

A COMPUTATIONAL FRAMEWORK FOR IMPLEMENTATION OF E-GOVERNANCE IN DEVELOPING COUNTRIES: AN ANALYTICAL CASE STUDY OF NEPAL

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ABSTRACT

This study addresses the persistent challenges in implementing e-governance in developing countries, with a focus on Nepal where infrastructural limitations, institutional fragmentation, and low digital literacy continue to hinder effective adoption. The research aims to identify key determinants influencing e-governance implementation and to propose a computational framework that integrates technological, institutional, and human dimensions. Using a quantitative survey of 250 respondents across Nepal's seven provinces, the study applies multiple regression analysis to examine relationships among critical factors. The findings reveal that institutional support [$\beta = .35, p < .001$] and digital literacy [$\beta = .29, p < .001$] are the most significant predictors, explaining 63% of the variance in adoption [$R^2 = .63$]. Based on these insights, a four-layer computational framework is proposed. The study concludes that effective e-governance implementation requires coordinated institutional reforms, enhanced digital capacity, and inclusive infrastructure development. The findings contribute both theoretically and practically by offering a scalable model for developing nations.

Keywords: *E-Governance, Computational Framework, Nepal, ICT, Developing Countries, Digital Literacy, Institutional Support.*

1. INTRODUCTION

The digitization of public administration has transformed how governments interact with citizens, businesses, and institutions. E-governance the strategic use of information and communication technologies (ICTs) in public service delivery has proven to improve efficiency, transparency, and accountability. However, its successful implementation in developing countries remains uneven due to infrastructure limitations, policy fragmentation, and digital inequality [1][2].

Nepal offers a compelling case study. Despite numerous e-governance initiatives such as the National e-Governance Master Plan - 2019 [3] and the Digital Nepal Framework [2020], overall adoption remains modest. Service delivery is still dominated by physical processes, and rural regions face persistent digital exclusion. The challenge is not only technological but also institutional and human requiring a holistic computational framework that integrates systems, governance, and people.

This paper addresses two key questions:

1. What are the primary barriers and enabling factors affecting e-governance implementation in Nepal?
2. How can a computational framework be designed to strengthen adoption and sustainability in developing contexts?

Despite existing policies and digital initiatives, the fundamental question remains: why does e-governance adoption continue to lag in Nepal, and how can it be effectively improved? This study addresses this gap by combining empirical analysis with a computational framework approach. Unlike previous studies that focus primarily on descriptive challenges, this research provides a data-driven model to explain adoption behaviour and proposes an integrated solution. The key contribution of this paper lies in:

- i. identifying statistically significant determinants of e-governance adoption,
- ii. developing a multi-layer computational framework, and

- iii. offering policy-relevant recommendations tailored to developing country contexts.

2. LITERATURE REVIEW

E-governance has evolved as an intersection of technology, policy, and social change. Studies across developing countries highlight that while ICT infrastructure is foundational, institutional readiness and human capacity are equally critical [4]. In contexts such as Nepal, weak inter-agency coordination, limited broadband penetration, and resistance to digital systems are major barriers [5][6].

The literature identifies five recurring dimensions of e-governance implementation:

- i. **Infrastructure Readiness** – availability and reliability of ICT networks.
- ii. **Digital Literacy** – citizens’ and officials’ skills to use digital tools.
- iii. **Institutional Support** – leadership, coordination, and funding.
- iv. **Policy Clarity** – legal frameworks, standards, and interoperability.
- v. **Trust And Security** – confidence in data privacy and online transactions.

Prior studies in Nepal emphasize that many e-services exist only at pilot stages, lacking integration and long-term maintenance [7]. To move beyond fragmented initiatives, a computationally integrated approach is essential one that connects technology design with organizational processes and citizen behaviour. The study by [8] shows that e-governance at the local level in Sudurpashchim Province faces many practical problems, such as weak ICT infrastructure, poor internet access, shortage of skilled staff, and low digital awareness among officials and citizens. These issues reduce the effectiveness of digital services at the grassroots level. Similarly, the United Nations E-Government Survey 2024 highlights that although countries like Nepal are slowly improving digital public services, major challenges remain due to limited infrastructure, gaps in human capacity, and unequal access to online services (United Nations Department of Economic and Social Affairs-(UNDESA), 2024)[9][10][11]. Overall, both studies emphasize the need to strengthen local capacity, improve infrastructure, and promote inclusive digital access to make e-governance more effective in Nepal. Below table shows the chronological order of ICT related initiative taken in Nepal.

Table 1: ICT Initiatives in Nepal

| Year | ICT / E-Governance Initiative | What Happened |
|------|--|---|
| 1997 | Telecommunications Act | Opened the telecom sector and made phone and internet services possible across the country. |
| 2000 | National Information Technology Policy | First national policy to promote computers and IT use in government and society. |
| 2003 | Establishment of NITC | National Information Technology Center was created to manage government ICT systems. |
| 2006 | First E-Governance Initiatives | Government began using websites and basic online services for public information. |
| 2008 | Electronic Transaction Act | Legalized digital signatures and online transactions. |
| 2009 | E-Governance Master Plan [Phase I] | Planned how ICT would be used to improve government services. |
| 2011 | Online Company Registration | Businesses could be registered online through the Office of Company Registrar. |
| 2012 | Government Integrated Data Center [GIDC] | Central data center built to host government digital systems securely. |
| 2014 | E-Procurement System | Public procurement and bidding process moved online. |
| 2015 | Online Tax System | Tax filing and payment started through online platforms. |
| 2015 | National ICT Policy | Updated policy to expand ICT infrastructure and digital services. |
| 2018 | E-Governance Master Plan [Phase II] | Focused on integrated systems and citizen-oriented services. |
| 2019 | Digital Nepal Framework | National roadmap to make Nepal a digitally enabled country. |
| 2019 | Nagarik App | One-stop mobile app for multiple government services. |
| 2021 | National Identity Card System | Biometric digital ID system introduced for citizens. |
| 2022 | E-Governance Commission | Commission formed to coordinate e-governance nationwide. |

| | | |
|---------|--|---|
| 2022 | E-Passport System | Electronic passports introduced with embedded chips. |
| 2023 | Integrated Online Government Services | Ministries started linking systems for better service delivery. |
| Ongoing | Local E-Governance & Land Digitization | Local governments digitizing records and services. |

The existing body of research indicates that Nepal has experienced steady but inconsistent progress in the area of digital governance and e-governance. Although various studies point out that necessary policies, legal frameworks, and institutional mechanisms have already been established, their practical execution has remained weak and uneven. Scholars note that the gap between policy formulation and actual implementation continues to be one of the major obstacles in achieving effective digital governance outcomes [12][13]. Despite the introduction of online public services, digital platforms, and ICT initiatives at the local level, limitations related to infrastructure, skilled manpower, and inter-governmental coordination have restricted their overall impact [5][14].

The literature further advises that e-governance initiatives in Nepal have yet to fully address the needs of citizens. Several challenges, including low levels of digital literacy, inefficiencies in service delivery, institutional resistance to change within the civil service, and unequal access to technology, continue to undermine the efficiency of digital systems [15] [1]. These challenges are not isolated to the digital sector alone but reflect broader issues of development and reconstruction, where

3. CHALLENGES AND BARRIERS IN NEPAL

Despite strong political commitment, several issues constrain effective e-governance implementation in Nepal:

- i. **Digital Divide:** Rural regions, especially in Karnali and Sudurpashchim provinces, face poor connectivity and unreliable electricity.
- ii. **Low Digital Literacy:** A majority of citizens lack basic ICT skills to access e-services, while civil servants often rely on manual procedures.
- iii. **Institutional Fragmentation:** Ministries operate independently with overlapping mandates, causing duplication and data silos.
- iv. **Policy And Legal Gaps:** Outdated IT policies and absence of data-protection laws undermine trust.

economic, social, and institutional constraints slow reform processes [16][17].

In addition, the success of digital governance is closely tied to democratic values and good governance practices. Research highlights that without transparency, accountability, and citizen participation, the use of technology in governance cannot yield meaningful or sustainable results [18]. Studies focusing on e-readiness also underline the importance of enhancing human capital, improving digital skills, and strengthening institutional capacity to support long-term digital transformation [19].

The persistence of e-governance challenges in Nepal highlights a critical gap between policy formulation and implementation. While technological solutions are available, the lack of institutional alignment, insufficient human capacity, and weak governance structures continue to impede progress. This indicates that e-governance is not merely a technical issue but a systemic problem requiring integrated solutions. Therefore, a strong conceptual foundation that links technology, governance, and human behaviour is essential to generate meaningful and sustainable outcomes[20].

- v. **Financial And Human Constraints:** Limited budgets and lack of trained IT personnel reduce project sustainability.
- ✓ **Trust Deficit:** Public scepticism regarding cybersecurity and misuse of personal data reduces service uptake.

These barriers are deeply interconnected, necessitating a multi-layered computational and institutional framework.

4. RESEARCH METHODOLOGY

4.1 Research Design

This study adopts a quantitative explanatory research design, aimed at identifying causal relationships between key determinants and e-governance adoption. The design is informed by prior studies conducted in developing countries, ensuring comparability and methodological rigor.

4.2 Sample

The sample comprised **250 respondents: 150 citizens** [end users of government services] and **100 government officials** (implementers services). Stratified random sampling ensured diversity across urban and rural areas.

4.3 Instrument and Variables

A structured questionnaire using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) measured six constructs:

- i. Infrastructure quality
- ii. Digital literacy
- iii. Institutional support
- iv. Policy clarity
- v. Trust in digital services
- vi. E-governance adoption [dependent variable]

Reliability analysis yielded Cronbach's α values ranging from .78 to .86, confirming internal consistency.

4.4 Data Analysis

Data were analysed using SPSS 27. Descriptive statistics summarized perceptions, while Pearson correlations and multiple regression tested relationships among variables.

4.5 Hypotheses Development

Based on the literature and conceptual framework, the following hypotheses are proposed:

1. Infrastructure quality positively influences e-governance adoption.
2. Digital literacy positively influences e-governance adoption.
3. Institutional support positively influences e-governance adoption.
4. Policy clarity positively influences e-governance adoption.
5. Trust in digital systems positively influences e-governance adoption.

5. THE COMPUTATIONAL FRAMEWORK

The study proposes a **four-layer computational framework** integrating technological, organizational, and human factors as described in figure 1.

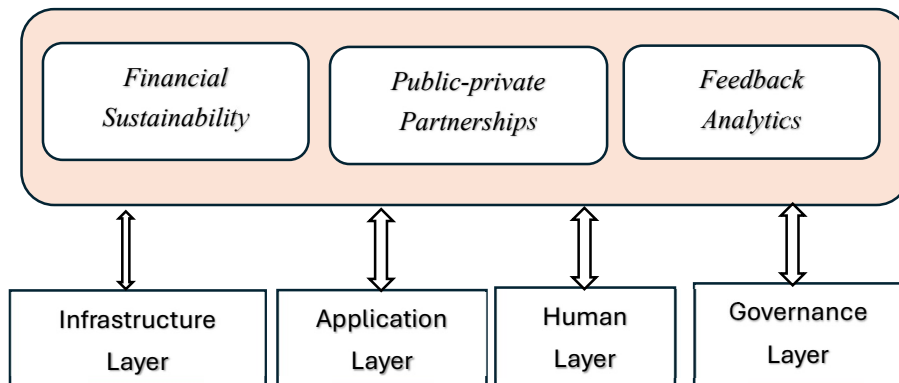


Figure 1: Four-layer computational framework

The framework consists of four horizontal layers:

- i. **Infrastructure Layer** – physical networks, broadband, and data centres.
- ii. **Application Layer** – portals, service platforms, and digital identity systems.
- iii. **Governance Layer** – policies, standards, interoperability, and cybersecurity.
- iv. **Human Layer** – digital literacy, citizen participation, and institutional culture.

Vertical Pillars—*financial sustainability, public-private partnerships, and feedback analytics*—connect all layers, ensuring adaptive and data-driven governance. The framework envisions a closed feedback loop where user data guide real-time policy and service improvement[21][22].

Table 2 summarizes average scores (1–5 scale). Officials generally rated readiness higher than citizens, reflecting better internal exposure to ICT systems.

6. ANALYTICAL FINDINGS

6.1 Descriptive Statistics

Table 2: Descriptive Statistics of Key Variables [N = 250]

| Variable | Mean [Citizens] | Mean [Officials] | SD | Interpretation |
|---------------------------|-----------------|------------------|------|----------------|
| Infrastructure quality | 3.21 | 3.48 | 0.71 | Moderate |
| Digital literacy | 3.05 | 3.60 | 0.82 | Moderate |
| Institutional support | 2.88 | 3.15 | 0.77 | Low–moderate |
| Policy clarity | 3.02 | 3.34 | 0.69 | Moderate |
| Trust in digital services | 2.79 | 3.10 | 0.81 | Low |
| E-governance adoption | 3.12 | 3.45 | 0.75 | Moderate |

Rural citizens scored lower on infrastructure (M = 2.84) and literacy (M = 2.66), indicating the persistent digital divide.

Table 3 displays Pearson correlations among variables. All independent variables are positively correlated with e-governance adoption, with the strongest relationships for institutional support and digital literacy.

6.2 Correlation Analysis

Table 3: Correlation Matrix of Key Factors

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|-----------------------|-----|-----|-----|-----|-----|---|
| Infrastructure | 1 | | | | | |
| Digital literacy | .61 | 1 | | | | |
| Institutional support | .54 | .63 | 1 | | | |
| Policy clarity | .45 | .52 | .66 | 1 | | |
| Trust | .49 | .59 | .57 | .50 | 1 | |
| Adoption | .58 | .65 | .72 | .64 | .60 | 1 |

Note. $p < .01$

6.3 Regression Analysis

A multiple regression model tested how the five predictors influence e-governance adoption.

Table 4: Regression Results Predicting E-Governance Adoption [N = 250]

| Predictor | B | SE | β | t | P |
|------------------------|------|------|---------|-----|--------|
| Infrastructure quality | 0.24 | 0.05 | .22 | 4.8 | < .001 |
| Digital literacy | 0.31 | 0.06 | .29 | 5.2 | < .001 |
| Institutional support | 0.38 | 0.07 | .35 | 5.4 | < .001 |
| Policy clarity | 0.19 | 0.05 | .17 | 3.6 | < .01 |
| Trust | 0.16 | 0.04 | .14 | 3.3 | < .01 |

Model

Summary: $R^2 = .63$, $F[5, 244] = 48.9$, $p < .001$

Institutional support and digital literacy emerge as the strongest predictors, jointly accounting for over half the explained variance in adoption.

7. DISCUSSION

The findings confirm that Nepal's e-governance success depends on synergizing infrastructure, literacy, and institutional coordination. While infrastructure remains essential, institutional support has the highest predictive power, emphasizing the need for coherent leadership and cross-ministerial collaboration.

The digital divide between urban and rural citizens also emerged clearly: respondents in Kathmandu and Gandaki reported higher adoption scores than those in Karnali. Trust deficits—driven by security and privacy concerns—remain significant behavioural barriers.

This aligns with international findings that e-governance implementation requires balanced attention to both *technology readiness* and *human readiness* [4][23]. The proposed computational framework thus addresses these interdependencies, ensuring that technological investments are matched with institutional and educational reforms.

The findings are consistent with previous studies [4] [5], which emphasize the importance of institutional and human factors in e-governance success. However, this study extends existing literature by quantitatively demonstrating the dominant role of institutional support over purely technological factors. This challenges the common assumption that infrastructure alone drives digital governance success.

8. POLICY RECOMMENDATIONS

- i. **Strengthen institutional coordination:** Establish a central e-governance authority integrating ICT functions across ministries.
- ii. **Expand broadband infrastructure:** Prioritize rural connectivity through public-private partnerships and universal access funds.
- iii. **Enhance Digital Literacy:** Implement targeted training for civil servants and community-level awareness programs for citizens.
- iv. **Build Trust and Security:** Enact comprehensive data protection and cybersecurity legislation.
- v. **Integrate Data-Driven Decision-Making:** Use analytics and feedback loops to refine services continuously.
- vi. **Ensure Financial Sustainability:** Incorporate e-governance maintenance into national and provincial budgets rather than relying on donor projects.

9. SCOPE AND LIMITATION

This study focuses on e-governance adoption in Nepal using survey-based quantitative data. It covers key determinants such as infrastructure, literacy, institutional support, policy clarity, and trust. However, the study does not include longitudinal data analysis or advanced computational simulations. Additionally, qualitative insights from policymakers could further enrich the findings.

Future studies may address these limitations by adopting mixed-method approaches.

10. CONCLUSION

This study integrated theoretical and empirical insights to propose a computational framework for e-governance implementation in developing countries, using Nepal as a case study. Quantitative analysis of 250 respondents revealed that institutional support, digital literacy, and infrastructure quality significantly influence adoption.

The four-layer framework developed here spanning infrastructure, applications, governance, and human capacity offer a scalable model adaptable to other developing contexts. For Nepal, sustainable e-governance will depend on aligning digital strategies with human development and institutional maturity.

Future research could expand this study by using longitudinal data or integrating advanced computational tools such as AI-based service analytics to evaluate real-time performance and citizen satisfaction.

While this study provides a comprehensive framework, it also raises important questions for future research: How can real-time data analytics improve governance responsiveness? What role can artificial intelligence play in enhancing citizen engagement? Addressing these questions will be crucial for advancing digital governance in developing countries.

This study contributes to the growing body of knowledge by bridging the gap between theory and practice and offering a scalable, evidence-based framework for e-governance implementation.

This study makes three key contributions:

- i. It provides empirical evidence on determinants of e-governance adoption in Nepal,
- ii. It proposes a novel multi-layer computational framework, and
- iii. It offers actionable policy insights for developing countries.

11. DECLARATIONS

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