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A Big Data Adaptability Framework in Developing Democracies, Challenges and Opportunities

ADAM A. Alli[1], KASADHA Juma[2], MUGIGAYI Fahadi[3], WALUSANSA Y. Yahya[4]
[1]*Department of Computer Science, UTC Bushenyi & Islamic University in Uganda, Mbale, 00256, Uganda, Tel: +256 772 498552, Email: adam@iuiu.ac.ug*
[2] *School of Communication, Media and Journalism, Wenzhou-Kean University, Zhejiang Province, China 325060, Tel: +852 5267 1126, Email: jkasadha@kean.edu*
[3]*Department of Computer Science, Islamic University in Uganda, Mbale, 00256, Uganda Tel: +256 700697404, Email: mugigayi.fahadi@iuiu.ac.ug*
[4]*Registry, Uganda Technical College, Bushenyi, 00256, Uganda Tel: +256 772388450, Email: walusansa@gmail.com*

Abstract: As oil and electricity shaped prospects of many developed economies in the previous centuries, the information age is shaped by big data analytics and artificial intelligence-related mechanisms to propel future economies. Big Data analytics provide a bountiful platform of real-time facts derived from data accumulated from the government's information and communications technologies (ICTs). In this paper, we reflect on the opportunities big data creates in re-conceptualizing governance in Africa's developing democracies. Through well-structured systematic literature survey, we explore the applications and adaptability of big data in developing democracies and their structures of governance. We connote that governments are likely to create significant value from structured, semi-structured and unstructured big data that appear naturally because of using respective ICTs governance through a big data lens. This value is in terms of inclusive e-governance, provision of government services among others.

Keywords: Big data, Big data analytics, Emerging ICTs', African democracies, smart country.

1. Introduction

In earlier centuries, metal, oil, and electricity were seen to be the most lucrative resources that augmented many economies to heights, created and revolutionized industries, and uplifted societies' standard of living. In the present and future centuries, data and its related applications shall lead to augmented industrial, business and government revitalisation. This is due to increase in data generated from daily routines of individuals, machines and processes in organisations[1]. For the aforementioned reasons, governments have a) placed regulations to restrain the flow and usage of data, b) levied taxes on companies and users of data, and c) adapted information technologies[2]. Along with the same reasoning, data analytics lie in the middle of refining data into information, knowledge, and wisdom. This phenomena will drive industries, businesses and services in health , education, and, other societal developments[3],[4]. The impact of data-driven economies has started to be felt in the employment world in a way that old jobs that depended on human intervention have been taken over by machines and are shrinking faster in a limited skills set environment[4],[5]. Currently, new kinds of jobs that depend heavily on data and information technologies have appeared. This new marvel must lead change in prospects towards the use of big data analytics and related artificial intelligences by organisations, businesses, and governments. For example, in the developed democracies such as Australia and New Zealand, different state departments; agencies and political parties have taken

advantages of data to redress the deficit in democratic participation and reinvigorate the public sphere in democratic processes[6].

Social media platforms have also played an important role in reshaping the data discussion in developing democracies. These discussions are hinged on how countries can harvest, analyse and make sense of data for socio-economical transformations of the developed and developing democracies. Jungherr at el.[7] in their study points out how former president Trump used twitter to tilt the conventional campaign styles expected of a presidential candidate. However, this increased his public visibility seen through tweets, retweets, likes and mentions. By the end of the 2016 US presidential campaigns the big tweets earned Mr Trump an unprecedented victory[8]. Similarly, in Uganda today, General Muhoozi Kainerugaba, the first son has used twitter to air out controversial ideas in bid to increase his popularity among the general Populus[9]. Kasadha at el. [10] in their study observed that African economies other than taxing social media use, would benefit greatly from untapped and ill analysed big data generated from social media and other sources in respective African countries. This confirms that a lot of data is generated by persons in developing democracies but goes unutilized due to lack of an explicit framework.

Africa holds the highest proportion of online engagements [11]–[13]; which creates avenues through which African states especially the East African developing democracies of Burundi, Rwanda, South Sudan, Uganda, Kenya and the United Republic of Tanzania can reshape their systems and structures of governance through the adaptability of big data framework at local government levels. Moreover, for the past half a century, African countries have continued to work towards the realization of a peaceful, prosperous, and integrated continent managed by its citizens as representatives of a dynamic force in the international arena.

Under the African Union (AU) umbrella, African countries adopted the Science, Technology, and Innovation Strategy for Africa (STISA-2024) as a multi-functional tool and enabler for achieving continental and sustainable development goals[14]. Yigitcanlar at el. [15] connotes that for the realization of sustainable development, the quality of society; economy, management and environment should be improved to foster social-cultural, economic and urban development. Moreover, in Gardner report [16] it is observed that the explicit use of information technology to fuel competitiveness and economic transformation in education, science, technology and Innovation (STI) fostered development. Thus, we can deduce that the use of new technologies like big data, Artificial intelligence, cloud computing, crowdsourcing would engineer innovations in agriculture, clean energy, education, health, and governance in African democracies for development.

To date, African governments are drastically changing through their adaptability to technologies leading to crowdsourcing, open business models, digital commerce, cloud service provision, big data analytics as a service, digital wallet and retail payments[16]. Although, the International Telecommunication Union [ITU] 2018 report observed that 4 out of 5 people in 47 Least Developed Countries (LDCs) have no access to ICTs; it indicated that there is clear room for growth with some countries reaching 45%. Further, the ITU 2012 report presages that African sectors have the highest proportion of online engagement[17]. An aspect evidenced in recent study [18]; online engagements have encouraged and enabled African communities in Uganda to engage in different socio-political related activities that support good governance. According to [19] the use of information technologies has resulted in increased political participation of citizens subsequent to holding the government accountable.

Therefore, for Africa to realize sustainable development, the use of emerging technologies necessitates the adaptability of big data to derive valuable business insights from data at different government processes. Processes in core sectors of government are heavily dependent on the amounts of data collected for appropriate decision and

policymaking. For example, good governance calls for healthy citizens who can afford necessities such as food and health care. To provide good health care, the government should ensure that health facilities are well stocked with specialized personnel and medicine. Providing relevant health care and healthcare personnel is dependent on aliments and their prevalence in specified places of the country. To determine the prevalence of ailments, the government requires carefully designed analytics to enable it to make rational decisions, which requires big data analytics. Other examples that require big data analytics in government constitute resource allocation, distribution, and accountability for services. Unless proper analytics are used, the allocation of government resources becomes complex in the events of rapid population growth.

Consequently, the adoption of big data technologies in the various sectors of governance provides key insights pertaining society, particularly in areas of healthcare, municipal planning, tourism, environment, which in turn increase levels of citizen participation in governance-related activities[20]. Developments in information technologies especially in the use of smart devices and Internet of Things generate massive amounts of data [21][22], at the same time fosters new kinds of citizen relationships, connectedness and socialization in the realization of a common goal [18]. Therefore, there is a scholarly need in examining how big data technologies can result in bettering local governance in the least developed economies and democracies. Governments that have adopted ICTs and their related services have gained in terms of effectivities and citizen participations. This framework is a pillar for governments and governors to use insights generated by business processes in governments for proper resources allocations, decision making and trend predictions. From the academic perspective this study provides scholarly platform for academicians to continue investigating issues of local governance and emerging technologies

In this paper, we examine the opportunities that big data technologies will convey to refining local governance in developing democracies. Also, we enlist challenges that come with the adaptability of big data in so doing, we: a) create a new understanding of the benefits of big data analytics, in particular, the opportunities to transform society based on reasonable facts derived from data of any form, b) create a framework upon which data can be gathered, analysed and construed to foster policy and decision-making.

The study was guided by three objectives: i) identify the benefits of big data analytics in transforming the local democracies, ii) analyse the trends, opportunities and challenges related to local governments in East African countries, and lastly iii) create a framework for the adoptability of big data in local governments in East African countries

Thus, the rest of this paper is organized as follows, section 2 provides the methodology of the study. In section 3 an overview of local democracies in East Africa is presented, section 4 presents an overview of the emerging ICT trends in Africa; section 5 discusses the Local governance (LG) big data framework (LgBigD), and lastly section 6 illuminates the discussion, limitations and conclusion of the study.

2. Methodology

Generally, in this study we employ systematic literature review to create an understanding of the benefits of big data analytics in transforming local democracies. We achieved this by analysing the current trends, opportunities, and challenges through soliciting secondary data from reports and web portals of ministries, agencies, and departments. Data from communication commissions, telecommunication companies, bureaus of statistics and standards was used.

The framework presented in this study was constructed by identifying the LG issues that required big data technologies for a technological solution. In addition, we confined the problem to local governments of east African countries to build a model by consulting

relevant literature. There after we translated the model into guideline and principles that used to address the big data adaptability framework in developing democracies.

3. Overview of Local democracies in Africa

Up to 1980, many governments in Africa practised centralized governance in which the Authority to determine and execute measures was left to the central government. Given the diversity of the countries, centralized form of government could not deliver government services effectively to the peripherals of the country. The inefficiency in the delivery of services led to the need for decentralization. Since the early 80's governments started finding means of decentralizing authority, resources, and responsibility to sub-national governments. There is a consensus that many countries south of the Sahara regardless of poverty, wars and fragile democratic institutions have widely adopted decentralization. Countries like Uganda, Rwanda, Tanzania, and Kenya have made progress in implementing local governments that are decentralized.

Adoption of decentralization is thought as a practical way of involving masses in peripheral areas of the country to obtain equitable public services from the government and improve citizen participation in policy choices. In context of the Central government, decentralization is often looked at as a way of offloading the service responsibilities and burden of rolling out unpopular structured adjustment programs that may need heavy administration. In one way or the other, decentralization is popularized as the best means of governance as compared to centralization. In so doing, politicians in East Africa attempted to try decentralization in hope that it yields better citizen engagement and increase their popularity and electability in the next circle of a mandatory election as required by world order.

In Africa, impressive creativity has been exhibited in adopting local governments, for example, all the countries in East Africa are organized in some form of local government [23]–[25]. In Uganda, local governments are body corporate organized in a 5-tier system (Local council (LC), 1, 2, 3, 4, 5). These local governments implement a broad range of policies, which include (a) developing, approving and executing their budgets (b) implementation of their development plans, (c) hiring and managing staff [26]. In Rwanda, the functions of local governments are similar to that of their counterpart Uganda except that LG's in Rwanda are organized in the 4-tier system (District, sector, cells, and villages) whose mission is to promote the well-being of the population through good governance [25]. Local governments in Kenya are motivated by the same principle of good governance except that in Kenya LGs are organized as county governments whose responsibility is to provide government functions and delivers services to urban and non-urban sub-counties[27]. In countries such as Ethiopia, South Africa, and Nigeria, federal governments have been adopted.

Most African governments are taking a toll in appreciating the use of ICT in government undertakings. For example, Kenya has moved to use a biometric system for their electoral processes to prevent questions over the integrity of the voters' register and allegations of fraud and ballot stuffing[28]. Uganda has computerized its citizen information which is a basis for providing national identification card at the same time using the same data for their elections. These technological systems though were characterised by electoral questions, worked considerably well [29]. Rwanda has not only promoted the use of advanced identity database with uneven benefit in managing its government processes but gone further to use ICT in Education, health, and agriculture among other government sectors [30]. Acceptance of the use of ICTs in dimensions of government will result in the accumulation of immense amounts of data in government archives. An abundance of data from different platforms means not only having multiple formats (Audio, pictures, text, video etc.) but also having data that may be structured, semi-

structured, and/or unstructured. Secondly, as users continue to use the systems, usability data continue to surface, these include logs, events, and activities. Plenty of data from government practices at all levels of governance provides fertile grounds for utilizing Big Data analytics to harvest value from data that cannot be otherwise seen when using the existing traditional information system.

On close observation, most of these decentralized governments adopt some kind of hierarchical frameworks and some degree of Information Communication Technology use that allows them to twinkle services and resources to cater for both rural and urban areas in a perceived equitable and fair way. Procedures and activities by local governments in the management of civic affairs in African countries provide opportunities for effectively using Data analytics technologies to improve governance and social service delivery. Though we observe opportunities for adoption of big data in addition to existing e-governance technologies, there exists very little scholarly evidence to this effect. In this study, we elaborate possible opportunities and practices that local governments can utilize to achieve proper governance and service delivery. Based on the above, therefore, we elaborate in the following section the benefits that local government can find in the use of data analytics technologies

3.1 Benefits of big data technologies in local democracies

Big data in this context is a platform for importing, storing, and analysing data to uncover information not previously known. Local democracies in LDC's have the opportunity to use Big Data to unlock the value gained from data and information gathered by the existing local government information systems. Through data transformation, hidden facts, relationships, and indicators can be found. Signals and trends exhibited by the hidden facts can be used to transform the way local democracies provide services to its citizens. In addition, analytics can enable democracies to focus on most valuable services by boosting decision-making capabilities over some wide range of domains within their operations.

The areas in which data analytics presents opportunities that benefits local governance are: i) education services ii) primary health services, water, sewage, and sanitation services, iii) municipal planning, building regulations, public works and transport iv) local economic development, trade and tourism v) Natural resources and environmental management vi) rural electrification and vii) social protection and community empowerment. Below we present a discussion on practices and benefits of big data analytics in each of the area mentioned herein:

a) Education services

Unlike in the earlier days, there is a growing desire for education systems in East African countries to streamline learning, identify learners and teachers' drawbacks, trace students and teachers' achievements in a bid to ensure education accountability to learners, parents and stakeholder expectations [36].

Analytics in education can allow policy makers identify issues that affect performance (institution, students and teachers), mentor-ship, processes, curriculum development, learners sentiments etc [37]. Since education is a public service, it is incumbent on governments at all levels to provide quality education. Quality of education in a country can be informed by fine grained facts extracted from analytics of big data gathered from school Enterprise resource planning (ERP) systems, school website feed backs and school social media sites[38].

b) Primary Health Services, Water, Sewage and Sanitation Service

Primary health care is one of the LDCs undertaking. LDCs have large health demands as a result of high-rate population increase, the limited resource available, widespread poverty, lack of equipment and lack of health insurance. Unlike developed countries where health care policies have matured and advanced in the use of health technology, LDC's health

sector still suffer inefficiencies and inequalities starting from staffing, funding, low salaries, infrastructure, and medicine. In addition to health service issues concerning clean water, sewage and sanitation are still wanting.

Big Data analytics could be used in tracking spread of epidemics, optimizing health resources (cost-effectiveness and equity), distribution of drugs to existing health facilities and predicting patient inflow to the health facility[39].

c) Municipal Planning, Building Regulations, Public Works and Transport

As the population grows rapidly in LDC's, rural-urban migration is becoming unavoidable challenge. This challenge is a driving force to congestion, environmental degradation, and rapid urbanization. To mitigate congestion, governments must provide planned housing for citizens migrating to urban areas. Secondly to avoid hazardous development of infrastructure and utilities, councils must provide municipal planning and well stipulated building regulations. Currently, many local governments in east Africa use traditional town/city management mechanisms.

To this end, big data technologies can be used to collect, process, and analyse urban data in real time to improve quality decision making, monitor behaviour patterns, examine urban life in terms of population growth, and infrastructure development.

Noting that town and cities in developing countries have become complex places characterized by heavy traffic, congestion, and unprecedented slum development, adopting Big Data in the management of cities and towns can provide insight into the environment, security, and infrastructure development.

d) Local Economic Development and Tourism

There is a close relationship between tourism and economic development that need to be optimized for the well-being of the society[40]. East Africa as a region is blessed with unique biodiversity and natural tourist sites that are often not found in many parts of the world. In this region natural sites that include mountains, freshwater lakes, hills and heritage sites are things that tourist flock to every year.

During their visits, they pay fees, buy from retailers, use transport and seek for accommodation, this, in turn, boosts economic development and provides employment for local masses. In LDC's, tourism suffers from lack of promotion, poor maintenance of tourism industry, poor collaboration amongst stakeholders, lack of skills, safety and security. Amidst all these problems, tourism has never seized to be among the biggest revenue generator in East Africa.

Using Big Data, it is possible to observe the trends in tourist visits and feedback from social media platform to observe tourist preference, shape policies, formulate strategy for promotion, gazette insecure tourism areas and improve local participation.

e) Natural resources and Environmental Management

Environmental issues are of great concern today especially during this era of global warming. Coupled with the ease of gathering data from the environment using sensors embedded in smart phones, social media activities, and geo-information systems, it is easy to predict disaster, pollution, and changes in environment. Although little is known on how to incorporate such analytics in citizens conversations and existing e-governance systems[41]. It is important to note that multiple dimensions of information can be generated from people's daily activities to predict and act on environment.

f) Social Protection and community empowerment

Since independence in mid-60's, most of the East African countries either have settled out of civil war or still struggling with the effects of war. For example, internal conflicts have been observed in Uganda until recently, Rwanda has recently come out of the 1994 genocide and still recovering, southern Sudan and Burundi are still at war. Combined with mass unemployment, population growth, and the dependency on subsistence agriculture, governments are meant to question how to promote employment, end poverty, and optimize

taxes. Big Data analytics can be used to inform difficult policy debates on the status of employment, poverty, social infrastructure, and taxes benefits for low income-groups. In addition, issues relating to communities such as crime, domestic and gender-based violence, school dropout rates, teenage pregnancies and early marriages can be informed by the big data analytics[42][43].

4. Emerging ICT trends, opportunities, and challenges in African democracies

4.1 Emerging information communication trends

Many governments around the world are shifting from conventional means of governance to electronic ones in a bid to improve efficiency, accountability, transparency, and citizen participation. As a result**,** there is increased use of ICTs in service delivery, administration of government structures and assets, government infrastructures **(**cities, town, rural centres, roads etc.)[32]. In particular, the East African governments have drawn deliberate e-government strategies to better operations of public sector[33]. Governments' have encouraged innovations through constructing innovation and incubation centres [35], stimulated academia to join ICT innovation strategy through teaching science, technology and innovation(STI) and conducting research. Ministries in charge of ICTs have signed memorandum of understanding that facilitated upcoming IT startups, and created government structures to regulate policy, build strategic plans recognizing ICT as enabler, enhancer and promoter of national development. Based on the above notion therefore, we present the trends and indicators that encourage adaptability of big data technologies in selected African democracies.

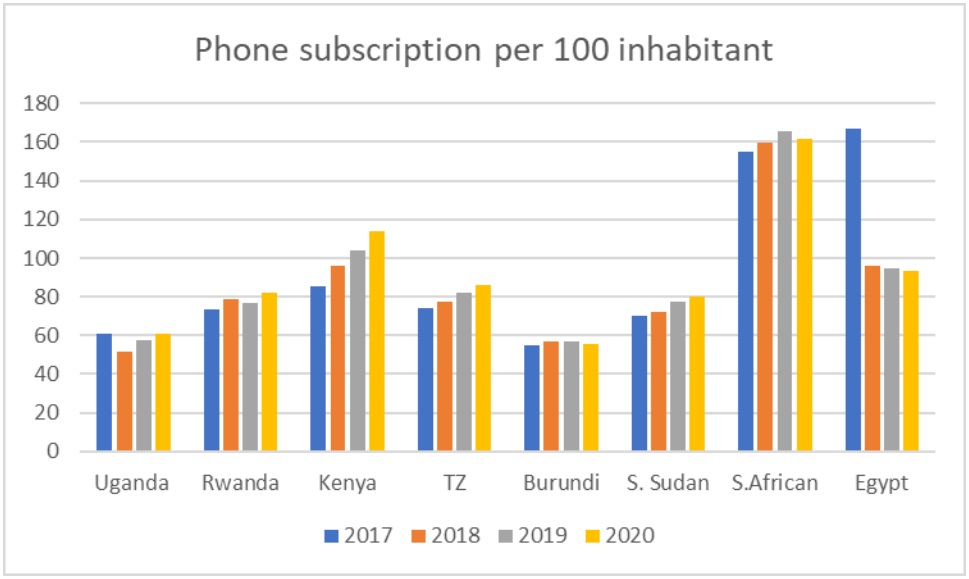

Figure 1: showing the levels of phone penetration per 100 inhabitants.

Figure 1 presents a snapshot of phone subscription per 100 inhabitants for Uganda, Rwanda, Kenya, Tanzania, Burundi and South Sudan, together with the two counterparts S. Africa and Egypt. From the data on average 57 inhabitants subscribe to any of the existing phone networks in Uganda, as compared to 78 for Rwanda, 99.8 for Kenya, 79 for Tanzania, 55 for Burundi and 74 for Sudan.

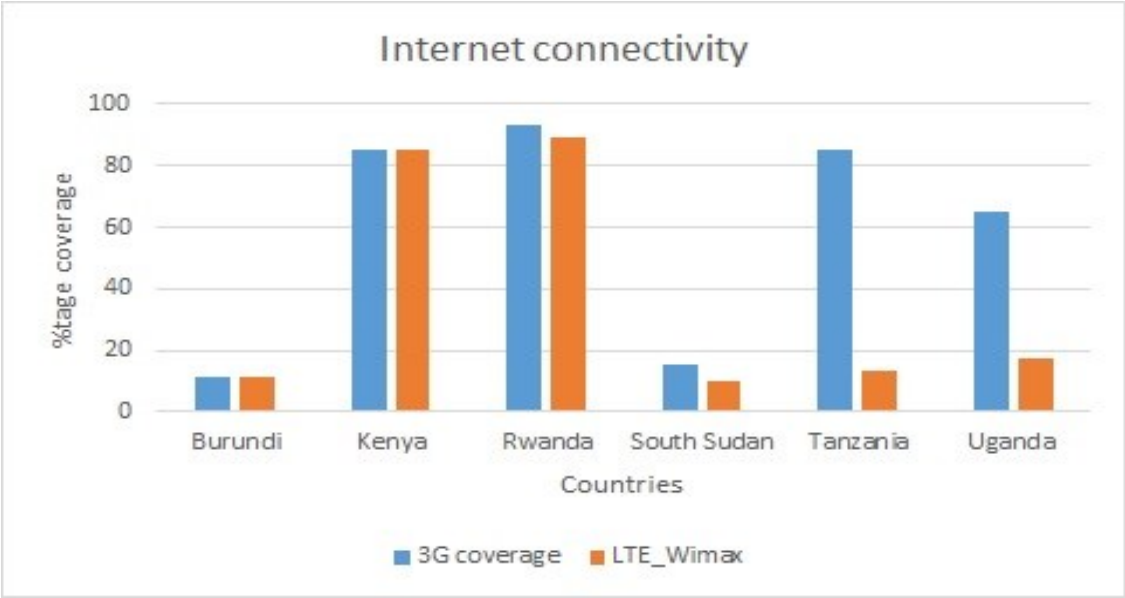

Figure 2: percentage Internet connectivity

Figure 2 presents a snapshot of Internet connectivity for Uganda, Rwanda, Kenya, Tanzania, Burundi, and South Sudan. We observe that percent coverage for Internet in each of the countries apart from Burundi and South Sudan is over 60%

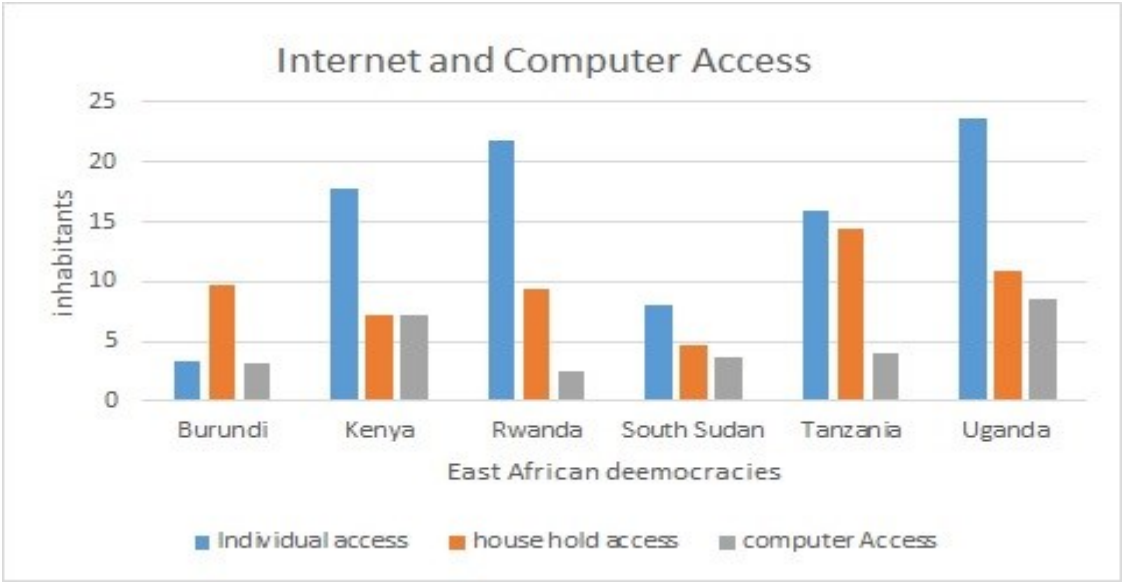

Figure 3: Internet and computer use

Figure 3 presents a snapshot of internet and computer use as per 100 inhabitants for Uganda, Rwanda, Kenya, Tanzania, Burundi and South Sudan, we note that the individual use of internet is above 15 users per individual access and slightly below 10 at household level. Computer use is put at less than 5 individuals per household.

Figure 4: Facebook subscribers

Figure 4 presents a snapshot of Facebook subscription per 100 inhabitants for Uganda, Rwanda, Kenya, Tanzania, Burundi, and South Sudan. We note that Kenya and Rwanda have more that 10% of their population as Facebook subscribers and the rest of the east economies are slightly below 10%.

As a result of digital interactivity across different governance structures, billions of data at local governments is easily collected, thus the need for East African governments to adapt the proposed Local government Big Data (LgBigD) framework.

5. Technological description

5.1 The Local government Big Data (LgBigD) adaptability framework

The Local government Big Data (LgBigD) generates its massive data from mainly human activities and machines. A classic example of human generated big data is the social media, whereas machine generated big data is found in video surveillance systems. The term Big Data, is used to describe data coming from various sources which, include websites, games, internet, sensors, social media, medical etc. The challenges associated with big data is that they are huge, varied, complex in such a way that they cannot be handled by traditional databases, spreadsheets or statistical tools, and grow exponentially [31]. In Figure 5, we present the aspect of big data in the local government big data (LgBigD) ecosystem that form the local government big data adaptability framework.

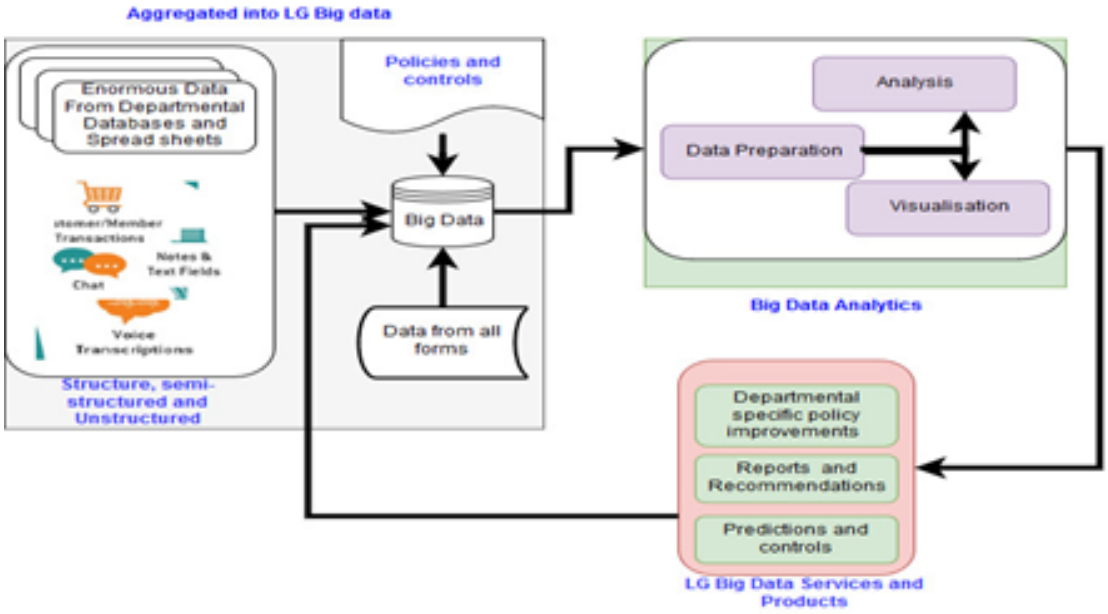

Figure 5: showing the LG adaptability framework.

The adaptability framework uses data aggregated from departmental databases, spreadsheets, documents, government transactions, policy and control documents and all other forms of data that may include notes, minutes, charts, social media feeds etc. Through data preparation, analytics and visualization, adaptability model which does descriptive and predictive modelling of services and products is constructed.

LgBigD architecture is divided into three parts. The first component consists of aggregation of data from different sources. The types of data include emails, pdfs' photographs, WhatsApp feeds, Facebook feeds, audio, video, and sales. All these data sets are part of the organizational data asset. The second component is the big data analytics which is responsible for (a) Data preparation and management: a process that involves finding the right data from existing data sources; getting to know the data at the same time discovering what is expected to be done to the data in specific context; removing extraneous data, outlier, filling missing values, masking sensitive data, etc. and updating the data to reach a well understood format that is acceptable by the users before storing the data in LG data centres or government clouds. The data preparation activity clears way for analysis and visualization process. Preparation of data forms the most intensive process of big data analytics. (b) Data Analysis: inhere patterns and connections that might be hidden are uncovered and explored. This process provides useful insights to the local governments for superior decisions. Recently, analytics across many businesses have occasioned into powerful analytics tools that include Hadoop, MapReduce and NoSql. (c) Visualization: a technique that is about converting big data into graphics that are easy to appreciate. Visualization enables interpretation of patterns with less efforts. Beyond boxplots, histograms, fever diagrams, and heat graphs, decision makers in governments can use visualization to explore data set for correlations, regression, and expected patterns. visualization features take in big data and return graphics that are complex and easy to understand. Visualization offers effective mechanism to review large amounts of data, spot trends, identify relationship and present information and wisdom to decision makers. The third component of LgBigD framework is the LgBigD services and products. This component is accessed through user interfaces. Based on real-time analytics of data, personalized departmental plans, optimized LG procedures, reports and recommendations can be generated that improve policy at different levels of governance.

Assumptions

i) There are multiple sources of data that form the inputs of the framework, its therefore important to label the data elements with both the source unique identifier and time stamp so that the analytics associated with some sources and time stamp tells a story in same time space. This goes without saying that data from the sources can age. For example, if a policy p_i is formulated as a result of analytics at time say t_i , and later at time t_{i+1} better insights are uncovered to improve policy p_i to p_{i+1}, then p_i may be replaced by p_{i+1}.

ii) The second assumption is that data grows at substantial rate, that means data v_i at one point in time t_i quickly changes to v_{i+1} at another point at time t_{i+1} at each of these time lines results of analytics may bear completely different trend. In so doing, data can be analysed in real time (real time analytics) or later in time yielding transitional and business analytics, therefore infrastructure to perform analytics in this case may assume hierarchical framework at all levels of local government structures.

iii) Another assumption is that there exists massive unexploited information that might be of value to influence government policies, objectives, and this information can bridge the knowledge gap between central governments and local governments. Most vitally, the accessed information can influence governments positively at all hierarchies of decentralized governments. we further assume that issues of ownership, data handling, security, trust among others are transparent. Furthermore, the massiveness of the data might hide deeper insight due to levels of complexity or size of the class of data may need to be analysed causing imbalances in the data. These complexities and imbalances in data collected vary from cased to case.

iv) Lastly, we assume that each government entity in a region is unique both vertically and horizontally along the hierarchies of governance, therefore each entity produces unique analytics whose generalization may not be transferable to another local government. This implies that analytics of one local government at village level may not be a representation of a county, district, or country. Further, big data adds a perception that uniquely changes the activities of leaders and citizens, improves the way citizens participate and interact with governance business. In addition, the analytics generated from the framework is transparent, and reflects, masks, and reveals hidden insights that may be relied on in decision making and creation of policies that drive local governments thereby influencing the social dimension of its citizens.

6 Discussion, Limitations and Conclusion

6.1 Discussion

As a result of the emerging information communication trends, numerous opportunities have been created to bolster institutional governance and interactivity in enhancing provision and access of services within benefiting communities. This is attributable to basically: a) the accumulated digital presence, b) increased social interactivity, and c) accumulated and unexploited data as discussed below.

a) Digital presence

East African governments and business entities are offering a multitude of e-services to its citizens. The digital services include mobile money services, e-taxes, access to learning material, examination results electronic services, electronic identify cards and passports, e-banking, e-health, biometric voting solutions etc. Leaders of these democracies realize that internet forms the vehicle towards digitization. Therefore, they have embarked on the new

paradigms of pushing the last mile connectivity to the rural areas including the ventures to explore solar powered internet are under way. Based on the digital presence trend we can conclude there is considerable amount of data that is produced around these democracies but have not been given sufficient attention yet.

b) Social Media presence in Local governments and social engagements

There is a growing presence of social media platforms (Facebook, YouTube, Pinterest etc.) in the East Africa democracies. These platforms are used for different reasons across the societies. Of recent they have been used as political mobilization tools to destabilize governments in the Sudan, Egypt etc. Social media has found its way in business and marketing, news, education, and entertainment. As a result, new employment opportunities have appeared for example blogging, content management, digital marketing etc. What starts as a view or opinion shared on social media can orchestrate into a powerful mechanism to mobilize masses, act as a catalyst for a big movement or remedy to understand society grievances. Many government ministries, departments, agencies, and many local governments have shown social media presences. social media platforms serve as a connecting string between government entities and the citizen. Online engagements on social media provides the high of velocity big data that can be used to analyse citizen sentiments and find faults in the system where service may not have reached.

c) Accumulated and unexploited data

In context of this study, citizens' digital presence fosters their interactivity online with numerous government and non-government structures. This results in the generation of massive human and machine data across different sources—as highlighted in the Local government Big Data (LgBigD) framework's assumptions (i), (ii), and (iii).

The adaptability of LgBigD within governance structures enables the realization of the proposed assumption (iii) through which governments can access and interpret the accumulated data to guide and shape policy initiatives within the existing hierarchical governance structures—creating a standardized mechanism of how data is accessed and handled across the numerous governance structures or targeted sectors for relevant policies. We connote the use of LgBigD framework bolsters the aforementioned standardization in accessed data and helps in lessening complexities and imbalances in collected data.

As a result, LgBigD framework enhances: (a) Data preparation and management, (b) Data Analysis, and (c) Visualization. This enables governments realize unique vertical and horizontal data analytics within existing governance structures as stated in the framework's assumption (iv). These observed unique data analytics are not transferable—this creates unique identifications and bolsters the realization of appropriate policy measures rather than generalized policies that often fail to meet targeted transformations within a government. In addition, the generated analytics exhibit the framework as being transparent, and able to reflect, mask, and reveal hidden insights that are vital in decision making and creation of policies that drive local governments thereby influencing the social dimension of its citizens.

6.2 Limitations

The notion of using Big Data in local democracies in LDCs in hoped to improve efficiency and effectiveness in local governments. Along with brighter prospects granted by Big Data analytics to local governance domain, several challenges are envisaged. This includes; huge volume of data that puts pressure on computing resources including processors and storage, new methods of data analysis that require expertise in interpretation, privacy security of both data and information generated out of the Big Data, data integration, expensive maintenance cost all pose challenges to big data initiatives in the least developed

countries[44], [45]. Below we present a discussion on the limitations that may deter implementation and acceptance of big data analytics in local governments.

a) Policy issues

Sufficient literature has been written on how big data can turn the Data asset into a profitable venture. The question that remains unanswered for many LDC's is who owns the data, models used in mining facts from the huge data of local governments? what happens in case of breach of contracts? what are the legal consequences in case something goes wrong?[46]. In LDC's laws, policies and guidelines governing information and communication technology usage and ownership are still at novice stages leave alone Big data technologies. Accepting using big data analytics amidst no proper laws could result in a nightmare. Until LDC's legislate laws governing ICT's, social media, the privacy of Data (what and when to share, publish etc.), adopting the use of Big Data technologies may still be held back in local governments.

b) Dealing with large and complex data sets

The ability to process big amounts of data is a big challenge in the Big data industry. This challenge cuts across the whole lifecycle of Big Data analysis. Starting from capturing Data, cleaning integrating, constructing model's way to the final product. Coupled with other infrastructure problems in LDC's dealing with large volumes of data is a challenge that cannot be ignored. In addition, the lack of metadata possesses issues relating to standards and definitions across board.

c) Availability of skilled manpower

While advances have been observed in Big Data domain, human expertise is required to make meaning of the analytics at the same time implement the facts that have been observed because of the analysis. This expertise has not fully developed in LDC's. Even in terms of academia, not many universities in LDC's have grasped the notion of Big Data analytics to level that they create courses that can train manpower to bridge manpower needs of Big Data analytics for local governments. The few available manpower in this area is employed in mostly high-profile organization such as central banks, statistical bureaus, Bureaus of standards, telecommunication companies, revenue authorities etc.

d) Lack of Big data infrastructure and other related issues

Big data infrastructure is a big investment that may take considerable time to acquire. This coupled with less skilled manpower to build and maintain may take considerable number of resources from the pockets of local governments.

The inability of Local governments to acquire substantial infrastructure to house Big Data facility is a challenge.

Related to infrastructure, the cost of maintaining Information Technology's (IT's) is normally recurring. Big Data like IT attract recurring cost of maintenance, which may not be affordable by Local governments in the long run.

The benefit of big data analytic and statistical analysis in planning and decision making in general not appreciated to a greater length in the developing countries. In Uganda for example the budget allocation is now dependent on performance in the sectors which is guided by available statistics. This innovation has been in existence for just a few years. However, many areas of management, planning and decision making remain untouched. This implies that Ministries, Departments and Agencies (MDAs) and higher local governments should embrace technologies that translate available data into tangible outcomes to realize exponential growth. This can only be achieved with the big data technologies which remain seemingly a new phenomenon.

6.3 Conclusion

Big Data analytics provide a fertile platform upon which local democracies in LDC's can achieve good governance based on real-time facts derived from data that is accumulating from government information systems and other sister applications like social media. Using Big Data tools, leaders can shape policy to cater for progressive developments and provide relevant services to the citizen in addition to proper accountability.

In this paper, we have focused on opportunities and practices those big data analytics can offer to LDC's. The goal of our research is to deal with the study and application of Big Data in local governments of developing democracies the aforementioned East African countries given that few studies have been done in this specific domain.

In future, the present research will extend the study to the specific function of local democracies, apply tools to the entity of government through which a practical implementation of Big Data tools on handling Structured, semi-structured, unstructured data generated from government information systems can be observed and its relevance to local governance concluded on.

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