

e-Government and Big data analysis

E-GOVERNMENT ADOPTION AND FRAMEWORK FOR BIG DATA ANALYTICS IN NIGERIA

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ABSTRACT

The continuous advances in today's digital universe and integration of computing into virtually every facet of human life are no doubt making the concept of Big Data a ubiquitous paradigm for deploying novel technologies/applications hitherto not practicable by conventional methods. Big Data, a general term for the massive amount of digital data being generated from different sources, extremely large, structured/unstructured too complex for analysis through conventional relational database techniques. It is estimated that 2.5 quintillion bytes of data is added each day of which approximately 90% is unstructured. This Big Data offers new opportunities for discovery, value creation, and rich business intelligence for decision support in any organization. Nigeria as a country is steadily moving towards digitizing some of the government departments, scheme and services in Federal, State and Local government levels. Due to increase in digital literacy of the people and availability of data intensive network access that is emerging, the need for use of E-governance applications is on the increase. Interestingly, gathering and processing of vast amounts of data is not new to humanity. What is new is the speed at which one can process a complex data and extracting actionable business intelligence or big insight from data. Volume, Variety and Velocity are characteristics nature of big data that need careful choice of relevant technology and framework to handle. Big Data is therefore redefining the landscape of data management, from extract, transform, and load, or ETL processes to new technologies (such as Hadoop) for cleansing and organizing unstructured data in Big-Data applications, bringing up challenges of complexity, security, and risks as well as a need for new technology skills for analytics. In this paper, the model that illustrates how analytics of Big Data can result in the transformation of the government by increased efficiency and effectiveness in the e-governance service with citizen engagement in decision-making will be discussed.

Keywords: Big Data; Ubiquitous Paradigm; Novel Technologies; Applications; e-governance.

INTRODUCTION

A great challenge for government of developing nation is to figure out how best to make use of the opportunities offered by Information and Communication Technologies (ICT) to offer good services to its citizenry and, ultimately, improves the human development conditions for its people. Governments worldwide are integrating computer-based technologies into the centerfold of public administrative reforms to digitize the delivery of services and the process of governance. Under the right conditions, ICTs offer government an effective resource to serve citizens and other stakeholders through electronic-government (“e-Government”) strategies in very exciting and wonderful ways.

For a long time countries across the globe tried to use ICT in governance in various ways in an effort to achieve the development goals and also offer a transparent and accountable government functions, convenient and faster access to government services, improved democracy, lower costs of administrative services and ultimately improved the living conditions of their citizens.

Electronic government (e-Government), digital government and electronic governance (e- Governance) are three terms widely used to represent the use of Information and Communication Technologies in public sector organizations.

The goals of e-Government vary considerably among governments worldwide. Rightfully, the goals and success of e-Government are determined locally based on the political leadership of each government. However, key institutional stakeholders influence these goals among many countries. World Summit on the Information Society (WSIS) 2005 Plan of Action recommends for governments to “Develop national e- Government initiatives and services, at all levels, adapted to the needs of citizens and business, to achieve a more efficient allocation of resources and public goods” (united nation, 2005).

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Through e-Government, governments expect to improve the quality of services and reduce the costs of delivering services through utilization of scarce resources, encourage citizen participation, enhance accountability and transparency, expand the role of markets, and restore citizen trust and faith in government. Essence of this plan of action is to re-orient governments to treat citizens as customers of government services and improve the day-to-day management of financial and budgetary systems.

E-GOVERNMENT IMPLEMENTATION IN NIGERIA

Nigeria as a nation has strived to make use of ICT to improve governance process at different level. It can be said that there is a relative success been recorded in the country's quest to adopt and implement e-Government process. However the little success recorded by the country through these electronic and e-government projects has not been visible due to the fact that there is no national framework that will guide development of e-government projects and integrate them at various level of development. As we speak most of the e-government services are operating in silos and many with poor visibility. This has definitely hindered the growth of the services in all sectors.

National Information Technology Development Agency (NITDA) has developed a national e-Government framework in 2010. The e-Government Framework for Nigeria is the most recent and comprehensive plan for Nigerian e- Government systems and their supporting infrastructure. It is considered a baseline and that a solid e-Government platform is a necessary delivery mode for the fast tracked economic transformation aimed at in vision 20-2020. In line with the National Vision, the vision for the e-Government development in Nigeria was also set to achieve the top 20 ranks in the UN e-Government Survey by the year 2020.

The e-Government framework architecture was designed in three tier layers, which incorporates the end users with the providers within the environmental factors to ensure the scheme's success. These three tiers consist of the

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service subscribers (the users); the service providers (the supplier); and the service support enablers (the environment).

The tier 1 framework consists of the design and development of a super secure e-Government portal; “the enforcement of a directive that all federal, state and local government services be made progressively available on the e-Government portal between 2011 and 2015; and the assigning of Verifiable Digital Identity to citizens” (NITDA, 2010). This approach is to help create a consumer centric market place.

The tier 2 framework provides the architecture for integration of all services across all platforms through clearly defined interoperability policies; security standards and policies; connectivity policies; centralized data exchange infrastructure; and back-end service policies. This approach is to spur specialized and unified services to ensure system consolidation and integration of key and common services such as client common interface, Network security, transaction gateways and the data exchange infrastructure.

The tier3 framework provides the legal and leadership framework for actualization of the e- Government dream. “ On the legal front, the tier 3 framework suggest that a law called the Nigerian e- Government law should be promulgated to articulate the definition of e-governance in the Nigerian context along with its objectives and role; coordination and oversight mechanisms, support structures at various levels, their functions and responsibilities; roles, functions and responsibilities of government organizations at various levels; mechanism for financial arrangements including public- private partnerships; specifying the requirements of a strategic control framework for e-Government projects dealing with statutory and sovereign functions of the government; responsibility for selection and adoption of standards and inter-operability framework; and a framework for digital security and data protection “ (NITDA, 2010).

Successful implementation of any e-government application requires effective integration of process, technology,

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data and budget, in which technology and data plays major role.

NIGERIA'S E-GOVERNMENT RANKING – UN E-GOVERNMENT SURVEY 2014

The Department of Economic and Social Affairs of the United Nation produces the United Nations E-Government Survey every two years. It is the only report in the world that assesses the e-government development status of the 193 United Nations Member States. The aim of the survey is to serves as a tool for decision-makers to identify their areas of strength and challenges in e-government and to guide e-government policies and strategies.

The theme of the 2014 edition of the *United Nations E-Government Survey*—“E- Government for the Future We Want” (United Nation, 2014)—is particularly relevant to addressing the multi-faceted and complex challenges that we face today.

SURVEY METHODOLOGY

Since its inception in 2003, the conceptual framework of the United Nations E- Government Survey has adopted a holistic view of e-government development resting on three important dimensions:

- (i) The availability of online services,
- (ii) Telecommunication infrastructure and
- (iii) Human capacity.

The methodological framework has remained consistent across survey periods while carefully updating its components to reflect evolving successful e-government strategies, pioneering practices and innovative approaches to tackling common challenges for sustainable development. The conceptual framework is based on the following guiding principles.

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First, e-government in this Survey is considered to be the means to an end, the end being development for all. It is considered to be a powerful tool at the disposal of governments, which, if applied effectively, can contribute substantially to eradicating extreme poverty, protecting the environment and promoting social inclusion and economic opportunity for all. It is intended to support the development efforts of United Nations Member States.

Second, the Survey and its results must be placed in the context of the overall pattern and level of development of each country concerned. It is vital that the assessment of the on-line presence of governments highlighted by the Survey does not provide a distorted picture of the progress made—and challenges faced—by Member States. At the same time, it is equally important to underscore the promise of e-government. Therefore, main measurements in this Survey are based on e-government readiness, which duly takes into account not only countries' specific e-government initiatives, as evidenced by web presence, but also their infrastructure and human resource endowments.

Third, the focus of the Survey is on provision of socio-economic and environmental services to the population through the use of e-government as a programmatic tool, as well as on participation and social inclusion.

Finally, the Survey assesses e-government readiness worldwide, taking the view that the ultimate objective remains the “inclusion of all” in development.

Table 1. ES1 World and Regional e-government leaders (United Nation, 2014).

World e-Government Leaders	Regional e-Government Leaders	
Republic of Korea	AFRICA	Tunisia
Australia		Mauritius
Singapore	AMERICAS	United State of Americas
France		Canada
Netherlands	ASIA	Republic of Korea
Japan		Singapore
United State of America	EUROPE	France
United Kingdom		Netherlands
New Zealand	OCEANIA	Australia
Finland		New Zealand

Table 2. ES1 World and Regional e-participation leaders (United Nation, 2014).

World e-Participation Leaders	Regional e-Participation Leaders	
Netherlands	AFRICA	Morocco
Republic of Korea		Kenya
Uruguay	AMERICAS	Uruguay
France		Chile
Japan	ASIA	Republic of Korea

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United Kingdom	EUROPE	Japan
Australia		Netherlands
Chile	OCEANIA	France
United State of America		Australia
Singapore		New Zealand

Table 3: Top 20 countries in Africa (United Nation, 2014).

Country	Level of Income	EGDI	2014 Rank	2012 Rank	Change in Rank
HIGH EGDI					
Tunisia	Upper Middle	0.5390	75	103	↑28
Mauritius	Upper Middle	0.5338	76	93	↑17
Egypt	Lower Middle	0.5129	80	107	↑ 27
Seychelles	Upper Middle	0.5113	81	84	↑ 3
Morocco	Lower Middle	0.5060	82	120	↑38
MIDDLE EGDI					
South Africa	Upper Middle	0.4869	93	101	□↑□8
Botswana	Upper Middle	0.4198	112	121	□↑9
Namibia	Upper Middle	0.3880	117	123	□↑6
Kenya	Low	0.3805	119	119	-
Libya	Upper Middle	0.3753	121	191	□↑70
Ghana	Lower Middle	0.3735	123	145	□↑22
Rwanda	Low	0.3589	125	140	□↑15

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Zimbabwe	Low	0.3585	126	133	□↑7
Cape Verde	Lower Middle	0.3551	127	118	□↓9
Gabon	Upper Middle	0.3294	131	129	□↓2
Algeria	Upper Middle	0.3106	136	132	□↓4
Swaziland	Lower Middle	0.3056	138	144	□↑6
Angola	Upper Middle	0.2970	140	142	□↑2
Nigeria	Lower Middle	0.2929	141	162	□↑21
Cameroon	Lower Middle	0.2782	144	147	↑3
Regional Average		0.2661			
World Average		0.4712			

Impact of the three Components of e-Government development Index 2014 in Nigeria as curled from UN e-government survey 2014 report is shown in table 4 below.

- i Online Service Index 2014 and Its Components
- ii Telecommunication Infrastructure Index and Its Components
- iii. Human Capital Index and It's Components

Table 4: E- Government Development Index by region- Africa (United Nation, 2014).

Rank	Country	Sub-Region	EGDI	Online Service Component	Telecommunication Infrastructure Component	Human Capital Component
136	Algeria	Northern Africa	0.3106	0.0787	0.1989	0.6543

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140	Angola	Middle Africa	0.2970	0.2992	0.0978	0.4941
180	Benin	Western Africa	0.1685	0.1102	0.1196	0.2756
112	Botswana	Southern Africa	0.4198	0.3071	0.2969	0.6555
117	Namibia	Southern Africa	0.3880	0.3228	0.2719	0.5693
191	Niger	Western Africa	0.0946	0.1260	0.0385	0.1192
141	Nigeria	Western Africa	0.2929	0.3071	0.1905	0.3811

Nigeria has recorded success in its e-government drive as it move up from 162 to 141 positions in the African continent. The EGDI rating is 0.2929 as against 0.2676 in 2012. The figure is slightly above the regional average with 0.0268 points. There is increase in online participation compared to 0.2222 index of 2012 survey. This can be attributed to the increase of web presence by MDAs after directives by Federal Ministry of Communication to all MDAs through the National Council of ICT heads in MDAs, Mandating all MDAs to comply before 2015 dead line. Telecommunication infrastructure also improved to 0.1905 from the index figure of 0.1270 in 2012. The National Broad Band policy launched in 2013 and establishment of National Broad Band Implementation committee has really busted the Internet penetration drive. In spite of the growth, there is still much to be done as currently we are second to the last (Cameroun) in the top 20 in Africa.

WHAT IS BIG DATA.

There are many definitions of Big Data, but the widely accepted definition is that by Gartner (2013) who define Big Data as “...high-*volume*, high *velocity* and/or high *variety* information assets that demand cost-effective innovative forms of information processing for enhanced insight, decision making and process optimization”.

The continuous growth of the technology and the internet in today’s digital universe and integration of computing into virtually every facet of human life are no doubt making the concept of Big Data a ubiquitous paradigm for deploying novel technologies/applications hitherto not practicable by conventional methods. The unending trend in the quest to conquer the challenges posed by management and control of the Big Data revolution is currently leading the entire ICT community to a plethora of systems. New activities spring up, more and more data sets are being created, faster than ever before. And these new sets, in some cases, hold the key to unlock new streams of activities that will make both the government and the public have better understanding of business that will make it more efficient and effective.

CHARACTERISTICS OF BIG DATA.

Phillip Russom (2011, 4th Edition) provided a similar definition to Gartner’s idea with emphasis on volume, variety and velocity, but with further insight on each of the 3V’s. The summary of Philip Russom’s definition is as shown in the diagram below

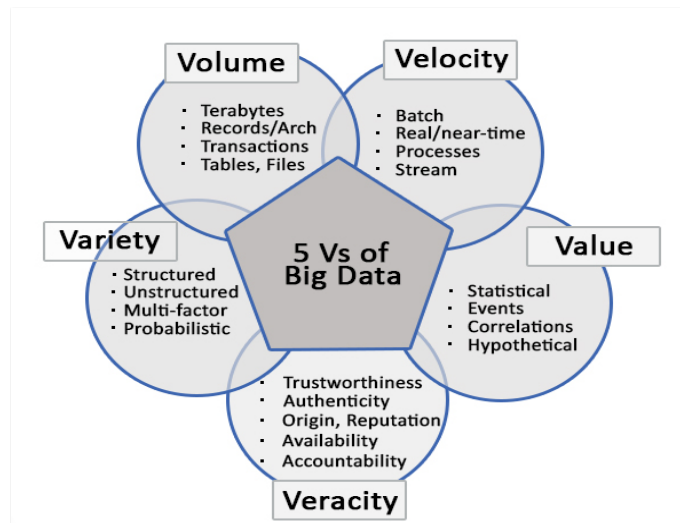


Figure 1: Summary of Big Data characteristics.

Typically, big data is categorized based on three characteristics:

- **Volume:** How much data
- **Velocity:** How fast data is processed
- **Variety:** The various types of data

This is a convenient and simple categorization especially on a relatively small amount of very disparate, complex data or even a huge volume of very simple data that can be structured or unstructured.

Structured data is straightforward to analyze. Unstructured data is different than structured data in that its structure is unpredictable. Data from e-mails, blogs, digital images, videos, social media and satellite imagery are

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unstructured in nature. This type of data accounts for the majority sources of data in both private and public domain.

Another Vs that are of important is the fourth V, *veracity* and the fifth V *value*. How accurate is that data in predicting business value? Do the results of a big data analysis actually make sense? Data must be able to be verified based on both accuracy and context. For example, an innovative business may want to be able to analyze massive amounts of data in real time to quickly assess the value of that customer and the potential to provide additional offers to that customer. It is necessary to identify the right amount and types of data that can be analyzed in real time to impact business outcomes.

BIG DATA IN NIGERIA

In Nigeria, with about 170 million population, the challenges of data collection and mining is surely a challenge particularly with various organs of government that are involved in the management and usage of data for different purposes. Some of the agencies that are mandated to collect and manage data in Nigeria include:

- i. National Bureau of Statistic (NBS) with the official mandate for production of national official Statistics;
- ii. Federal Road Safety Commission (FRSC) for drivers' license and vehicle number plates;
- iii. National Identify Management Commission (NIMC) for national identity database
- iv. National Population Commission in charge of national demographic data.
- v. Independent National Electoral Commission (INEC) for voters registration exercise.
- vi. Other organizations including the banks in the financial sector and Telecommunication companies in the telecommunication sector.

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Most of these data collected by these organizations are structured in nature and very suitable for current e-governance services. The collected data is used only for statistical purpose and not solving any mission critical challenge that can improve the quality of the government service or schemes.

This huge amount of data should be recognized as a national asset. The amount of data is expected to grow as new technologies are adopted and an increasing amount of both structured and unstructured data become available from outside government. The application of Big Data analytics to this growing resource can increase the value of this asset to government and the people. There is the need to have national ICT strategy that will identify the need to have framework for Big Data analytics so as to further develop government capability in Big Data.

Simple example of where Big Data is used in Nigeria is in the telecommunication sector. Prior to SIM registration exercise, customers were usually segmented based on amount of money they spent on the network. To a greater extent, major use of these data generated by the telecommunication companies are in customer classification mainly for network expansion, planning for promotion or even marketing. But as soon as government directives was passed on mandating all the telecommunication service providers to carry out SIM registration of their customers, most (if not all) Telecommunication companies migrated their Customer Relationship Management (CRM) systems to one with Big Data analysis integrated. Why? ... The answer is to give them better understanding of their customers and plan for efficient service delivery. Another example is in the Bank Verification Number exercise recently by the banking sector. This is another source of huge amount of structured data that can be used for so many planning and policy formation.

A critical component of decision-making process is information derived from aggregation of data from various sources. The exponential growth and availability of structured and unstructured data is what makes Big Data important. Depending on the purpose and volume of data, various strategies are being deployed in the management and usage of data for policy and planning purposes in organizations in both public and private settings.

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Big data analytics can be used to streamline service delivery, create opportunities for innovation, and identify new service and policy approaches as well as support the effective delivery of existing programs across a broad range of government operations - from the maintenance of our national infrastructure, through the enhanced delivery of health services, to reduced response times for emergency personnel and to national planning for economic growth and development. The uses cannot be over emphasized.

In a country like Nigeria with a population of 170 Million, the number of users expected to be utilizing e-governance application and services is assumed to be huge. Effective management and analysis of large-scale data should pose an interesting but critical challenge to Nigerian government. A democratic country like Nigeria public participation as willingness on part of government to share information and make citizens a partner in decision-making process and in governance is very important. With proper Big Data analytics, government can offer easy access to diverse and large quantities of data to its citizens.

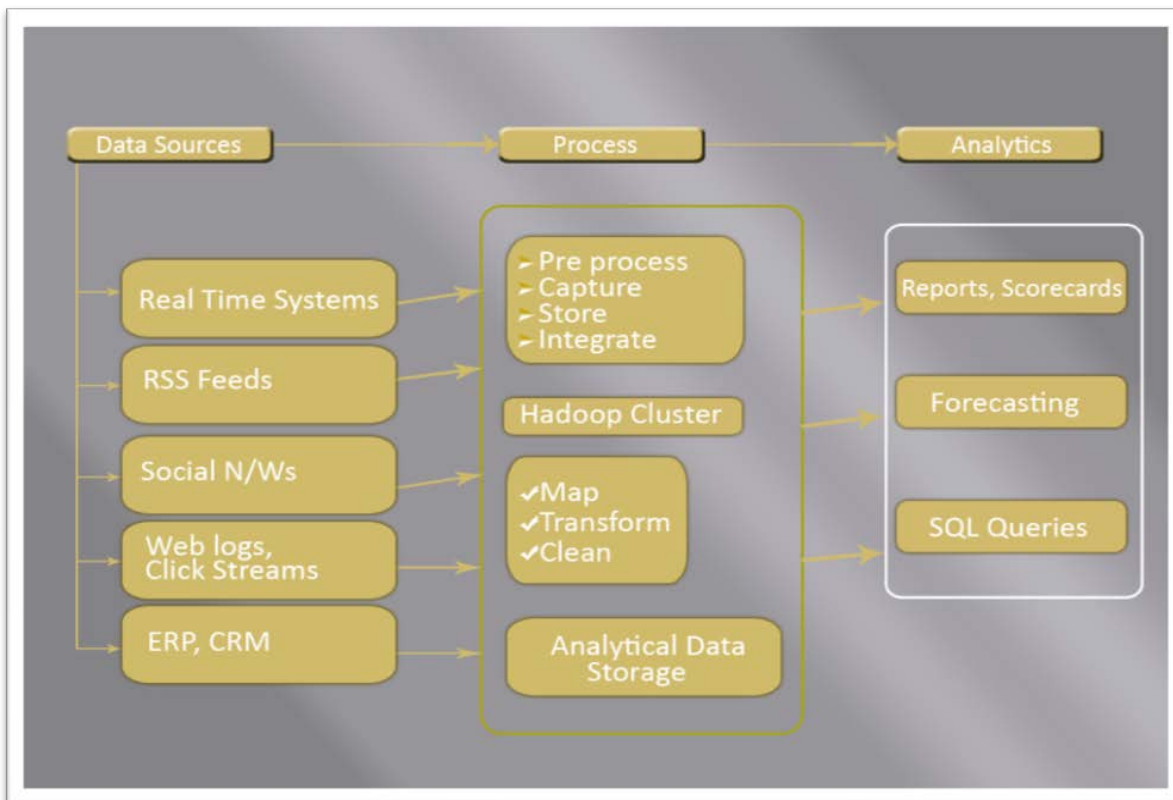


Figure 3: Big Data analytics process.

CHARACTERISTICS OF TRADITIONAL VS BIG DATA ANALYTICS.

Table 5: Characteristics Of Traditional Versus Big Data Analytics.

Traditional e-government	Big Data - good government
Only structured data	Raw, unstructured and semi- structured data.
Statistical analytics with known condition	Discovery of unexplored business questions.
Tera-bytes of data	Large and messy data
Traditional analytics is batch oriented and one need to wait transformation jobs to complete before the required insight is obtained.	Big Data Analytics is aimed at near real time analysis of the data using the support of relevant software meant for it.
Text analytics.	Graph, audio and video analytics.

Traditional analytics based on the relation data model. Analytics based on the known relationship.	Very difficult to establish relationship between all the information in a formal way, and hence unstructured data in the form of images, videos, Mobile generated information, RFID etc... have to be considered in big data analytics.
Ad-hoc query report, high latency for large volume of data.	Low latency, interactive, Visualization, decision-making and analytics reports
Type of operation: relational and conditional.	Analytics : Sentimental, predictive, behavioral. Machine Learning etc.

Benefits of government data with Big Data analytics are safer communities, smarter decisions, better-served citizens, improved fiscal performance greater innovation and citizen engagement, which is important in a democratic country like Nigeria.

FRAMEWORK FOR BIG DATA ANALYTICS

The Big Data analytics framework is a plan for a Big Data analysis systems and their supporting infrastructure, which maximizes the ability of a business to achieve organizational objectives. Good Big Data analytic framework should be able to support a range of technology with Big Data analysis capability and requirements such as availability, scalability, and high performance. Some important considerations in selecting Big Data application analysis framework include the following:

- i Support for multiple data types;
- ii Handle batch processing and/or real time data streams;
- iii Support NoSQL and other newer forms of accessing data;
- iv Overcome low latency;

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- v Provide cheap storage, and Integrate with cloud deployments.

While all these characteristics are important, the perceived and actual value of creating applications from a framework is quicker time to deployment.

A Big Data framework for government should be able to support the four (4) basic components of -:

- i. Resource management,
- ii. Data organization and management,
- iii. Analytics and discovery,
- iv. Decision support and visualization report.

Below is a typical Big Data analytic framework that can suite any government for Big Data analytics.

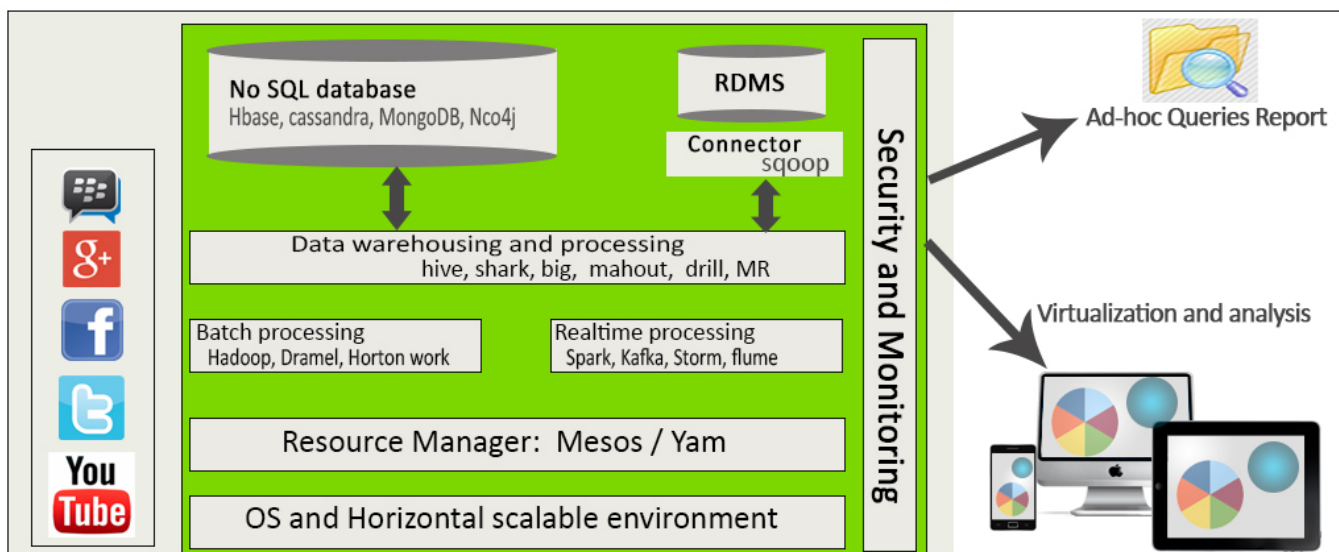


Figure (4) big data analytic framework

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There are various framework developed in different companies with different strength and own problem solving capabilities of certain class of application. In all, what is critical and ultimate for the developers of these frameworks is to stay on top and be in control of fast and reliable data processing capability.

Resource management and scheduling platform - Mesos and Yarn (Apache.org & Hadoop.apache.org), in the diagram above is a typical of resource management component with capability to increase resource utilization of clusters by sharing cluster resources among multiple processing frameworks like Hadoop, Spark, MPI etc. This approach is cost effective with improved in performance and sharing capability. (British Embassy Tokyo)

Data organization and management level in the diagram above is the software that processes and prepares all types of structured and unstructured data for analysis. Typically most data models are either - Relational Database Management System (RDBMS) or NoSQL database management system. RDBMS is optimized for scale and speed in processing huge relational data i.e structured and static data sets. Big Data analytics Stack interact with RDBMS through connector – Sqoop. The Sqoop tool above is designed for efficiently transferring bulk data between Hadoop related system (like HDFS, Hbase and Hive) and RDBMS (like Oracle, MySQL, Postgres, HSQLDB etc..). In the NoSQL database management system, Hbase and Cassandra are for columnar database, MongoDB for document and Neo4j for graph based No-SQL database. This layer is rich in functions and enough to serve all data type (British Embassy Tokyo).

Data Analytics and discovery is part of the framework design to supports offline and online data processing. The level has two layers with applications like Hadoop, Dramel, Horton Works for offline batch processing on one part and application like Spark, Kafka, Storm and Flume for dynamic real-time analysis on the other part. Data mining and streaming and iterative computations are also carried out on this layer.

Decision, support and virtualization layer is the analysis and reporting layer. It contains tools for user-friendly

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representation of information from various sources that can be analyzed and used for decision-making. Report can be visualized in a form normal to end user like the general public for analysis and informed decision making.

A good data analytic framework like the one in the figure (4) above has capability to analyze and explain trends or events that is transform (office, Australian Government Information Management)ative and unique. The framework has the ability to carry out Predictive analysis, Behavioral analysis, Comparative analysis, Fraud analysis, Risk analysis, prediction and forecast and so many things with the information derived from the analyzed data. Some government across the globe using Big Data Analytics includes:- (office, Australian Government Information Management), (Whitehouse) (eight-great-technologies) (British Embassy Tokyo) (Thomas) (Liao) (Dutch flood control).

RECOMMENDATIONS

Nigerian government to effectively explore the huge opportunities in Big Data analytics and run effective (Thomas) e-government the following guidelines are very necessary steps to follow:

- Development of national master plan for e-government.
- Development of a strategic plan to guide e-Government services;
- Understand the needs of all segments of public through popular engagement that will enable citizens to participate in the design of e-Government services;
- Use well established system development practices used by successful e-government nations like Korea.
- Create a learning organization where employees are encouraged to participate in developing and managing e-Government services including Big Data generation, capture and analytic process.

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- Develop effective Big Data governance mechanisms to assign roles and responsibilities for managing and making decisions about e-Government services and Big Data analytics.
- Develop Big Data analytic framework with capabilities for resource management, data organization and management, analytics and discovery, decision support and visualization report, and focusing on building a suitable ICT infrastructure to sustain long- term investments in e-Government, Big Data analytics and human capital development.
- Create enabling environment for Big Data analytics business through a national Big Data analytics framework.
- Provide a secure experience for web visitors by developing secured e-Government services, data security and disaster recovery plan.

CONCLUSION

Countries across the globe are trying to adopt big data technology in various domains like healthcare, crime prevention, agriculture, transportation, education and natural disaster prevention management. Through Big Data analytics, Nigeria can lay solid foundation that can solve the numerous problems militating her much desired and needed progress. Issues of weak economy, un-employment, corruption, insecurity, weak private sector and many more can be tackled securely if we can convert the opportunities offered by Big data analytics by making proper analysis that will guide the leadership to make informed decision, proper economic planning and policy formulation.

Currently most (if not all) serving e-governance applications are in silos. There is no integration of these services through any integrating Enterprise Resource Planning (ERP) platforms like SAP, SAGE, DYNAMIX etc. At

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present most of the government data are in silos in custody of various government institutions with limited or no sharing capabilities. Galaxy Backbone (GBB) that handles government data center is yet to integrate all data into a common platform. The 1-gov.net-project design as a single window for source of information and data for government is still at the stage of mere web presence. Effective e-government programme can only be successful if there is a platform for data integration and applications for ERP system. Developing country like Nigeria having huge population with potential to generate large volume of data, big data analytics can offer the government tools for good planning and better decision-making and provide better service. There is also huge opportunity for revenue generation as organizations can outsource big data analytics service to the government at a cost. The open source Big Data analytics framework above can provide a cost effective solution and aid in effective service implementation. If implemented in our data centers, further resource management and scheduling mechanism can utilize the data center resource efficiently.

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