

# Application of big Data in e-Governance

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## Abstract

*Nepal is moving towards digitization. In Nepal federal, province and Local government are steadily moving towards digitizing all the government departments, scheme and services. e-Government is defined as an effort created, managed and implemented by public entities to use information and communication technologies (ICTs) to improve delivery of public services and increase public and democratic participation.*

*Three tier government of Nepal is moving towards achieving good governance through e-governance and utilization of big data for decision making and predication. The spread of e-governance initiatives has had a positive impact on the quality of governance. Geographical, social, & economic disparities are the biggest barriers for full-fledged e-governance. Illiteracy and IT Illiteracy, lack of ICT infrastructure, security and privacy of personal and financial data are other constraints. The aim of this paper is to identify the application and utilization of big Data to Transform Government to e-Government, the issues, challenges and obstacles ahead. The study provides a framework for e-governance in Nepal by analyzing the its essential application and role in achieving good governance using big data.*

**Kye Words :** Communication, technologies, Illiteracy, framework.

## Background and Introduction

The new Constitution of Nepal which came into effect on September 20, 2015 established a federal system of government comprising seven provinces. In terms of existing opportunities for socio-economic growth, Lumbini province has huge potential for commercial agriculture and agro-industries and more pronounced prospects for tourism given the presence of a number of prominent religious sites and tourist attractions "The birth place of Lord Buddha". Lumbini province remains in a comparatively advantageous position to secure overarching growth and development aspirations of its citizens.

The world is moving towards digitization. In Nepal, the federal, provincial, and local government sectors are progressively advancing in their efforts to digitalize various government departments, programs, and services. The concept of e-Government involves initiatives developed, overseen, and executed by public entities, utilizing information and communication technologies (ICTs) to enhance the efficiency of public service delivery and foster greater public and democratic engagement.

"E-Government strives to enhance the efficiency of service delivery in provinces and local governments by minimizing document management and communication costs, restructuring government agencies, and eliminating administrative silos associated with paper-based documents. Crucially, it aims to alleviate administrative burdens on citizens and businesses by streamlining interactions with public authorities, making them faster, more convenient, and cost-effective. This, in turn, fosters competitiveness, economic growth, and effective grievance handling. Despite the recent underutilization of open data by the Government of Nepal (GoN) and public and private organizations, collaboration with third parties has presented new insights into issues and potential services.

Moreover, the opportunities provided by e-Government for citizens to engage with public entities and officials, offering suggestions, comments, and influencing policies and grievance handling, can enhance transparency and encourage greater participation in democratic public life. Whether pertaining to individuals or organizations, data is a crucial asset. Although the public sector lags behind the private sector, it is increasingly recognizing the transformative potential of big data and its applications across various aspects of e-governance.

Big data, a term used for the massive amount of digital data collected from various sources, offers new opportunities for innovation, value creation, and decision making to any organization. The definition and scope of big data have evolved from collecting vast amounts of data to the process and technology through which organizations can derive value from their data.

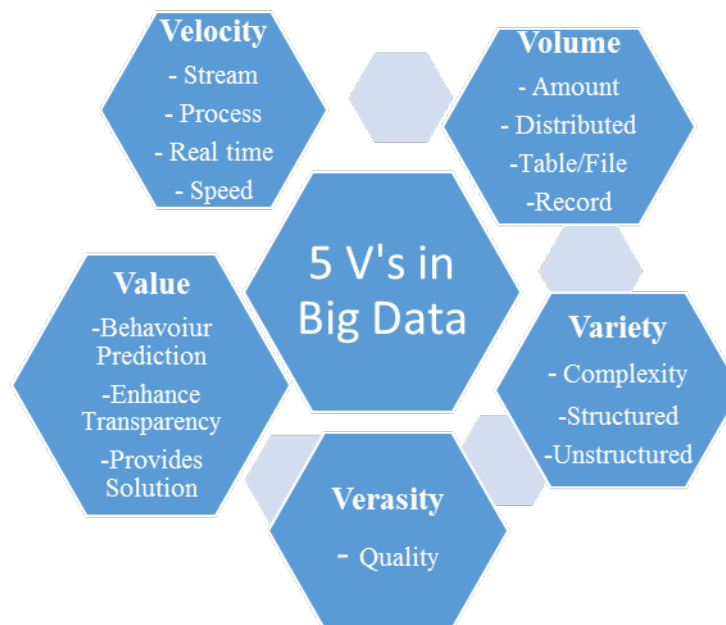


Fig: 5'v in Big Data

The primary reason for the growth of data is the dramatics reduction in the cost of storing data. Literally, the first “V” in big data signifies the exponential expansion of conventional business data alongside data generated by machines. The volume of data is increasing due to datafication which means Datafication refers to the process of transforming various aspects of life, activities, and phenomena into digital data. Datafication enables the collection, aggregation, and analysis of vast amounts of data from diverse sources, including sensors, social media, transactions, and interactions. This process facilitates the extraction of valuable insights, patterns, and trends, which can be used for decision-making, optimization, innovation, and understanding complex phenomena in various domains such as business, healthcare, education, and governance. The second V (Velocity) pertains to the speed at which data is generated and Processing streaming data in real-time. Over the last two decades, data generation has significantly increased due to advancements in sensors and other technologies. The third V (Variety) encompassing the diverse forms of data that are present. It also represents the complexity of data which could be of structured, semi-structured and unstructured form of data. For instance, variety in big data welcomes all types of data, whether structured like SQL or unstructured like video and mp3 files. The fourth V(Veracity) places a primary focus on the accuracy and validity of data. It is concerned with ensuring the truthfulness and precision of the data. Fifth V(Value) is for value of data. Big data needs to be sifted and organized by quality, for it to be put to any great use. This brings the value of data. Value needs to be extracted form data by aligning it with specific business objectives.

Currently, big data is closely associated with data intelligence, analytics, and mining, expanding its applications beyond reporting and decision support to encompass forecasting, prediction, and decision-making. While private businesses are at the forefront of incorporating big data into their operations, governments worldwide have also started integrating it into their processes. Amidst the global COVID-19 pandemic, numerous governments utilized big data and complementary data technologies to track the transmission of viruses such as the coronavirus, disseminate real-time information, and offer assistances to their citizens.

### **Aim and objectives**

The primary objective of the study is to develop a comprehensive and user-friendly big data governance framework that can be utilized by organizations to effectively manage various aspects of big data, thereby enabling them to progress in their big data-driven strategies. The specific goals are as follows:

- Conduct a thorough review of existing literature to comprehend the current state of big data governance.
- Evaluate existing governance frameworks for big data, considering their limitations, with the aim of generating design recommendations for an enhanced approach.
- Analyze data from parliamentary inquiry submissions to identify common complexities associated with big data that can be addressed through effective governance.

- Establish a system for identifying and recognizing challenges or risk factors related to big data, aiding in understanding which factors require mitigation through effective governance to improve the overall success of the framework.

### **Benefits of Big Data Analytics in E-Governance**

Data is considered as fuel of 21<sup>st</sup> century, since we live in the world of data. All most all decisions are based on data. So, we must not ignore the importance of value of data. We are collecting huge amount of data from different source from operational level data to day data to historical data, unstructured data, semi structured and structured data using different apps.

Utilizing big data analytics in e-governance initiatives yields significant advantages, including enhanced online information and service provision for business analytics, fostering transparency in operations, monitoring and visualizing performance metrics, predicting citizen needs, deriving valuable intelligence for novel projects, and refining existing services to offer improved citizen experiences.

Big Data Analytics plays a crucial role in enhancing e-governance, providing numerous benefits to governments and citizens alike. Here are some key advantages:

1. **Efficient Service Delivery:** Big Data Analytics enables governments to analyze large datasets to identify areas for improvement in service delivery. This leads to more efficient and effective public services.
2. **Data-Driven Decision Making:** Governments can make informed decisions by analyzing vast amounts of data. This helps in crafting policies, optimizing resource allocation, and addressing public needs based on real-time insights.
3. **Predictive Analysis for Planning:** Big Data Analytics allows governments to predict trends and patterns, aiding in long-term planning. This is especially beneficial for anticipating future citizen needs, infrastructure requirements, and potential challenges.
4. **Fraud Detection and Prevention:** Governments can use big data to detect and prevent fraud in various areas such as social welfare programs, tax collection, and public procurement, ensuring transparency and accountability.
5. **Public Safety and Security:** Analyzing data helps in identifying potential security threats, managing emergency situations, and enhancing overall public safety. This is crucial for timely responses to incidents and disasters.
6. **Citizen Engagement and Participation:** Big Data Analytics can be employed to understand citizen sentiments, preferences, and concerns through social media and other platforms. This information can be used to foster citizen engagement and improve government responsiveness.
7. **Resource Optimization:** By analyzing data related to government resources, including manpower, finances, and infrastructure, e-governance can optimize resource allocation and utilization, leading to cost savings and improved efficiency.
8. **Healthcare Management:** Big Data Analytics is valuable in healthcare management, aiding in disease surveillance, monitoring public health trends, and optimizing healthcare services for citizens.

9. Smart Urban Planning: In smart cities, big data analytics helps in managing traffic flow, monitoring energy consumption, and improving overall urban infrastructure. This leads to more sustainable and efficient city planning.
10. Transparency and Accountability: By leveraging big data, governments can enhance transparency in their operations. Citizens can access information about government activities, expenditures, and outcomes, fostering trust and accountability.
11. Customized Public Services: Big data analytics enables governments to tailor public services based on individual preferences and needs, offering a more personalized and citizen-centric approach.

While these benefits are significant, it's important for governments to address data privacy and security concerns to ensure the responsible and ethical use of citizen data in e-governance initiatives.

### Literature Review

How did the term Big Data coin? As explained by IMF expert (Hammer, Kostroch, & Quirós, 2017), The concept of 'big data' has evolved beyond mere hype. In 2017, the International Monetary Fund (IMF) acknowledged this shift, while a 2006 Harvard Business Review piece by Tom Davenport highlighted how organizations like Amazon, Capital One, and the Boston Red Sox leveraged analytics to gain competitive advantages. Davenport observed these entities' deep immersion in data and proficiency in data analysis. Similarly, in 2010, Hal Varian discussed computer-mediated transactions, wherein economic activities involve computer systems like point-of-sale terminals and electronic commerce platforms. Although the term 'big data' wasn't explicitly used by these authors, the concepts they discussed laid the foundation for the broader discourse on big data that emerged later on.

Holm and Ploug highlighted Denmark as a nation that prioritizes Big Data analysis across various sectors including healthcare, education, employment, housing, and pollution management ( Holm & Ploug, 2017) . By implementing government regulations that support the utilization and sharing of public data, significant research progress has been achieved. However, they now propose adopting a consent-based model for accessing private records for research endeavors. This research serves as a blueprint for promoting Big Data e-governance in South America.

(Patel, Roy, Bhattacharyya, & Kim, 2017) published a journal named “Necessity of Big Data and Analytics for Good e-governance” and the article titled 'The Essential Role of Big Data and Analytics in Effective E-Governance' emphasizes the significance of big data analytics in addressing various challenges and predicting future issues. The focus of the paper revolves around the positive impact of big data and analysis on achieving good e-governance. By leveraging big data, valuable insights and predictive analyses can be obtained, contributing to the enhancement of e-governance practices. The authors highlight that employing big data with sound analytics approaches in the e-governance domain can significantly improve work methodologies. This approach allows for the thorough analysis of new reforms or schemes before implementation, increasing the likelihood of successful

outcomes. Big data analytics in e-governance not only facilitates the delivery of effective services to citizens but also enables the government to efficiently organize events for various purposes, ultimately benefiting the public and raising awareness about government schemes and programs.

(Tseng, Hsueh, Tseng, Yang, & Chao, 2018) Tseng and colleagues introduced a solution leveraging Big Data platforms to make decisions during instances of traffic congestion in the Taiwan Area National Freeway Bureau. Their approach utilized Apache Storm to process vast volumes of streaming data, including factors like road density, traffic incidents, and weather conditions, in order to forecast traffic congestion.

Wright explored the utilization and effectiveness of Big Data analysis across various enterprises (Wright, 2018). For example, Shell employs Big Data to monitor equipment functionality and predict oil and gas reserves, while CERN employs it to analyze the immense volume of data generated annually—30 petabytes—from sensors tracking millions of subatomic particles resulting from particle collisions, aiming to deepen understanding of the universe's fundamental structure.

In 2009, (Kim, Trimi, & Chung, 2014) the U.S. government introduced Data.gov as part of its efforts to enhance government transparency and accountability. This repository currently holds 420,894 datasets (as of August 2012) encompassing various fields such as transportation, economy, healthcare, education, and human services. These datasets serve as the foundation for numerous applications, including 1,279 developed by governments, 236 by citizens, and 103 designed for mobile platforms.

### **Big Data Applications in E-governance**

"Big Data has the potential to fuel various applications in e-governance, contributing to more efficient and citizen-centric public service delivery. Below are several ways in which big data can play a pivotal role in assisting governments with their initiatives:

**Citizen Services:** Governments can meet citizens' expectations for personalized, on-demand, and efficient services by leveraging big data. Massive government datasets can offer insights into various citizen services, including education, healthcare, taxes, housing, food distribution, and land registration. This data can be utilized to develop innovative delivery channels and enhance overall citizen services.

**Disaster Management:** Big data analytics proves crucial in disaster management, as witnessed during the Covid-19 pandemic. Government organizations utilized big data analytics to track virus spread and implement countermeasures. It aids in disaster preparedness, providing accurate information gathering and weather forecasting to alert citizens about impending calamities. Additionally, it helps identify vulnerable groups, such as the elderly and children.

**Law Enforcement:** Big data solutions enable law enforcement agencies to leverage data and information for enforcing laws, reducing crime rates, and expanding services. Technologies like facial recognition, speech recognition, drones, and predictive analytics strengthen law

enforcement efforts. In Bogota, Colombia, researchers from the World Bank leverage big data and risk terrain modeling to comprehend the relationships between crime and develop solutions.

**Policy Planning:** Big data analytics empowers policymakers to utilize information from diverse sources, generating economic indicators for informed policy decisions. Analyzing high-frequency and granular data through big data mining provides actionable insights into human mobility and economic behavior. For instance, urban planning and public transport organizations leverage satellite images, vehicle sensor data, traffic information, and video feeds to identify citizen needs, plan land usage, and execute road construction projects. This analysis aids in traffic regulation and enhances the efficiency of intersections.

**Fraud Detection:** Big data plays a crucial role in building robust fraud detection mechanisms for government projects susceptible to fraud and corruption. For example, the Australian Electoral Commission (AEC) employs data simulations to investigate electoral fraud. Big data is utilized to maintain the accuracy, integrity, and completeness of electoral data. Simulations help detect anomalies and fraudulent activities, leading to continuous improvement in polling processes, optimized resource allocation, and reduced voting time.

### **Data Analysis techniques in Big Data**

As illustrated by the (Stephenson, 2022), 'Big Data' is the application of specialized techniques and technologies to process very large sets of data. These data sets are often so large and complex that it becomes difficult to process using on-hand database management tools. Examples include web logs, call records, medical records, military surveillance, photography archives, video archives and large-scale e-commerce.

According to IDC Canada (IDC, 2022) a Toronto-based IT research firm, Big Data is one of the top three things that will matter in 2013. With that in mind, there are 7 widely used Big Data analysis techniques that we'll be seeing more of over the next 12 months:

- Association rule learning
- Classification tree analysis
- Genetic algorithms
- Machine learning
- Regression analysis
- Sentiment analysis
- Social network analysis

### Big Data Architecture of e-Governance

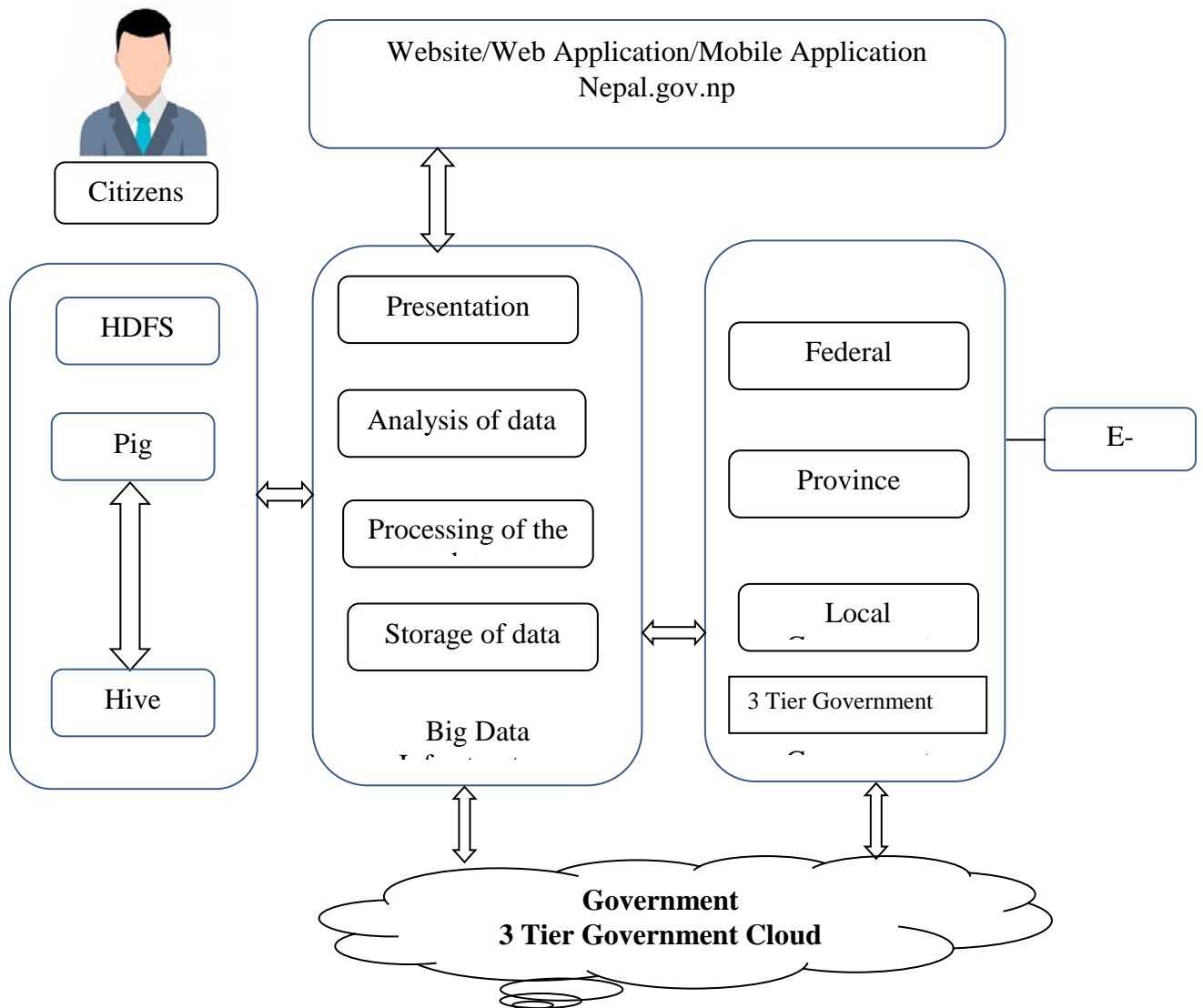


Fig: Architecture of E-government Nepal

According to (Navdeep, Arora, & Sharma, 2016) as the authors illustrated in their Conceptual Model of big data analysis briefly describes the data which is residing in different formats from different sources and different locations is transformed using different big data analytics tools and platforms. Here, various decisions are made regarding the data approach, distributed design, tool selection and analytics models. Finally, four applications of data analytics i.e. queries, reports, OLAP and data mining are generated. The authors has concluded that Big data analytics has the ability to change the landscape of e-



Governance projects such as how data is generated, maintained, analyzed and used for taking future decisions based on the results produced. So, the use of Big data analytics techniques should be encouraged as they can prove to be helpful in further improvement, better planning and decision making of e-Government projects.

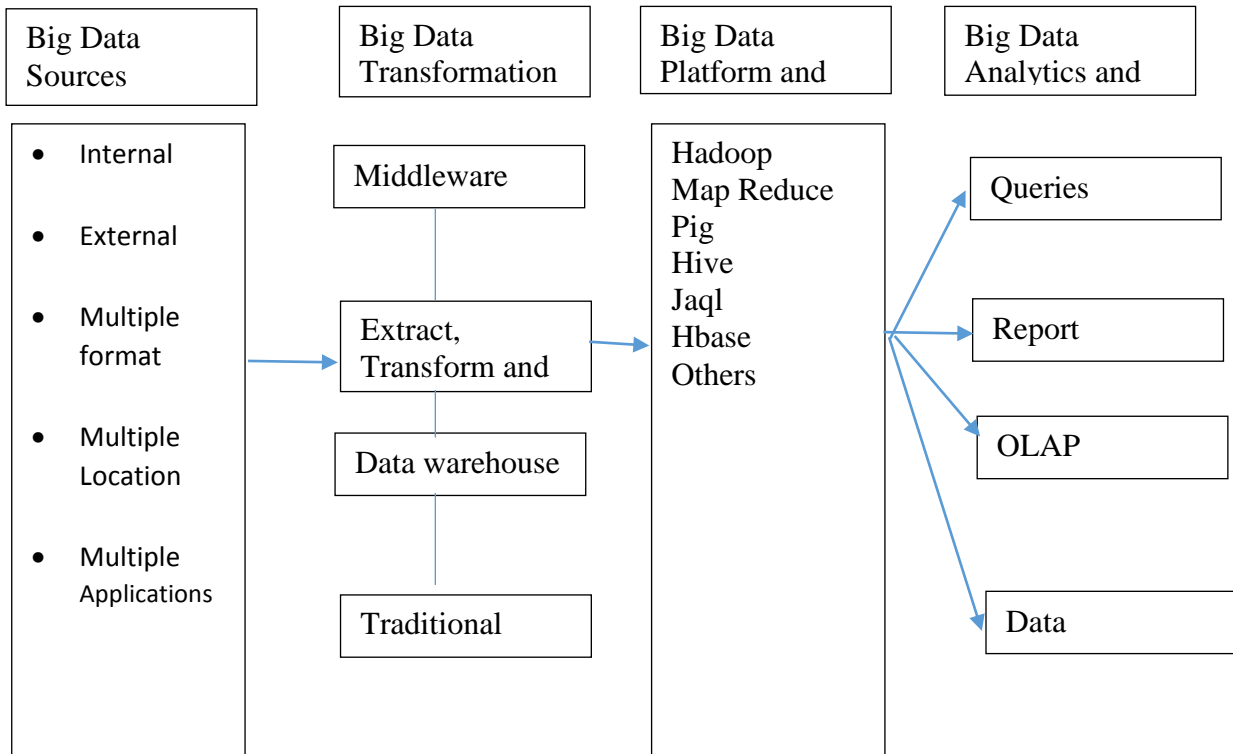


Fig: Conceptual Framework of Big Data Analytics adopted by (Navdeep, Arora, & Sharma, 2016)

**Big data in Nepalese context**

With the rapid development of the Internet ecosystem and industry, such as Augment reality, Virtual reality, big data, cloud computing and Internet of things, data has shown an explosive growth trend. People are being surrounded by the massive data. The era of big data has come. Big data brings opportunities to e-government innovation, but also brings great challenges to traditional public management methods. In the face of opportunities and challenges, how to release the value of government data and contribute to social development; how to complete the combination of big data and new technologies, create more new specialties and fields; how to transform the challenge of big data into great development opportunities through the national strategy, thus winning the competitiveness of the commanding heights of science and technology, The question we have to think about. Seize the opportunity and face the problem, we can further promote the transformation and development of e-government development mode and implementation path in the new era and new conditions.

The most of the developed countries are getting benefited utilization of big data in decision making, GoN has not explored importance of big data for improvement of public service delivery with the adoption of this technology. The big data one of the most developed technologies, which is not well known among top leaders and decision makers of GoN and even bureaucracy. Reuse of data is for non-repeated and reliable data collection.

### Data Creator and facilitator in Nepal

Table 1: Government data Owner and providers

Sn	Name of Organization	URL	Types of Service	Remarks
1.	University Grant Commission, Bhaktapur	<a href="https://www.ugcnepal.edu.np/">https://www.ugcnepal.edu.np/</a>	Higher Education	All URLs are accessed on 24th December 2023.
2.	Nepal Telecommunication Authority, Kamaladi	<a href="https://nta.gov.np/">https://nta.gov.np/</a>	Regulatory organization for Telecom and ISP	
3.	Nepal Rastra Bank, Baluwatar	<a href="https://www.nrb.org.np/">https://www.nrb.org.np/</a>	Regulatory organization for Banking and Financial Institutions	
4.	National Personnel Record (Civil/Teacher/Polic)	<a href="https://nijamati.pis.gov.np/">https://nijamati.pis.gov.np/</a> <a href="https://teacher.pis.gov.np/">https://teacher.pis.gov.np/</a> <a href="https://police.pis.gov.np/">https://police.pis.gov.np/</a>	Manage and maintain the details of civil employee of Nepal	
5.	Nepal Electricity Authority, Ratnapark	<a href="https://nea.org.np/">https://nea.org.np/</a>	Regulatory organization for Power production and distribution	
6.	Teacher Service Commission, Bhaktapur	<a href="https://tsc.gov.np/">https://tsc.gov.np/</a>	Service commission organization for Teacher	
7.	Nepal Health Research Council	<a href="https://nhrc.gov.np/">https://nhrc.gov.np/</a>	A Research institution on health sector	
8.	Nepal Agriculture Research Council	<a href="https://narcnepal.org/welcome">https://narcnepal.org/welcome</a>	A Research institution on Agriculture	
9.	National Examination Borad, Bhaktapur	<a href="http://www.neb.gov.np/">http://www.neb.gov.np/</a>	Examination Management	
10.	Department of Land management and archive, Babarmahal	<a href="https://dolma.gov.np/">https://dolma.gov.np/</a>	undertakes Land Reform, Land Administration and Management	
11.	Civil Aviation Authority Nepal, Babarmahal	<a href="https://caanepal.gov.np/">https://caanepal.gov.np/</a>	Regulatory organization for civil aviation	
12.	Department of Labour and occupational	<a href="https://dol.gov.np/en">https://dol.gov.np/en</a>	Maintaining the implementation of the	

	Safety, Kathmandu		law, provision and policy related to the labour
13.	Department of National Id and Vital Registration, Singhdurbar	<a href="https://dol.gov.np/en">https://dol.gov.np/en</a>	Manage the ID and Vital Event
14.	Department of Passport, Tripureshwor	<a href="https://nepalpassport.gov.np/">https://nepalpassport.gov.np/</a>	Issues Passport and travel Document on the behalf of GoN
15.	National Statistics Office Thapathali	<a href="https://nsonepal.gov.np/">https://nsonepal.gov.np/</a>	Central agency for the collection, consolidation, processing, analysis, publication and dissemination of data.

### List of Private data Solution Provider Organization in Nepal

Table 2: Private organization

Sn	Name of Business	URL	Types of Service	Remarks
1.	Nepal in Data	<a href="https://nepalindata.com/">https://nepalindata.com/</a>	Dissemination of data	
2.	Graph Nepal	<a href="https://graphnepal.com/">https://graphnepal.com/</a>	Nepal's first infographics blog	
3.	Db2map for Development	<a href="http://www.db2map.com/">http://www.db2map.com/</a>	Manage the heterogenous data into single platform	
4.	Kathmandu Living labs	<a href="https://kathmandulivinglabs.org/">https://kathmandulivinglabs.org/</a>	Data and Technology solution provider	
5.	Open Data	<a href="https://opennepal.net/">https://opennepal.net/</a>	Open data portal for data analysis	
6.	Fusemachines Nepal, Baneshwor	<a href="https://www.fusemachines.com/">https://www.fusemachines.com/</a>	Enterprise AI Transformation	
7.	Grow By Data Pvt. Ltd.	<a href="https://growbydata.com/">https://growbydata.com/</a>	Data Analysis	

### Implementation of Bigdata in e-Government

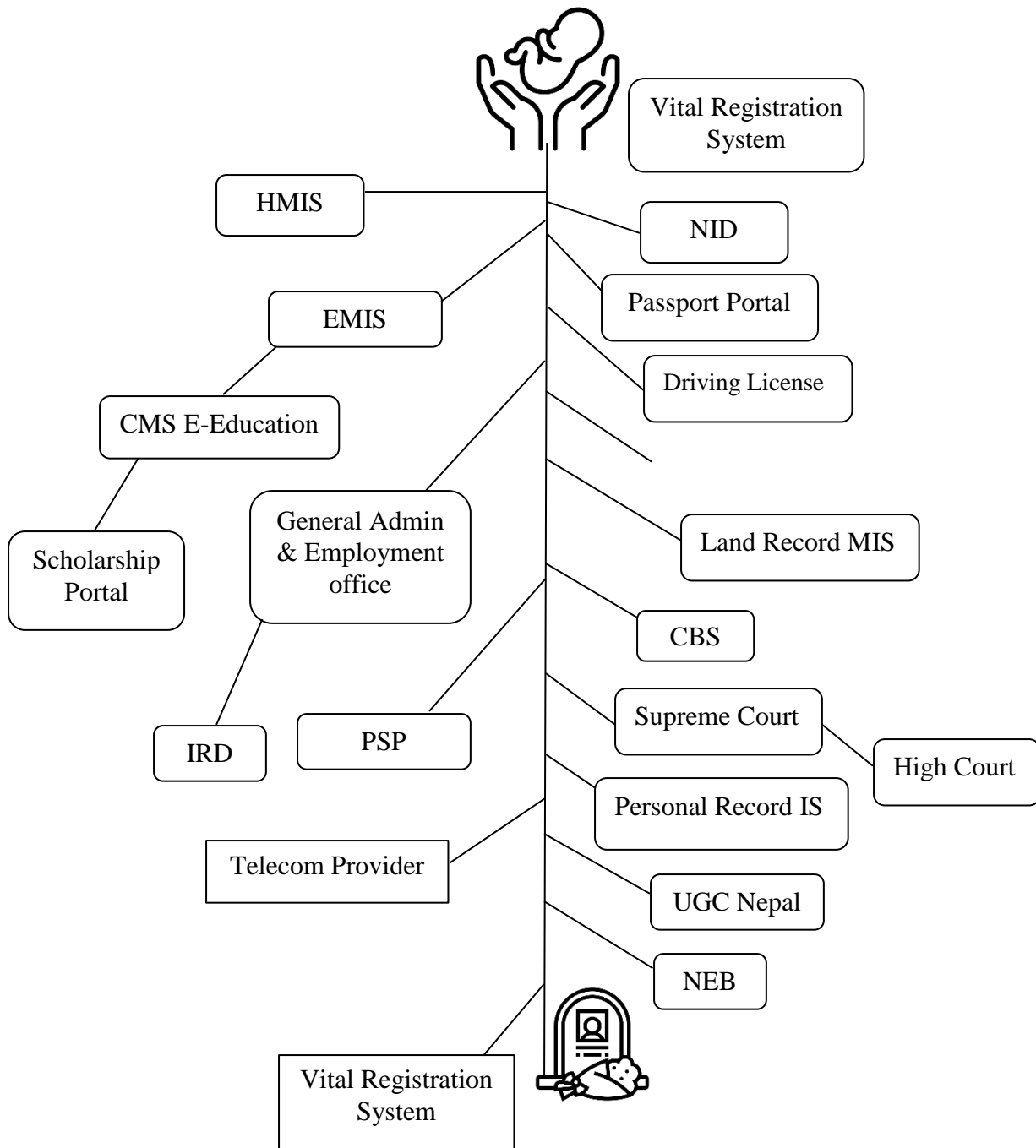


Fig E-government Service

Let's see, how big data can be implemented in e-governance, With the aim to deliver maximum government services to citizens, the government and its various department must digitally transform themselves from an intradepartmental to interdepartmental perspectives. This requires active engagement of multi-stakeholders such as Ministries, departments, private sectors and most importantly the citizens.

Almost every department faces many challenges among them one is working in siloes which gradually leans to multiplicity of processes and across various department, different department affiliate on various disparate and disjointed technology system leads potential data integrity and data consistency concerns. While not recommending severe should be upgrade to establish Information System (IT) part processes in various government process functions, this will be certainly significant to aggregate multiple digital identities accorded to citizen in each department thereby making cross referencing easier.

Let me take an example, how does a big data in a network eases the life of citizen right up to his birth? The hospital generates and issues the birth certificate and a digital identifier is created the citizen. This established the medical history for the citizen, subsequently the department of vital registration also updates the birth certificate id against same digital identifier.

As the citizen, proceed to complete his or her school level education and university education, graduate from university, all the academic including other professional document records are updated on the network, and academic repository updated and maintained.

When the citizen applies for the job in public service commission, or any organization, it allows an employer to validate his academic qualification through the network, the employer updates the citizen employment details as well as mask the salary account details on the network, this creates the professional listing for the citizen, then the citizen goes onto a bill for medical insurance provided by the employer and avails a loan from a bank and respective stakeholder updates all necessary medical records and investment details on the network and cycle goes on.

### **Challenges to implement big data**

The effectiveness of big data analytic techniques in e-governance projects has been demonstrated, yet there are still challenges or deficiencies that need to be addressed for their successful implementation in e-governance. These include:

**Data security:** Storing e-governance project datasets on remote servers can expose them to intentional or unintentional security threats.

**Lack of skilled personnel:** There is a shortage of trained professionals capable of fully utilizing big data analytics to uncover hidden patterns and insights.

**Reliability of information:** The accuracy and reliability of reports generated from big data analytics depend on the competence and integrity of the individuals generating them.

**Privacy concerns:** Big data analytics often require processing citizens' personal information such as UIDs, bank details, health records, and purchasing data. If this information is mishandled, it poses a threat to privacy.

**Ethical considerations:** Citizens may not be aware that their personal data is being collected and analyzed for future use, raising concerns about the ethical use of power to access sensitive information.

### **Observation and Recommendation**

Big data is the one of the emerging technologies among the technologies of fourth industrial revolution. Big data and its application in e-Government can bring a lot of opportunity to achieve the good governance in the developing country like Nepal. The challenging factors mentioned in the research study must be addressed by the concerned government bodies and stakeholders. Good governance can restore trust of citizens in governments and make governments accountable to them based on the big data analysis. The three-tier government requires to make effort in implementing the policies.

The attitude of the government administration must be forced to be changed by first training the bureaucrats and their concerned IT departments. Nepal's Strategic Development Goal (SDG) documentation must outline the big data compulsion projects. Training must be added in local administration and technical institutes. Consultant hiring from reputed global organization can play a key role in turning the traditional working scenario. National fiscal year budget reading must include the major projects. Trust of the users must be gained by announcing and prioritizing the projects. Data utilization program and open data sharing policies must be studied and put into the SDG outlines. The Open Governmental Data (OGD) platforms must be immediately opened with 'https://data.gov.np' and encouraged for reuse. Integration and collaboration must be clearly guided at least within the inter department administrations.

A civil society endeavor aims to ensure ongoing accessibility of Nepal's data online through a portal. This platform enables individuals to freely publish, discover, retrieve, and utilize data for creating their own visual representations, applications, and services without limitations.

Entertainment and Telecom industries are the gold mine of data. The regulatory body such as Information dept and NTA must make guidelines for sharing of telecommunication data and/or public and private data sharing policy.

Big data is transforming the way governments are using data and information to gain insights and make informed decisions. As it becomes more mainstream, big data analytics can change the landscape of e-Governance projects.

Utilizing big data analytics in e-governance initiatives yields significant advantages, including enhanced online information and service provision for business analytics, fostering transparency in operations, monitoring and visualizing performance metrics,

predicting citizen needs, deriving valuable intelligence for novel projects, and refining existing services to offer improved citizen experiences.

### **Bibliography**

- Holm, S., & Ploug, T. (2017). Big Data and Health Research-The Governance Challenges in a Mixed Data Economy. *Journal of Bioethical Inquiry*.
- Long, C., Agrawal, R., Trung, H., & Pham, H. (2021). A big data framework for E-Government in Industry 4.0. *Open Computer Science*.
- Wright, N. H. (2018). Tracking Corporate Stewardship of Environmental Services-Opportunities of Big Data Applications and Long Term Value. *SPEHSE*.
- Hammer, C. L., Kostroch, D. C., & Quirós, G. (2017). *Big Data: Potential, Challenges, and Statistical Implications*. IMF.
- IDC. (2022, 10 20).
- Kim, G. H., Trimi, S., & Chung, J. H. (2014). Big Data Application in the Gvoernment Sector. *Communication of the ACM*, 78-85.
- Navdeep, P., Arora, D., & Sharma, D. (2016). Role of Big Data Analytics in Analyzing e-Governance Projects. *GIAN JYOTI E-JOURNAL*.
- Patel, B., Roy, S., Bhattacharyya, D., & Kim, T.-H. (2017). Necessity of Big Data and Analytics for Good e-governance. *International Journal of Grid and Distributed Computing*, 11-20.
- Stephenson, D. (2022, 11 09). *Blog*. Retrieved from Touchpoint by Firmex: <https://www.firmex.com/resources/blog/7-big-data-techniques-that-create-business-value/>
- Tseng, F. H., Hsueh, J. H., Tseng, C. W., Yang, Y. T., & Chao, H. C. (2018). Congestion Prediction With Big Data for Real-Time Highway Traffic. *IEEE Access*.