

Interoperability Service Delivery Architecture among Ministries of Nepal

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Abstract

Interoperability service delivery architecture refers to a structured framework that enables seamless sharing, exchange, and integration of data and processes among diverse government entities, enhancing the efficiency and effectiveness of public services. Examining the interconnectivity of Information Systems in Nepal's ministries is vital for streamlined public service delivery. Interoperability challenges among Nepalese government ministries arise from historical independent computing systems, hindering effective service utilization. Trust issues, literacy constraints, and governance obstacles further impact service delivery enhancement efforts. This research aims to devise an Interoperability framework to enhance public service delivery across Nepalese ministries, with secondary goals encompassing comparative analysis, innovative strategies for ministry services, and the creation of a comprehensive interoperability framework. In this study, a mixed research design is utilized to create an interoperability framework for Nepal, involving in-depth interviews and surveys to comprehend the local-level framework, incorporating quantitative data and human perspectives for a holistic understanding. The study highlights the need for an integrated interoperability framework to address challenges in government ministry systems, including data exchange issues. A comprehensive approach encompassing technical, organizational, and contextual aspects is vital for effective collaboration, restoring trust, and enhancing service delivery. The research findings on interoperability system delivery architecture offer valuable implications. Government entities are suggested adopt the proposed framework for efficient data exchange and collaboration. Policymakers can shape regulations based on insights to promote interoperability standards. Additionally, the private sector and technology developers can align solutions with identified needs for an enhanced public service delivery landscape. Keywords: Interoperability, Service Delivery, Architecture, Framework and Data Exchange

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1. Introduction

Interoperability is the ability of two or more systems (computers, means of communication, networks, software and other components of information and communications technology) to interact and exchange data according to a defined method, in order to obtain the expected results. Interoperability in e-Governance is defined by the seamless collaboration and communication between different systems and stakeholders involved in the governance process. It entails the sharing of information and knowledge through the various business processes supported by these systems. Particularly in a federated governance structure, the exchange of information within and between organizations is a fundamental requirement for the delivery of e-services (UNDP, 2007). The main aim of interoperability in government is to achieve loose coupling between systems. This means that systems interoperate by exchanging agreed messages that are independent of their internal workings. In this way, systems remain independent, and any part of the interoperable network can be replaced without impact on the other parts as long as the new system implements the agreed interfaces (National ICT, 2013).

E-Government interoperability is becoming an increasingly crucial issue, especially for developing countries that have committed to the achievement of the Millennium Development Goals (MDGs) by 2015. Enhanced government efficiency and transparency, coupled with the delivery of basic public services to all citizens, are essential components required to achieve such goals. To date, most governments have finalized the design of national e-government strategies and are busy implementing priority programmer (UNDP, 2007). The e-Government Interoperability Framework (e-GIF) sets out the government's technical policies and specifications for achieving interoperability and simplifying Information and Communication Technology (ICT) systems integration across the public sector.

Interoperability architecture is the ability of agents to interact and archive common goals by sharing information and knowledge with help of digital technology include public administrations business and citizens especially, when it comes to the public-sector interoperability is a must necessary condition for delivering digital public services of high quality securely at low cost and without delays (Al-Khanjari, Al-Hosni & Kraiem, 2014).

The architecture interoperability needs to ensure meeting the future requirements. It has also to ensure that the local architecture fits into the State level and the same into National and Global architecture. Interoperability is a major criterion while defining the architecture. Major goals of

interoperability include data exchange, meaning exchange and process agreement. Data exchange defines whether data can be exchanged. Exchange of meaning incomes all participants will interpret the meaning of data in the same way. Whereas in process agreement all participants must agree in earlier about what to do with the data they will receive in the exchange (Chander, 2012).

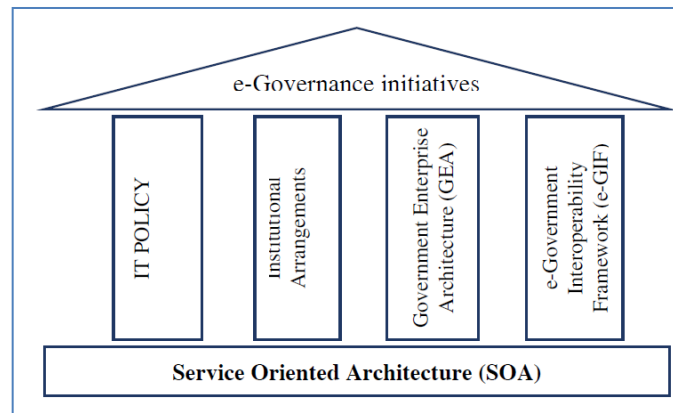


Figure 1: e-Governance SOA

Service Oriented Architecture is as approach for distributed Systems Architecture that employs loosely coupled services. Standard interfaces and protocols to deliver seamless cross platforms integration. It is used to integrate widely divergent components by providing them with a common interface and the set of protocols for them protocols for them communicate through what is called a service bus (Jarrar, Deik & Farraj, n.d).

An Interoperability Framework (IF) is a document or group of documents that specify a set of policies, guidelines, recommendations, concepts, principles, vocabularies, standards and practices for agencies that wish to work together, towards the joint delivery of public services (Ray, Gulla, Dash, Gupta, 2010). The IF supports the Government’s strategy of providing client-centric joined-up services by facilitating the interoperability of technical systems between Government departments, as well as between Government systems and systems used by the public including citizens and businesses (Government of Hongkong, 20022). Public Service is “any service or part thereof being provided to any person by the Central Government and the State Government or public authority either directly or through any service provider and includes the receipt of forms and applications, issue or grant of any license, permit, or certificate, sanction or approval and the receipt or payment of money by whatever name called in a particular manner” (Government of India, 2015).

The Interoperability Framework (IF) plays a crucial role in supporting the government's strategy of delivering client-centric and integrated services. It enables the seamless exchange of information and technical compatibility between government departments as well as between government systems and systems used by the public, including citizens and businesses. The IF comprises a set of specifications designed to facilitate interoperability among government systems and services. By consolidating these specifications within a comprehensive framework, IT management and developers have a centralized point of reference when identifying the required interoperability standards for specific projects. This allows system designers the flexibility to choose different hardware, systems, and application software while ensuring interoperability between systems.

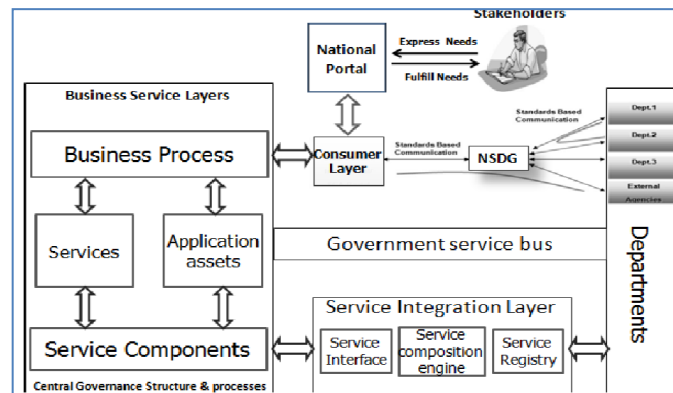


Figure 2: Interoperability Framework

2. Statement of the Problem

Ministries have historically developed separate computing systems tailored to their needs, less priority given to data exchange needs. This lack of interoperability and standards prevents effective service utilization across various administrative levels in Nepal. Moreover, the absence of standards enables misuse by malicious actors to create false documents.

3. Objective of the Study

The main objective of this research is to design Interoperability Framework that helps to provide better public service delivery among ministries of Nepal.

4. Literature Review

The technical aspect of interoperability involves the ability of different systems, applications, or components to exchange and interpret data effectively. It requires compatible interfaces, data formats, and communication protocols to ensure seamless integration and interaction between disparate systems. This may involve standardization of data models, APIs (Application Programming Interfaces), message formats, and protocols to enable interoperability. Technical interoperability also encompasses data transformation, validation, and mapping processes to ensure data consistency and integrity during exchanges (Ronoh, 2018). Furthermore, security mechanisms, such as authentication and encryption, are crucial to protect the privacy and integrity of the shared data. Overall, the technical aspect of interoperability focuses on enabling seamless and secure communication and data exchange between heterogeneous systems. According to Lallana, technical interoperability can be achieved through different layers. The first layer is the Interconnectivity Layer, which focuses on establishing communication between systems by implementing network and systems development standards. The second layer is the Data Integration Layer, which enables the exchange of data between different systems and involves standards for describing data. The third layer, the Information Access and Presentation Layer, deals with the various methods of presenting data to users, considering different access challenges. Lastly, the Content Management and Meta-Data Layer involves the standards necessary for retrieving and managing government information effectively (Lallana, 2008).

To ensure technical interoperability between systems, Lallana highlights four requirements that a system should meet. Firstly, a system should generate data that can be utilized by another system. Secondly, a system should process or consume data that is generated by another system. Thirdly, a system should rely on another system for the delivery of data. Lastly, a system should use software that operates on the same platform as another system. By fulfilling these requirements, systems can establish the necessary connections and interactions to achieve technical interoperability (Lallana, 2008). Information Systems' Interoperability Maturity Model (ISIMM) as a practical framework to assess the degree of interoperability between Information Systems. ISIMM is derived from the theories of LISI (Levels of Information Systems Interoperability) and GIMM (Government Interoperability Maturity Model) but focuses specifically on the technical aspects of interoperability for data sharing and exchange within an information systems environment (Staden & Mbale, 2012).

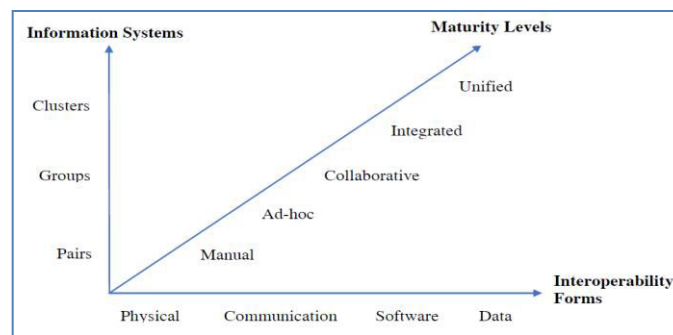


Figure 3: Information system interoperability model (ISIMM)

ISIMM defines five levels of information system interoperability maturity. The maturity interoperability computing environment levels of ISIMM are defined as Level 1: Manual, Level 2: Ad-Hoc, Level 3: Collaborative, Level 4: Integrated, Level 5: Unified (Anggoro, 2018). ISIMM serves as a tool to promote and facilitate the establishment of interoperability within the government by providing a comprehensive framework to assess and improve the interoperability maturity of Information Systems.

Interoperability adoption in the public service is influenced by various factors that can impact its successful implementation. Some of the key factors include Organizational Culture, Leadership and Governance, Policy and Legal Frameworks, Technical Infrastructure, Stakeholder Engagement and Collaboration, Capacity Building and Training, Funding and Resources, User Experience and Usability, Change Management, Performance Monitoring and Evaluation (Staden, 2011).

Despite making progress in infrastructure development for public service delivery, the development of e-Government in Nepal is still in its early stages. Several barriers impede the successful implementation of e-Government initiatives. These barriers include a lack of optimal leadership due to unstable government conditions, challenges in motivating and committing staff, a digital divide based on technological and geographical disparities, inadequate ICT infrastructure, and financial constraints (Anggoro, 2018). However, the government of Nepal has recognized the significance of e-Government and has begun implementing programs to establish a digital governance framework. By addressing these barriers and investing in necessary resources and capacity building, Nepal aims to overcome the initial stage of e-Government development and pave the way for improved public service delivery and citizen participation.

API technology, or Application Programming Interface technology, has played a crucial role in facilitating data exchange and interoperability between different systems and applications. By providing a set of rules and protocols, APIs enable different software applications to communicate

with each other and exchange data in a seamless and standardized manner (White, 2010). APIs act as intermediaries, allowing systems to access and retrieve specific data or perform certain actions. They provide a layer of abstraction that simplifies the complexity of integrating different technologies and ensures interoperability.



Figure 4: API Connectivity

To achieve the required state of interoperability, crucial steps are necessary. First, standardized protocols and data formats should be established for seamless integration across systems. Second, a common technical infrastructure should be implemented to foster communication and unified information flow. Third, shared software solutions must be promoted for consistent data handling. Clear governance mechanisms should be instituted to enforce interoperability standards, accompanied by continuous monitoring and refinement of processes. Embracing a culture of collaboration and commitment to interoperability principles is pivotal for successful integration and efficient service delivery.

5. Methodology, Data Analysis and Presentation

The researchers have adopted a mixed research design to develop an interoperability framework for Nepal. The research primarily focuses on understanding the existing framework of local level. This process involves intensive investigation and relies on quantitative data, with a strong emphasis on human perspectives. Additionally, closed questionnaires and surveys are employed to gather feedback from individuals involved in the process, enabling the identification of existing problems and challenges. In order to gain insights into the current processes, in-depth interviews are conducted to identify the existing framework and understand how the current workflow is being utilized.

For the purpose of this research, a questionnaire consisting of 25 interrelated questions related to the implementation of the present system for public services in Nepal was developed. The survey aims to gather valuable insights from IT persons of Bagmati Province's local levels who are

directly involved in the design, development, and maintenance of the current public services system in the country. This research employs a 25-question questionnaire to comprehensively examine the strengths, weaknesses, and areas of improvement of Nepal's present public services system. Targeting IT personnel of local levels, the survey investigates infrastructure, processes, and technologies used for service delivery. It seeks insights into challenges faced by IT personnel, system effectiveness in meeting citizen needs, and interdependencies among components. Out of the total 111 municipalities selected for the survey, only 85 municipalities responded, resulting in a response rate of approximately 76.6%. The usable data that was gathered from the questionnaires were coded and then tabulated using MS Excel 16 for easy presentation of data, analysis and interpretation. The data was evenly and accurately entered in the sheet and verified the recorded data to make sure that the data was recorded correctly.

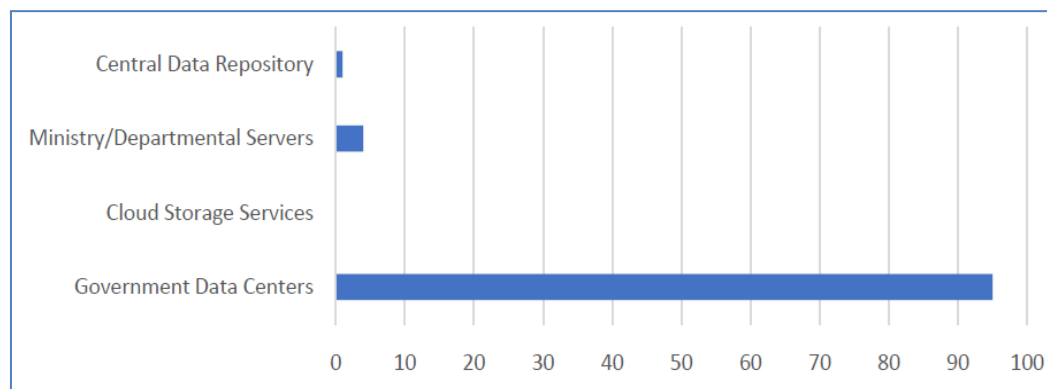


Figure 5: Response to data storage

Based on a comprehensive analysis of data storage preferences in Nepal was performed. The results reveal that a substantial majority of respondents 95 favored the Governmental data center as their preferred data storage option. Furthermore, 4 of participants indicated their preference for the ministry departmental server, while 1 expressed their choice for the central data repository. Notably, cloud storage services received minimal preference, with 0 or no one respondent opting for this option. These findings shed light on the prevailing data storage preferences among the surveyed individuals within the context of Nepal, providing valuable insights for data management and storage practices in the region.

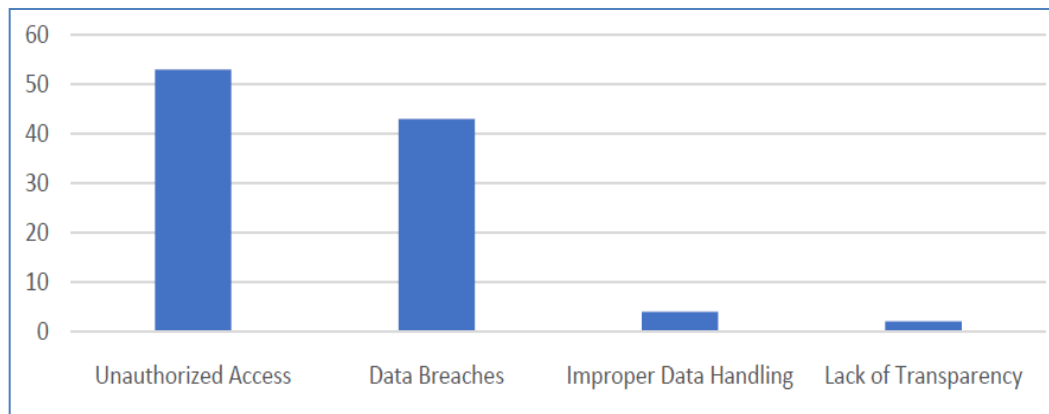


Figure 6: Response to data security or privacy

Based on the analysis of encountered data security or privacy concerns while utilizing public services, the data revealed that a considerable number of respondents expressed apprehension regarding various aspects of data security and privacy. Specifically, 53 instances of unauthorized access, 43 reported data breaches, 4 cases of improper data handling, and a significant number of 2 respondents cited concerns related to the lack of transparency. These findings underscore the importance of addressing data security and privacy issues in public services to safeguard sensitive information and enhance overall service quality and trustworthiness.

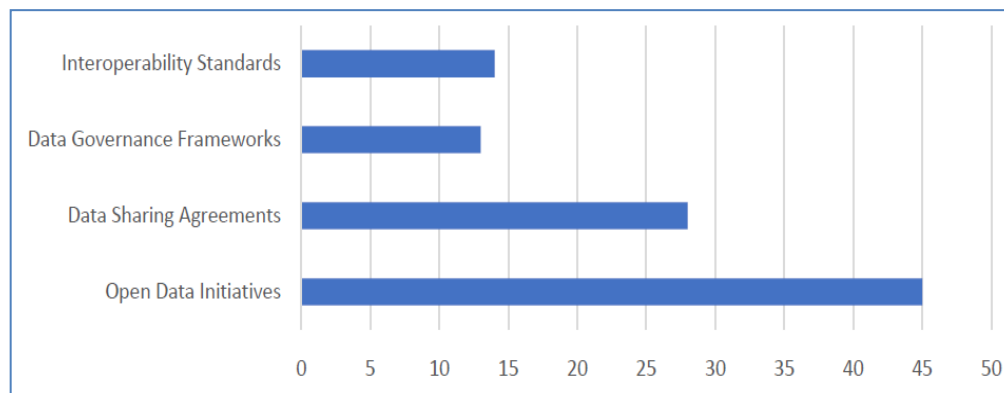


Figure 19: Response to promoting data exchange between ministries

Based on the analysis of initiatives aimed at promoting data exchange between ministries, Key findings reveal a strong focus on Open Data Initiatives (45 respondents) for data exchange between ministries, while Data Sharing Agreements were absent. (28 respondents) mentioned Data sharing agreement, only (13 responded) Data Governance Frameworks, and just (14 responded) mentioned Interoperability Standards, suggesting room for exploring additional governance approaches for enhanced data exchange. These results highlight the prevalence of Open Data Initiatives prevail

as the primary means to foster collaboration and information sharing among government entities, yet there is potential to diversify data management practices for improved effectiveness.

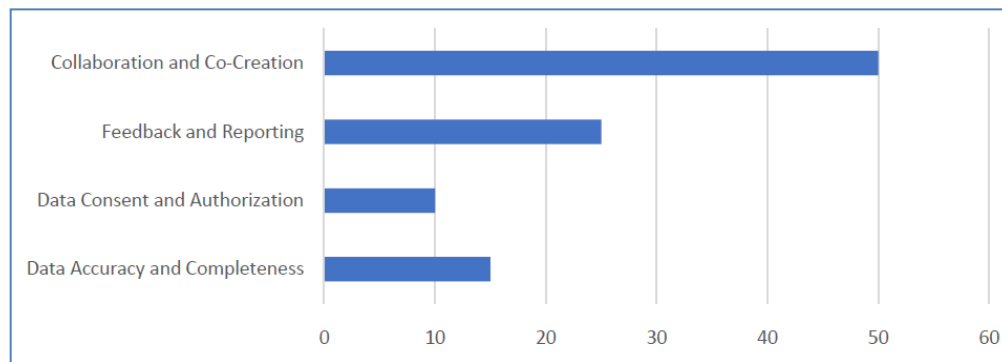


Figure 7: Response to promoting effective data exchange between ministries

The analysis highlights key factors promoting effective data exchange between ministries. Ensuring Data Accuracy and Completeness (15) is crucial for meaningful information exchange. Data Consent and Authorization (10) play a vital role in secure data sharing. Feedback and Reporting (25) enhance communication between government entities. Collaboration and Co-Creation (50) foster seamless data exchange and collective decision-making. These findings emphasize a multifaceted approach encompassing accuracy, consent, collaboration, and transparent communication to optimize inter-ministerial information flow and governance.

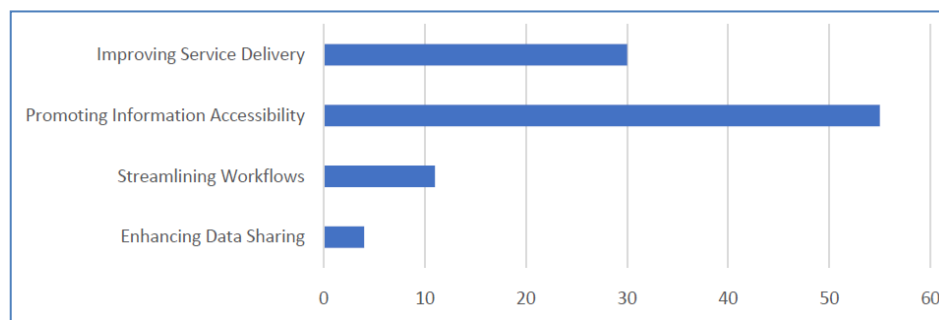


Figure 8: Response to interconnection between one system to another system

The analysis reveals that respondents prioritize Promoting Information Accessibility (55) and Improving Service Delivery (30) for efficient inter-system communication. Streamlining Workflows (11) received some recognition, but Enhancing Data Sharing (4) had fewer endorsements. These findings underscore the significance of Promoting Information Accessibility workflow efficiency to establish effective interconnections and foster seamless data sharing.

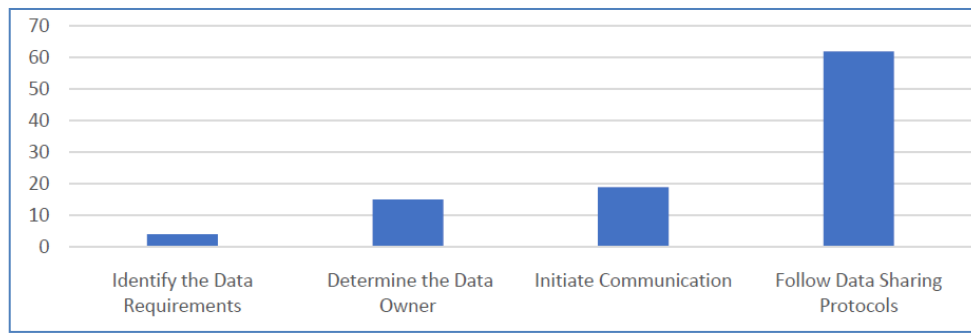


Figure 9: Response to required data from another department

The analysis reveals the step-by-step approach for data sharing between departments: Identifying Data Requirements (4), determining Data Owner (15), Initiating Communication (19), and Following Data Sharing Protocols (62). This approach emphasizes clear communication, protocol adherence, and data ownership determination to foster efficient interdepartmental collaboration in successful data exchange.



Figure 10: Response to particular challenges or issues

The analysis reveals noteworthy challenges related to data exchange: Interoperability (90) stands out as a prevalent issue, followed by Data Quality and Consistency (2). Governance and Coordination (3) are critical concerns, and Technical Infrastructure and Resources (5) present significant obstacles. These findings highlight key areas for improvement in promoting efficient data exchange practices.

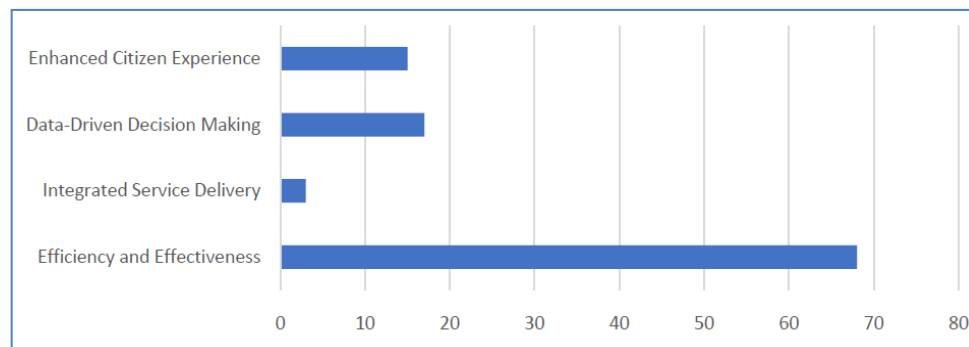


Figure 11: Response to data exchange is for improving public service delivery

The analysis reveals significant factors for data exchange between departments to improve public service delivery: Efficiency and Effectiveness (68) as paramount objectives, Integrated Service Delivery (3) potential, Data-Driven Decision Making (17) critical for informed decisions, and Enhanced Citizen Experience (15) for tailored services. These findings emphasize a multi-dimensional approach to achieve improved public service delivery through effective data exchange.

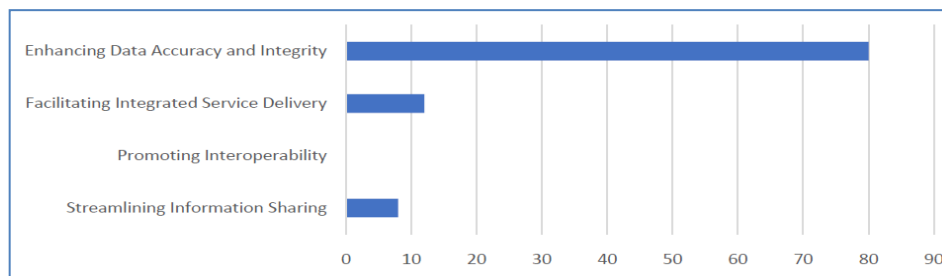


Figure 12: Response to data exchange to deliver public services in Nepal

Based on data exchange to deliver public services in Nepal emphasizes the critical importance of enhancing data accuracy and integrity (80) to ensure informed decision-making and effective service delivery. Streamlining information sharing (8) among government departments is recognized for efficient collaboration. Facilitating integrated service delivery (12) ensures seamless access to comprehensive services for citizens. However, promoting interoperability (0) requires attention to enable seamless data exchange across various systems and platforms. These findings underscore the need to prioritize data accuracy, streamline information sharing, and explore solutions for enhancing interoperability to optimize public service delivery in Nepal.

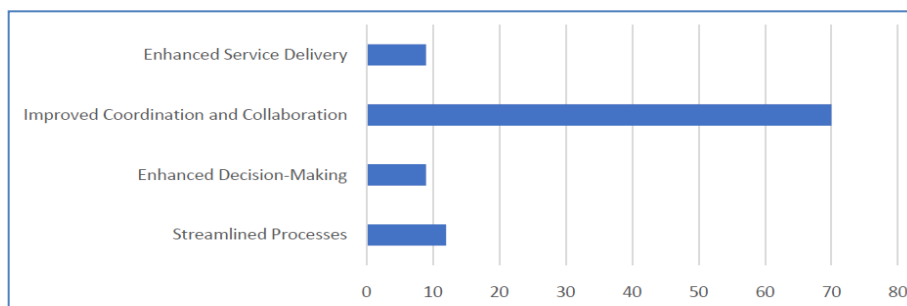


Figure 13: Response to enhance the efficiency and effectiveness of public service

To enhance the efficiency and effectiveness of public services, focus on improving streamlined processes (12) to optimize resource allocation and reduce bureaucratic inefficiencies. Emphasize enhanced decision-making (9) through data-driven insights and analysis for more informed and impactful policy choices. Prioritize improved coordination and collaboration (70) among government entities to facilitate seamless information exchange and integrated service provision.

Additionally, strive for enhanced service delivery (9) tailored to citizens' specific needs, ensuring a more responsive and satisfactory public service experience. These endeavors collectively contribute to a more efficient, effective, and citizen-centric public service delivery system.

System Architecture

Architecture is a picture of the structure of a system that describes the basic organization of components, linked to one another with their environment, with principles guide the design and evolution (Staden, 2011). The architecture is addressed to three things: a) the design is adapted to what is required, not limited to the available technology, b) the effective architecture will accelerate service delivery for the market and lead to cost savings, and c) the architecture should support the overall flexible public services (Lallana, 2008).

Architecture development principles of e-Government Interoperability are: a) to use of basic needs in regulations and legislation provided, b) the architectural design has the scalability, thus the implementation and development must be able to adapt to development needs and technological readiness also human resources, and c) to focus on efforts to improve the quality of public services gradually and sustainably.

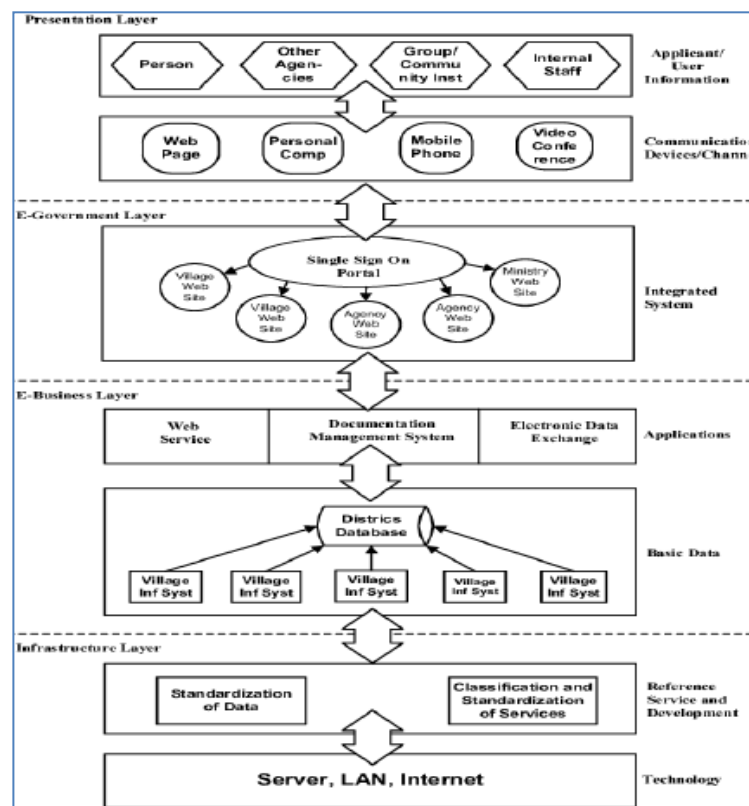


Figure 14: Architecture of e-Government Interoperability

The e-Government Interoperability architecture is designed to have a number of interconnected components, and the environment of e-Government Interoperability. By adopting the given architecture (Zakareya & Irani, 2005), the architectural model for e-Government Interoperability has four layers as a component Infrastructure Layer, E-Business Layer, E-Government Layer, Presentation Layer and Model Validation.

6. Conclusion

The interoperability system for public services is a transformative approach that holds great promise for enhancing the efficiency, effectiveness, and user experience of government services. By promoting seamless data exchange and collaboration among various government agencies and systems, the interoperability system breaks down barriers and fosters integrated service delivery. This result in streamlined processes, reduced redundancies, and improved accessibility for citizens. The standardized protocols and interfaces ensure that data and services can be shared and utilized across different platforms, enhancing overall system performance and responsiveness. As governments continue to embrace interoperability, citizens can look forward to a more connected and citizen-centric public service landscape, where accessing government services become more convenient and intuitive. The journey towards full interoperability may present challenges, but the potential benefits in terms of improved governance, greater transparency, and enhanced citizen satisfaction make it a worthy investment for building stronger, more efficient, and inclusive public services for the future.

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