Forum, “*The TOGAF Standard 9.2*,” 2018. Available: <https://pubs.opengroup.org/architecture/togaf9-doc/arch/index.html>
- [37] TOGAF. The Open Group Architecture Forum, “The Open Group Architecture Framework Version 9,” Zaltbommel: Van Haren Publishing, 2009. Available: <https://www.opengroup.org/architecture/togaf8/>
- [38] National IT Industry Promotion Agency, “Uganda e- Government Master Plan 2012,” 2012.
- [39] Government of Kenya, “Directorate of e-Government. Directorate of e-Government- Government of Kenya,” Kenya ICT Standards and Guidelines. Version 0.1, 2011. Available: <https://repository.kippra.or.ke/handle/123456789/1368>
- [40] C. Kombani, “Open Government Partnership in Tanzania,” 2013.
- [41] A. Ask, “The Role of Enterprise Architecture in Local eGovernment Adoption,” Ph.D. dissertation, Örebro University, Sweden, 2012. Available: <http://oru.divaportal.org/smash/get/diva2:553144/FULLTEXT01>
- [42] FEAF, “Federal Enterprise Architecture Framework,” Version 2, January 2013. Available: [https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/egov\\_docs/fea\\_v2.pdf](https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/egov_docs/fea_v2.pdf)
- [43] J. F. Ramirez Ro, “Federal Enterprise Architecture Framework,” Version 1.1, September 1999. Available: [https://www.academia.edu/13512768/Federal\\_Enterprise\\_Architecture\\_Framework](https://www.academia.edu/13512768/Federal_Enterprise_Architecture_Framework)
- [44] N. Green, C. Bate and E. T. Press, *Lost in translation: a handbook for information systems in the 21st century*. Evolved Technologist Press, 2007.
- [45] Her Majesty’s UK Government. “UK government reference architecture Government ICT Strategy,” version 1.0., 2012. Available: [https://www.academia.edu/37010910/UK\\_Government\\_Reference\\_Architecture\\_Government ICT\\_Strategy](https://www.academia.edu/37010910/UK_Government_Reference_Architecture_Government ICT_Strategy)
- [46] M. Janssen and K. Hjort-Madsen, “Analyzing Enterprise Architecture in National Governments: The cases of Denmark and the Netherlands,” in *2007 40th Annual Hawaii International Conference on System Sciences (HICSS’07)*, pp. 218a–218a, 2007. Available: <https://doi.org/10.1109/HICSS.2007.79>
- [47] M. Janssen and G. Kuk, “A Complex adaptive system perspective of enterprise architecture in electronic government,” in *Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS’06)*, pp. 71b–71b, 2006. Available: <https://doi.org/10.1109/HICSS.2006.6>
- [48] H. S. Katz, “Enterprise Architecture Adoption in the Integrated Justice System of South Africa,” Ph.D. dissertation, University of Johannesburg, SA, 2019. Available: <https://ujcontent.uj.ac.za/esploro/outputs/graduate/Enterprise-architecture-adoption-in-the-integrated/9913688407691>
- [49] E. C. Lallana, “e-Government Interoperability: A Review of Government Interoperability Frameworks in Selected Countries,” United Nations Development Programme (UNDP), 2007. Available: <https://www.unapcict.org/sites/default/files/2019-01/e-Government%20Interoperability%20-%20A%20Review%20of%20Government%20Interoperability%20Frameworks%20in%20Selected%20Countries.pdf>



- [50] V. Peristeras, K. Tarabanis, and S. K. Goudos, "Model-driven e-Government interoperability: A review of the state of the art," *Computer Standards & Interfaces*, vol. 31, no. 4, pp. 613–628, 2009. Available: <https://doi.org/10.1016/j.csi.2008.09.034>
- [51] P. Kotzé and R. Alberts, "Towards a Conceptual Model for an e-Government Interoperability Framework for South Africa," in *Proceedings of the 19th International Conference on Enterprise Information Systems*, vol. 3, pp. 493–506, 2017. Available: <https://doi.org/10.5220/0006384304930506>
- [52] A. Setiawan and E. Yulianto, "E-Government Interoperability and Integration Architecture Modeling Using TOGAF Framework Based on Service Oriented Architecture," *The Asian Journal of Technology Management*, vol. 11, no. 1, pp. 26–45, 2018. Available: <https://doi.org/10.12695/ajtm.2018.11.3>
- [53] Y. J. Lee, Y. I. Kwon, S. Shin, and E. J. Kim, "Advancing government-wide Enterprise Architecture-A meta-model approach," in *15th International Conference on Advanced Communications Technology (ICACT)*, IEEE, pp. 886–892, 2013.
- [54] L. M. Kekana, "An investigation into the role of Information and Communications Technology (ICTs) in the South African Public Service," M.S. dissertation, Potchefstroom Campus of the North-West University, SA, 2011. Available: [https://repository.nwu.ac.za/bitstream/handle/10394/10507/Kekana\\_LM.pdf?sequence=1](https://repository.nwu.ac.za/bitstream/handle/10394/10507/Kekana_LM.pdf?sequence=1)
- [55] P. Saha, *Enterprise Architecture for Connected E-Government: Practices and Innovations*. IGI Global, 2012. Available: <https://doi.org/10.4018/978-1-4666-1824-4>
- [56] S. Al-Nasrawi and M. Ibrahim, "An enterprise architecture mapping approach for realizing e-government," in *Proceedings of the 3rd International Conference on Communications and Information Technology (ICCIT)*, pp. 17–21, 2013. Available: <https://doi.org/10.1109/ICCITechnology.2013.6579515>
- [57] "Ghana Government Enterprise Architecture Implementation Plan," 2008.
- [58] M. A. Mohamed, G. H. Galal-Edeen and H. A. Hassan, "Towards Adoption of Government Enterprise Architecture: The Cases of Egypt and Syria," in *Proceedings of the 13th European Conference on eGovernment: ECEG Academic Conferences Limited*, 2013.
- [59] M. O. Ahmad, J. Markkula, and M. Oivo, "Factors influencing the adoption of e-government services in Pakistan," in *European, Mediterranean & Middle Eastern conference on information systems*, vol. 9, pp. 117–133, 2012.
- [60] S. AlAwadhi, "A Proposed Model of Trust Factors for E-government Adoption and Civic Engagement," in *Proceedings of the 52nd Hawaii International Conference on System Sciences*, 2019.
- [61] H. Alenezi, A. Tarhini, R. E. Masa'deh, A. Alalwan and N. Al-Qirim, "Factors Affecting the Adoption of e-Government in Kuwait: A Qualitative Study," *Electronic Journal of e-Government*, vol. 15, no 2, pp. 84–102 2017.
- [62] M. Kurfalı, A. Arifoğlu, G. Tokdemir and Y. Paçin, "Adoption of e-government services in Turkey," *Computers in Human Behavior*, vol. 66, pp. 168–178, 2017. Available: <https://doi.org/10.1016/j.chb.2016.09.041>
- [63] L. Glyptis, M. Christofi, D. Vrontis, M. Del Giudice, S. Dimitriou and P. Michael, "E-Government implementation challenges in small countries: The project manager's perspective," *Technological Forecasting and Social Change*, vol. 152, article 119880, 2020. Available: <https://doi.org/10.1016/j.techfore.2019.119880>
- [64] S. D. Müller and S. A. Skau, "Success factors influencing implementation of e-government at different stages of maturity: a literature review," *International Journal of Electronic Governance*, vol. 7, no. 2, pp. 136–170, 2015. Available: <https://doi.org/10.1504/IJEG.2015.069495>
- [65] S. Ozkan and I. E. Kanat, "e-Government adoption model based on theory of planned behavior: Empirical validation," *Government Information Quarterly*, vol. 28, no. 4, pp. 503–513, 2011. Available: <https://doi.org/10.1016/j.giq.2010.10.007>
- [66] M. A. Shareef, V. Kumar, U. Kumar, and Y. K. Dwivedi, "e-Government Adoption Model (GAM): Differing service maturity levels," *Government Information Quarterly*, vol. 28, no. 1, pp. 17–35, 2011. Available: <https://doi.org/10.1016/j.giq.2010.05.006>
- [67] V. Weerakkody, Z. Irani, H., Lee, I., Osman, and N. Hindi, "E-government implementation: A bird's eye view of issues relating to costs, opportunities, benefits and risks," *Information Systems Frontiers*, vol. 17, pp. 889–915, 2015. Available: <https://doi.org/10.1007/s10796-013-9472-3>
- [68] J. D. Twizeyimana, H. Larsson, and Å. Grönlund, "E-government in Rwanda: Implementation, Challenges and Reflections," *Electronic Journal of e-Government*, vol. 16, no. 1, pp. 19–31, 2018.

- [69] D. Napitupulu, M. Syafrullah, R. Rahim, A. Amar, and Y. G. Sucahyo, "Content validity of critical success factors for e-Government implementation in Indonesia," in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, vol. 352, article 012058, 2018. Available: <https://doi.org/10.1088/1757-899X/352/1/012058>
- [70] R. Nabafu and G. Maiga, "A Model of Success Factors for Implementing Local E-Government in Uganda," *Electronic Journal of E-Government*, vol. 10, no. 1, pp. 31–46, 2012.
- [71] A. Rabaiah and E. Vandijct, "A Strategic Framework of e-Government: Generic and best Practice," *Leading Issues in e-Government Research*, Academic Publishing International Ltd, pp. 1–32, 2011. Available: <https://academic-publishing.org/index.php/ejeg/article/download/505/468>
- [72] National Information Technology Authority Uganda, "Strategy Paper on Rationalization and Harmonization of Information Technology (IT) Initiatives and Services in Ministries, Departments and Agencies (MDAS)," 2012. Available: <https://docplayer.net/160452884-The-republic-of-uganda-national-information-technology-authority-uganda-nita-u-strategy-paper.html>
- [73] J. Nogrsek and M. Vintar, "Technology as the Key Driver of Organizational Transformation in the eGovernment Period: Towards a New Formal Framework," *Electronic Government. EGOV 2011. Lecture Notes in Computer Science*, vol. 6846, Springer, pp. 453–464, 2011. Available: [https://doi.org/10.1007/978-3-642-22878-0\\_38](https://doi.org/10.1007/978-3-642-22878-0_38)
- [74] N. Bharosa, S. Lips and D. Draheim, "Making e-government work: learning from the Netherlands and Estonia," *Electronic Participation. ePart 2020. Lecture Notes in Computer Science*, vol. 12220, Springer, pp. 41–53, 2020. Available: [https://doi.org/10.1007/978-3-030-58141-1\\_4](https://doi.org/10.1007/978-3-030-58141-1_4)
- [75] S. Thakur and S. Singh, "A study of some e-Government activities in South Africa," in *2012 e-Leadership Conference on Sustainable e-Government & e-Business Innovations (E-LEADERSHIP)*, IEEE, pp. 1–11, 2012. Available: <https://doi.org/10.1109/e-Leadership.2012.6524704>
- [76] The Kafkabrigade Network, "An international research network on red tape and dysfunctional bureaucracy," 2021. Available: <http://www.kafkabrigade.org/>. Accessed on Feb. 17, 2021.
- [77] European Commission, "European Interoperability Reference Architecture (EIRA)," 2022. Available: <https://joinup.ec.europa.eu/collection/european-interoperability-reference-architecture-eira/solution/eira/release/v500>. Accessed on July 8, 2023.
- [78] The Open Group Architecture Forum, "*The TOGAF Standard 10*," Digital Content of TOGAF, 2022. Available: <https://pubs.opengroup.org/togaf-standard/>
- [79] M. Lankhorst, *Enterprise Architecture at Work. Modelling, Communication and Analysis*. Springer, Heidelberg, Germany, 4th edition, 2017. Available: <https://doi.org/10.1007/978-3-662-53933-0>
- [80] M. Op't Land, E. Proper, M. Waage, J. Cloo, and C. Steghuis, *Enterprise Architecture: Creating Value by Informed Governance*. Springer, Heidelberg, Germany, 2008. Available: <https://doi.org/10.1007/978-3-540-85232-2>
- [81] E. W. Nafziger, *Economic development*. Cambridge University Press, 2012.
- [82] D. C. G. Orach, "Health equity: challenges in low income countries," *African Health Sciences*, vol. 9, no. s2, pp. S49–S51, 2009.
- [83] United Nations, "The least developed countries in the post-COVID world: Learning from 50 years of experience," United Nations Conference on Trade and Development. 2021. Available: <https://unctad.org/board-action/least-developed-countries-report-2021-least-developed-countries-post-covid-world>
- [84] A. Nakakawa and F. Namagembe, "Requirements for Developing Interoperable e-Government Systems in Developing Countries – A Case of Uganda," *Electronic Government an International Journal*, vol. 15, no. 1, pp. 67–90, 2019. Available: <https://doi.org/10.1504/EG.2019.096577>
- [85] M. R. Muhammad, "Managing the Implementation of E-Government in Malaysia: A Case of E-Syariah," *Australian Journal of Basic and Applied Sciences*, vol. 7, no. 8, pp. 92–99, 2013.
- [86] A. R. Hevner, S. T. March, J. Park and S. Ram, "Design science information systems research," *MIS Quarterly*, vol. 28, no. 1, pp. 75–105, 2004. Available: <https://doi.org/10.2307/25148625>
- [87] H. Noble and J. Smith, "Reviewing the literature: choosing a review design," *Evidence-Based Nursing*, vol. 21, no. 2, pp. 39–41, 2018. Available: <https://doi.org/10.1136/eb-2018-102895>
- [88] C. Wohlin, "Guidelines for snowballing in systematic literature studies and a replication in software engineering," in *Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering*, ACM, article 38, pp. 1–10, 2014. Available: <https://doi.org/10.1145/2601248.2601268>

- [89] S. AlAwadhi and A. Morris, "The Use of the UTAUT Model in the Adoption of E-government Services in Kuwait," in *Proceedings of the 41st annual Hawaii international conference on system sciences (HICSS 2008)*, IEEE, pp. 219–219, 2008. Available: <https://doi.org/10.1109/HICSS.2008.452>
- [90] Z. Ebrahim and Z. Irani, "E-government adoption: architecture and barriers," *Business Process Management Journal*, vol. 11, no. 5, pp. 589–611, 2005. Available: <https://doi.org/10.1108/14637150510619902>
- [91] V. Kumar, B. Mukerji, I. Butt, and A. Persaud, "Factors for successful e-government adoption: A conceptual framework," *Electronic Journal of E-government*, vol. 5, no. 1, 2007.
- [92] K. V. Andersen and H. Z. Henriksen, "E-government maturity models: Extension of the Layne and Lee model," *Government Information Quarterly*, vol. 23, no. 2, pp. 236–248, 2006. Available: <https://doi.org/10.1016/j.giq.2005.11.008>
- [93] K. Siau and Y. Long, "A stage model for e-government implementation," in *15th Information Resource Management Association International Conference (IRMA'04)*, pp. 23–26, 2004.
- [94] J. Sangki, "Vision of future e-government via new e-government maturity model: Based on Korea's e-government practices," *Telecommunications Policy*, vol. 42, no. 10, pp. 860–871, 2018. Available: <https://doi.org/10.1016/j.telpol.2017.12.002>
- [95] P. Joshi, "A Sustainability-Driven E-Government Maturity model (SDEGM) from the perspective of developing countries" Ph.D. dissertation, University of East London, UK, 2018. Available: <https://core.ac.uk/reader/219376140>
- [96] A. Fath-Allah, L. Cheikhi, R. E. Al-Qutaish and A. Idri, "E-Government Portals Maturity Models: A Best Practices' Coverage Perspective," *JSW*, vol. 10, no. 7, pp. 805–824, 2015. Available: <https://doi.org/10.17706/jsw.10.7.805-824>
- [97] K. Axelssona and G. Goldkuhla, "Government–citizen communication through the web," *Systems, Signs & Actions, An International Journal on Information Technology, Action, Communication and Work practices*, vol. 8, no. 1, pp. 1–5, 2014.
- [98] European Commission, "European Interoperability Framework (EIF)," 2021. Available: <https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/european-interoperability-framework-detail>. Accessed on July 8, 2023.
- [99] T. Almarabeh and A. AbuAli, "A general framework for e-government: definition maturity challenges, opportunities, and success," *European Journal of Scientific Research*, vol. 39, no. 1, pp. 29–42, 2010.
- [100] National Computer Centre and National IT Industry Promotion Agency, "Electronic Government Development & Strategy Assessment," Research, Strategy, and Implementation Plan, 2012. Available: [https://www.dbm.gov.ph/wp-content/uploads/MITHI/Philippines%20E-GovMasterPlan\\_%28final%20draft%29.pdf](https://www.dbm.gov.ph/wp-content/uploads/MITHI/Philippines%20E-GovMasterPlan_%28final%20draft%29.pdf)
- [101] P. Saha, *Advances in Government Enterprise Architecture*. IGI Global, 2008. Available: <https://doi.org/10.4018/978-1-60566-068-4>
- [102] Korea International Cooperation Agency, "e-Government Master Plan for Digital Bangladesh," 2018. Available: [http://bcc.portal.gov.bd/sites/default/files/files/bcc.portal.gov.bd/page/ecbb5603\\_1eac\\_4bf0\\_99fe\\_628e9980c279/eGovernment%20Masterplan%20for%20Digital%20Bangladesh\\_V6.0%20\(2\).pdf](http://bcc.portal.gov.bd/sites/default/files/files/bcc.portal.gov.bd/page/ecbb5603_1eac_4bf0_99fe_628e9980c279/eGovernment%20Masterplan%20for%20Digital%20Bangladesh_V6.0%20(2).pdf)
- [103] T. Zheng and L. Zheng, "Examining e-government enterprise architecture research in China: A systematic approach and research agenda," *Government Information Quarterly*, vol. 30, pp. S59–S67, 2013. Available: <https://doi.org/10.1016/j.giq.2012.08.005>
- [104] Ministry of Electronics and Information Technology Government of India. India Enterprise Architecture Framework, 2018. Available: [http://egovstandards.gov.in/sites/default/files/IndEA%20Framework%201.0\\_0.pdf](http://egovstandards.gov.in/sites/default/files/IndEA%20Framework%201.0_0.pdf)
- [105] P. Saha, "Architecting the connected government: Practices and innovations in Singapore," in *Proceedings of the 3rd international conference on Theory and practice of electronic governance*, pp. 11–17, 2009. Available: <https://doi.org/10.1145/1693042.1693046>
- [106] M. K. Farooq, S. Shamail, and M. M. Awais, "Enterprise Architectures for E-Government Development," *Developing E-Government Projects: Frameworks and Methodologies*, IGI Global, pp. 139–164, 2013. Available: <https://doi.org/10.4018/978-1-4666-4245-4.ch007>
- [107] J. A. Zachman, "A framework for information systems architecture," *IBM Systems Journal*, vol. 26, no. 3, pp. 276–292, 1987. Available: <https://doi.org/10.1147/sj.263.0276>

- [108] Chief Information Officer Council, “A practical guide to federal enterprise architecture (version 1.0),” 2001. Available: <https://www.gao.gov/assets/588407.pdf>
- [109] J. van’t Wout, M. Waage, H. Hartman, M. Stahlecker, and A. Hofman, *The Integrated Architecture Framework Explained: Why, What, How*. Springer Berlin, Heidelberg, 2010. Available: <https://doi.org/10.1007/978-3-642-11518-9>
- [110] L. Hooghe and G. Marks, “Types of multi-level governance,” *SSRN, European integration online papers (EIoP)*, vol. 5, no. 11, 2001. Available: <https://doi.org/10.2139/ssrn.302786>
- [111] W. R. King, “Strategic planning for management information systems,” *MIS Quarterly*, pp. 27–37, 1978.
- [112] S. Maleka, “Strategic management and strategic planning process: South African perspective,” in *DTPS Strategic Planning & Monitoring Workshop*, 2014.
- [113] C. G. Mkude and M. A. Wimmer, “Strategic framework for designing e-government in developing countries,” *Electronic Government. EGOV 2013. Lecture Notes in Computer Science*, vol. 8074, Springer, pp. 148–162, 2013. Available: [https://doi.org/10.1007/978-3-642-40358-3\\_13](https://doi.org/10.1007/978-3-642-40358-3_13)
- [114] N. K. Hanna, *Transforming Government and Building the Information Society: Challenges and Opportunities for the Developing World*. Springer, 2011. Available: <https://doi.org/10.1007/978-1-4419-1506-1>
- [115] D. Gichoya, “Factors affecting the successful implementation of ICT projects in government,” *The Electronic Journal of e-government*, vol. 3, no. 4, pp. 175–184, 2005.
- [116] A. M. Al-Naimat, M. S. Abdullah and M. K. Ahmad, “The critical success factors for e-government implementation in Jordan,” in *Proceedings of the 4th International Conference on Computing and Informatics, ICOCI*, pp. 391–398, 2013.
- [117] A. J. Gregory, J. P. Atkins, G. Midgley and A. M. Hodgson, “Stakeholder identification and engagement in problem structuring interventions,” *European Journal of Operational Research*, vol. 283, no.1, pp. 321–340, 2020. Available: <https://doi.org/10.1016/j.ejor.2019.10.044>
- [118] C. I. Nwakanma, B. C. Asiegbu, C. A. Ogbonna, and P. P. C. Njoku, “Factors affecting successful implementation of information technology projects: Experts’ perception,” *European Scientific Journal*, vol. 9, no. 27, pp. 128–137, 2013.
- [119] J. Morris, and F. Baddache, “Back to basics: How to make stakeholder engagement meaningful for your company,” BSR, 2012. Available: [http://www.advancingstates.org/sites/nasud/files/BSR\\_Five-Step\\_Guide\\_to\\_Stakeholder\\_Engagement.pdf](http://www.advancingstates.org/sites/nasud/files/BSR_Five-Step_Guide_to_Stakeholder_Engagement.pdf)
- [120] R. Young and E. Jordan, “Top management support: Mantra or necessity?” *International Journal of Project Management*, vol. 26, no. 7, pp. 713–725, 2008. Available: <https://doi.org/10.1016/j.ijproman.2008.06.001>
- [121] A. Elbanna, “Top management support in multiple-project environments: an in-practice view,” *European Journal of Information Systems*, vol. 22, no. 3, pp. 278–294, 2013. Available: <https://doi.org/10.1057/ejis.2012.16>
- [122] S. Finney and M. Corbett, “ERP implementation: a compilation and analysis of critical success factors,” *Business Process Management Journal*, vol. 13, no. 3, pp. 329–347, 2007. Available: <https://doi.org/10.1108/14637150710752272>
- [123] O. Zwikaël, “Top management involvement in project management: Exclusive support practices for different project scenarios,” *International Journal of Managing Projects in Business*, vol. 1, no. 3, pp. 387–403, 2008. Available: <https://doi.org/10.1108/17538370810883837>
- [124] E. M. D. Santos, and N. Reinhard, “Electronic government interoperability: Identifying the barriers for frameworks adoption,” *Social Science Computer Review*, vol. 30, no. 1, pp. 71–82. 2011. Available: <https://doi.org/10.1177/0894439310392196>
- [125] A. Nakakawa, F. Namagembe, and H. A. Proper, “Dimensions for scoping e-government enterprise architecture development efforts,” *On the Move to Meaningful Internet Systems. OTM 2018 Conferences. OTM 2018. Lecture Notes in Computer Science*, vol. 11229, Springer, pp. 661–679, 2018. Available: [https://doi.org/10.1007/978-3-030-02610-3\\_37](https://doi.org/10.1007/978-3-030-02610-3_37)
- [126] J. P. van Belle, J. Nash, and M. Eccles, *Discovering Information Systems: an exploratory approach*. University of Cape Town, 2010.
- [127] Government of India. “Policy on Open Standards for e-Governance: Government of India Ministry of Communications & IT,” Department of IT, Version 1.0, 2010. Available: <http://egovstandards.gov.in/sites/default/files/Policy%20on%20Open%20Standards%20for%20e-Governance.pdf>

- [128] M. B. Othman and A. Ramasamy, "Citizen identification system of Iraq: challenges and barriers in enabling e-Government services," in *Proceedings of the 4th International Conference on Computing and Informatics ICOCI*, 2013.
- [129] N. Nkwe, "E-Government: Challenges and opportunities in Botswana," *International Journal of Humanities and Social Science*, vol. 2, no. 17, pp. 39–48, 2012.
- [130] University of Suffolk, "Recruitment and Selection Policy. Recruitment and Selection Guidelines," Version 1.0., 2011.
- [131] UN Department of Economic and Social Affairs, International Telecommunication Union (ITU), "E-Government and Public Private Partnerships for Better Public Service Delivery and MDGS Implementation," United Nations Publication Geneva, Switzerland, 2009. Available: [https://www.itu.int/net/wsis/implementation/2009/forum/geneva/tw\\_e-government-UNDESA-ITU.html](https://www.itu.int/net/wsis/implementation/2009/forum/geneva/tw_e-government-UNDESA-ITU.html)
- [132] Ghana Health Service, "Ghana e-Government Interoperability Framework," 2009. Available: [https://www.ghanahealthservice.org/downloads/Ghana\\_eGIF\\_Main.pdf](https://www.ghanahealthservice.org/downloads/Ghana_eGIF_Main.pdf)
- [133] S. Sacheva, "Change Management for e-Governance," *I-WAYS, Digest of Electronic Commerce Policy and Regulation*, vol. 32, no. 2, pp. 109–117, 2009. Available: <https://doi.org/10.3233/IWA-2009-0177>
- [134] D. C. Misra, "Change Management for E Government," 2009.
- [135] R. Heeks, "Success and Failure in E-Government Projects Page: E-Government for Development project," University of Manchester, UK, 2008.
- [136] R. Gauld, "Public sector information system project failures: Lessons from a New Zealand hospital organization," *Government Information Quarterly*, vol. 24, no. 1, pp. 102–114, 2007. Available: <https://doi.org/10.1016/j.giq.2006.02.010>
- [137] E. Loukis and Y. Charalabidis, "Why do eGovernment projects fail? Risk factors of large information systems projects in the Greek public sector: An international comparison," *International Journal of Electronic Government Research (IJEGR)*, vol. 7, no. 2, pp. 59–77, 2011. Available: <https://doi.org/10.4018/jegr.2011040104>
- [138] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, "A design science research methodology for information systems research," *Journal of Management Information Systems*, vol. 24, no. 13, pp. 45–77, 2007. Available: <https://doi.org/10.2753/MIS0742-1222240302>
- [139] A. R. Hevner, "A three cycle view of design science research," *Scandinavian Journal of Information Systems*, vol. 19, no. 2, article 4, 2007.
- [140] J. Palmius, "Criteria for measuring and comparing information systems," in *Proceedings of the 30th Information Systems Research Seminar in Scandinavia, IRIS 2007*, pp. 1–24, 2007.
- [141] R. Wieringa, "Design science methodology: principles and practice," in *2010 ACM/IEEE 32nd International Conference on Software Engineering*, vol. 2, pp. 493–494. Available: <https://doi.org/10.1145/1810295.1810446>
- [142] H. Sharp, Y. Rogers, and J. J. Preece, *Interaction Design: Beyond Human-Computer Interaction*. 5th edition, John Wiley and Sons, 2019.
- [143] P. Jody, "Structured Walkthroughs and Formal Technical Reviews," 2017, Available: <http://www.jodypaul.com/SWE/WT/walkthroughs.html>. Accessed on Nov. 26, 2021.