

GOVERNMENT SOFTWARE DEVELOPMENT IN NEPAL: ASSESSING THE ALIGNMENT OF SOFTWARE ENGINEERING PRACTICES WITH THE E-GOVERNMENT MASTER PLAN AND GOVERNMENT ENTERPRISE ARCHITECTURE

Dr. Shreedhar Marasini[#], Dr. Abhijit Gupta^{*}

Young Minds Creation Pvt. Ltd,

¹shree@youngminds.com.np, ²abhi@youngminds.com.np

Abstract— Nepal has implemented several government information systems and electronic services since the beginning of its e-government programme. However, the development of individual applications does not necessarily create an integrated government information environment. This study examines the alignment of government software development with Nepal's e-Government Master Plan (eGMP) and Government Enterprise Architecture (GEA), using evidence available up to December 2018. The study applies documentary and comparative analysis to government policies, architecture documents, published Nepalese studies, selected e-government initiatives and the 2018 United Nations E-Government Survey. The analysis focuses on software architecture, interoperability, information security, infrastructure, human resources, quality assurance, institutional capacity and citizen-oriented service delivery. The findings indicate that Nepal had established important policy and architectural foundations, but implementation evidence indicates uneven progress toward integration.. The gap was not only technological; it also involved institutional ownership, skills, infrastructure, standards and project governance. The study proposes a software-development alignment framework linking policy, enterprise architecture, software engineering, interoperability, security and citizen service delivery. The framework can support more sustainable and integrated e-government development in Nepal.

Keywords— E-Government; Software Engineering; Government Enterprise Architecture; Interoperability; Nepal; E-Services; Digital Government.

I. INTRODUCTION

Existing studies on Nepal have primarily examined e-readiness, ICT infrastructure, information-system security and website accessibility. However, limited attention has been given to the relationship between government software-development practices and the architectural objectives established by the e-Government Master Plan and Government Enterprise Architecture. This study addresses this gap by examining software development as an architectural and institutional component of e-government rather than as a collection of independent applications.

Nepal's formal e-government development was supported by its Information Technology Policy

and the subsequent e-Government Master Plan of 2006. The eGMP proposed a vision of “Value Networking Nepal” based on citizen-centred services, transparent government, networked government and a knowledge-based society[1]. It also identified enterprise architecture, government portals, communication networks, national identification and integrated data infrastructure among its priority areas.

The Government Enterprise Architecture developed in 2011 provided a further technical foundation. It proposed common architectural principles covering business, data, applications, technology, security and integration[2]. Thus, Nepal had moved beyond viewing e-government simply as the development of websites and individual applications.

However, the implementation of government information systems remained challenging. Nepalese studies identified weaknesses in infrastructure, human resources, software and information systems, security and organizational readiness [3][4][5][6]. Information-system audit studies also identified security and governance concerns [7][8]. These issues raise an important question: were government software-development practices aligned with the architecture and integration objectives established by the eGMP and GEA?[9][10]

This study therefore examines the alignment between government software development and Nepal's e-government architecture up to 2018. It also uses the 2018 UN E-Government Development Index (EGDI) as a broader international benchmark.

II. LITERATURE REVIEW

An E-government development is generally understood as a progression from information provision toward interaction, transaction and integrated services. Layne and Lee proposed a four-stage model in which integration becomes increasingly important as government systems mature[11]. This is relevant to Nepal because independent departmental applications may provide useful services without creating an integrated government environment.

Heeks argued that e-government projects in developing countries are particularly exposed to “design-reality gaps”[12]. Differences between project assumptions and local organizational, technological and institutional realities can contribute to project failure. This perspective is useful for Nepal, where infrastructure, skills, institutional capacity and administrative practices vary considerably.

Gil-García and Pardo identified technical, organizational and managerial factors among the important conditions affecting e-government implementation[13]. Similarly, Rose and Grant found that planning and implementation issues can strongly influence e-government outcomes[14]. These studies indicate that software quality alone cannot guarantee successful government digital transformation.

Enterprise architecture provides a mechanism for addressing such fragmentation. Nepal's GEA was designed to provide a common architecture for government organizations and to support interoperability between government systems. The architecture included business, data, application, technology, security and integration components. The relationship between enterprise architecture and software development is therefore important: application development should not be treated as an isolated technical activity but as part of a wider government architecture.

Nepalese studies provide additional evidence. Gupta and Shakya examined information-system auditing in Nepalese e-government, while Marasini and Shakya studied human-resource e-readiness[5][7]. Their infrastructure study emphasized the importance of ICT infrastructure for e-government[8]. Gupta, Marasini and Shakya

proposed an e-readiness assessment for ministries, including software, information systems, infrastructure, human resources and security[3].

Security is another important dimension. Gupta and Shakya examined information-system security challenges, while their cloud-computing study identified security and control concerns associated with emerging infrastructure models[15].

Software development should therefore be assessed across technical and institutional dimensions rather than application functionality alone.

From a software engineering perspective, government systems require defined life-cycle processes covering requirements, architecture, development, testing, deployment and maintenance. ISO/IEC/IEEE 12207 provides a structured basis for software life-cycle processes, while the PMBOK framework emphasizes project integration, scope, schedule, cost, quality, resources and risk management. These principles are particularly relevant to public-sector software projects because government applications must remain maintainable beyond individual project and vendor cycles.[16]

III. METHODOLOGY AND CONCEPTUAL FRAMEWORK

This study uses a qualitative documentary-analysis approach. The term alignment assessment in this study refers to a documentary comparison of documented policy objectives, architectural requirements and available evidence concerning government information systems; it does not represent an empirical audit of all government software projects. The sources include Nepal's eGMP, GEA documents, government reports, Nepalese academic studies, international e-government literature, software engineering standards and the UN E-Government Survey 2018.

The analysis uses seven principal alignment dimensions:

1. software architecture;
2. data and interoperability;
3. security;
4. software quality and testing;
5. infrastructure;

6. institutional and human-resource capacity; and
7. citizen-oriented service delivery.

The conceptual framework assumes that policy and enterprise architecture establish the direction for government software development. Software engineering practices then influence interoperability, quality, security and sustainability. These factors collectively influence the availability and quality of integrated e-services.

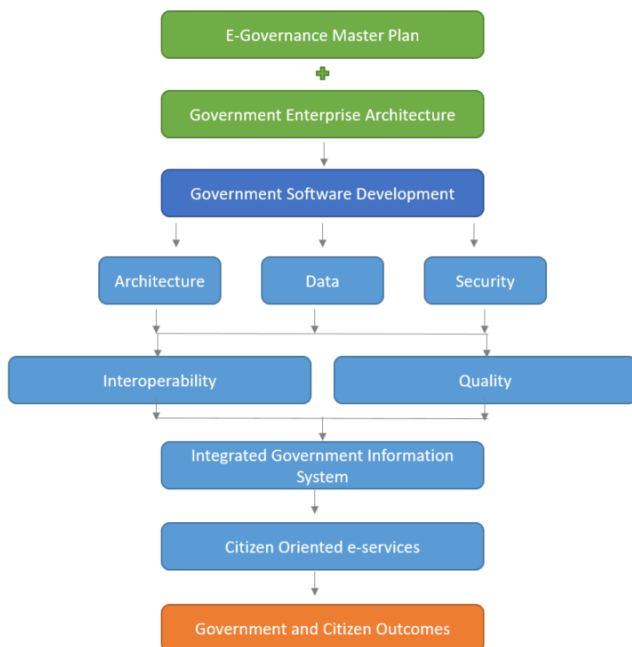


Fig 1. Conceptual alignment framework

IV. CASE STUDIES AND EXAMPLES

A. Government Enterprise Architecture

The Nepal GEA was one of the most important attempts to move government ICT development from independent applications toward a common architecture. The 2011 architecture addressed business, data, application, technology, security and integration domains[2]. Government documentation later reported that GEA standards were intended to guide the development of e-government applications and support information exchange between government organizations[17]. This indicates that the government recognized the need for common architectural and interoperability standards in government software development.

B. Government Web Services

Earlier research on Nepalese government websites identified weaknesses in accessibility and citizen interaction. Shah and Shakya evaluated 27 central government websites using WCAG-related criteria and found significant accessibility limitations[18]. Parajuli's analysis of ministry websites similarly found that important features supporting transparency, interaction, accessibility and usability were not widespread[16]. These findings illustrate that simply publishing information online did not necessarily constitute mature e-service delivery. These findings are relevant to software development because accessibility and usability should be incorporated into system requirements and quality assurance rather than treated solely as presentation-layer concerns.

C. Electronic Government Procurement

Nepal's e-Government Procurement system provides an example of a more integrated government digital service. The national e-GP initiative was supported by regulatory changes and subsequently expanded nationally. By 2017, the system had been rolled out to public entities and covered major procurement functions[15][19]. The case demonstrates the value of a common national platform rather than independent procurement systems.

TABLE I
ALIGNMENT ASSESSMENT

Dimension	eGMP/GEA expectation	Evidence before 2019	Assessment
Architecture	Common architecture	GEA established	Moderate
Interoperability	Information exchange	GEA initiatives	Developing
Security	Integrated security	Audit studies identify gaps	Weak–moderate
Infrastructure	Government ICT infrastructure	E-readiness studies identify constraints	Developing
Human resources	Skilled ICT personnel	HR e-readiness concerns	Developing
Accessibility	Citizen-oriented services	Website accessibility limitations	Weak
Integration	Connected government	Multiple initiatives, uneven implementation	Developing

E-services	Transactional services	e-GP provides evidence of progress	Moderate
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The assessment categories represent documentary evidence of alignment rather than statistically measured performance. ‘Moderate’ indicates that policy or architectural provisions and some implementation evidence were identified; ‘Developing’ indicates evidence of initiatives but incomplete or uneven implementation; and ‘Weak’ indicates documented limitations with limited evidence of effective implementation.

V. ANALYSIS AND DISCUSSION

The documentary evidence suggests that Nepal had developed important foundations for integrated e-government by 2018. The eGMP explicitly identified enterprise architecture and integrated infrastructure as priority areas [1]. The 2011 GEA subsequently provided architectural principles and reference structures covering application, data, technology, security and integration.

However, policy and architecture do not automatically produce architectural compliance. Nepalese e-readiness research identified weaknesses across software, information systems, infrastructure, human resources and security [20][21][22]. This suggests that the principal challenge was implementation capacity.

The problem can be viewed as an alignment gap. Government agencies could develop applications for immediate administrative needs, while national architecture required common standards and interoperability. Without strong requirements engineering, architecture review, common data standards and institutional ownership, applications could remain departmental systems.

Security also required greater integration into the software life cycle. Information-system audit research in Nepal emphasized security concerns[19]. Software development should therefore include security requirements, testing, access control, auditability and maintenance from the beginning rather than treating security as a final activity.

The evidence also indicates that citizen-facing services require more than technical deployment. Accessibility, usability, infrastructure and digital literacy affect whether citizens can actually use government services.

The 2018 UN E-Government Survey provides a useful external benchmark for Nepal's digital-government position. Nepal recorded an EGD of 0.4748 and ranked 117th among 193 countries. The index combines online services, telecommunications infrastructure and human capital and therefore should not be interpreted as a direct measure of software engineering quality. Nevertheless, Nepal's position provides contextual evidence that software and e-service development occurred within broader infrastructure and human-capital constraints.

VI. POLICY RECOMMENDATIONS

A. Establish government-wide software-development standardsGovernment Enterprise Architecture

Every major government software project should follow a common software-development life cycle covering requirements, architecture, development, testing, deployment, security and maintenance. ISO/IEC/IEEE 12207:2017 provides a useful life-cycle reference for defining and controlling software processes[16].

B. Make GEA compliance mandatoryGovernment Enterprise Architecture

Software procurement documents should require explicit compliance with government architecture, interoperability, security and data standards. Architecture review should occur before development begins.

C. Strengthen interoperabilityGovernment Enterprise Architecture

Government systems should use common data definitions, standardized interfaces and secure API-based information exchange. Interoperability should be included in system requirements rather than added after implementation.

D. Improve software quality assuranceGovernment Enterprise Architecture

Independent quality assurance should be separated from software development where

practical. Requirements validation, functional testing, performance testing, security testing, user acceptance testing and documentation should be mandatory.

E. Develop permanent government ICT capacityGovernment Enterprise Architecture

Government agencies require permanent technical personnel capable of managing vendors, reviewing architecture, maintaining systems and preserving institutional knowledge. Nepalese e-readiness studies indicate that human resources are a central component of organizational readiness[20][21].

F. Improve infrastructureGovernment Enterprise Architecture

Reliable connectivity, data-centre capacity, backup systems, disaster recovery and secure networks are necessary foundations for government applications. Infrastructure investment should prioritize shared government platforms rather than repeated departmental infrastructure.

G. Promote digital literacyGovernment Enterprise Architecture

Digital-literacy programmes should target both citizens and civil servants. Training should focus on basic digital skills, online forms, authentication, electronic payments, privacy and safe use of government services. Local governments and community institutions can be used to reach citizens with limited digital access.

H. Design services around citizensGovernment Enterprise Architecture

Government software should measure success through service completion, accessibility, usability, transaction time and citizen satisfaction rather than only system deployment. Accessibility should be treated as a software-quality requirement.

I. Improve procurement and vendor managementGovernment Enterprise Architecture

Government procurement should evaluate architecture, maintainability, security, documentation, interoperability and total cost of ownership rather than focusing mainly on initial development cost. Contracts should require source-code documentation, technical documentation,

knowledge transfer and defined maintenance responsibilities.

J. Use EGDI as a benchmark, not a software-quality measureGovernment Enterprise Architecture

The 2018 UN EGDI provides an international benchmark for Nepal. It should be used alongside technical and institutional indicators rather than treated as a direct measurement of software-development quality.

VII. CONCLUSIONS

Nepal had established significant foundations for e-government before 2019. The 2006 e-Government Master Plan established a national vision, while the 2011 Government Enterprise Architecture provided a technical and organizational direction for integration. However, the evidence reviewed in this study suggests that the transition from individual information systems to an integrated government architecture remained incomplete.

The principal challenge was not simply the absence of software. It was the alignment of software development with common architecture, data standards, interoperability, security, infrastructure, human resources and citizen needs. Nepalese research on e-readiness and information-system security supports this conclusion[20][21][22][19].

The proposed alignment framework contributes by connecting e-government policy with practical software-engineering activities. It emphasizes that government applications should be treated as components of a national information ecosystem rather than isolated projects.

The study has limitations. It is based on secondary evidence and does not include interviews, source-code analysis or systematic assessment of individual government projects. Therefore, its findings should be interpreted as a documentary assessment rather than a comprehensive empirical measurement. Future research should develop a measurable GEA-compliance index and evaluate a representative sample of government software projects using primary data.

The 2018 UN EGDI provides a useful external benchmark for the period examined. Nepal's future progress, however, depends not only on increasing the number of online services but also on building interoperable, secure, maintainable and citizen-centred government information systems.

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