IMPLICATIONS OF BIG DATA ON THE ROLE OF LIBRARIES IN THE REALIZATION OF SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Abstract

This paper presents an evaluation of the implications of big data on the role of libraries towards realization of sustainable development goals (SDGs). The paper begins with a brief overview of the concept big data and its potentials followed by a discussion of the role of libraries in the realization of SDGs. It then focuses on big data implications on the role of libraries as evident via new innovations that have moved the library's focus from being keepers of information resources to innovative technological developments and the effect these have on service provision and attainment of SDGs. Literature reviewed was selected from Academic Journal Databases popularly known to contain Library and Information Science publications (Elsevier, Emerald, Sage and Ebsco Host), International Federation of Library Associations (IFLA) and United Nations Global Pulse websites as well as Google Scholar. Literature reviewed indicates that libraries contribute to improved outcomes across the SDGs by supporting their implementation in regards to providing access to information, literacy and ICT skills and access to community space. However, as a result of big data deluge, the role of libraries and information professionals is changing in various ways including new roles such as libraries as innovation centers, data curation, research data management, designing taxonomies and community engagement. There are also challenges associated with this data deluge on libraries especially those in the developing world where technology infrastructure is still poor, skills required for new roles still beginning to evolve, lack of motivation among LIS professionals, lack of partnerships between governments and libraries, issues with open data policies among others. There is need for updating of Library and Information Science (LIS) curriculum especially in African Universities and continuous professional development trainings to cope up with the new roles and expectations. Libraries need to aggressively intensify advocacy for freedom of access to information balanced against protecting human privacy; build partnerships with governments, design taxonomies that address privacy and access, intensify information literacy and advocate for policy reform especially in developing countries to address the issues that have come up due to advances in information technology in particular, big data revolution.

Key words: *Big data; Role of libraries; Global Development Agenda; Sustainable Development Goals; SDGs*

Introduction

In just a short time, big data has caught global attention and spurred creative innovations in nearly every field and libraries as engines of access to information have also been affected by this new trend. Though, the role of libraries has traditionally been to collect, preserve and disseminate the intellectual output of the society which includes books, serials and other materials; scientists, scholars and all of society are now producing, storing and disseminating digital data that underpin the aforementioned documents in much larger volumes than before (Heidorn, 2011). Hoy, (2014) reported that modern life produces data at an astounding rate and shows no signs of slowing. This is attributed to the recent developments in ICT in particular, the widespread diffusion of digital technologies and their adoption in work places and individual lives that has led to explosive growth in volume and variety of digital data leading to new advances in data storage and analysis and the concept "big data" data (Miorandi, Sicari, De Pellegrinia, & Chlamtac, 2012; UN, 2013; Simo, 2015). Cisco and World Economic Forum report that a flood of data is created every day by interactions of billions of people using digital devices and that online or mobile financial transactions, social media traffic and GPS coordinates now generate over 2.5 quintillion byes of so called "big data" every day (Cisco, 2016; World Economic Furum, 2012). Michael and Miller argue that although data mining has occurred since people started to maintain records in the modern era, the so-called "big data" brings together not only large amounts of data but also various data types that previously never would have been considered together (Michael & Miller, 2013).

Essentially, (IFLA, 2015; United Nations, 2015) recognized that utilizing the data revolution is a critical enabler of the global goals not only to monitor progress but also to inclusively engage stakeholders at all levels to advance evidence-based policies and programs and to reach the most vulnerable and that access to information would be very crucial in attaining the global goals. Libraries have always been expected to provide access to information which entailed collecting, organizing and providing access to collections. As a result of big data deluge, there has been paradigm shift in focus from managing collections to one that emphasizes outreach and engagement. During the World Economic Forum held in Davos, Switzerland in January 2016, it was foreseen that a combination big data and new technologies were gradually merging to create a new reality which has the potential for revolutionizing our way of life to which (Frederick, 2016; Sugimoto, Ding, & Thelwall, 2013) foresaw the likelihood of changing role of libraries and wondered what role libraries might play in this revolution and how the information environment could be forever changed. With this trend, the pressure for libraries most especially those in developing countries to keep up with not only big data deluge but more profoundly with new expectations are immense.

The purpose of this review therefore was to ignite scholarly conversation on how big data affects the role of libraries as they strive to contribute to the realization of SDGs. The paper is motivated by the exceptional discourse places on big data's potential to transform into value for development endeavors (Chen & Zhang, 2014;

De Mauro, Greco & Grimaldi, 2016; IFLA, 2015; United Nations, 2015; World Economic Forum, 2012). This review tries to explore three key questions; (1) what is the role big data in realization of SDGs (2) what role do libraries play in the realization of SDGs?; and (3); what are the implications of big data on the role of libraries in the realization of SDGs?

The 2030 Agenda for Sustainable Development

The Global Development Agenda commonly known as "the 2030 Agenda for Sustainable Development is the new global development framework anchored around 17 SDGs adopted in 2015 by heads of states and governments at a special United Nations summit building on the Millennium Development Goals (MDGs) to include issues such as natural resources management, sustainable consumption and production, effective institutions, good governance, the rule of law and peaceful societies (United Nations, 2015). The SDGs are global in nature, universally applicable and all countries have a shared responsibility to achieve them. Poverty eradication is the overarching goal of the new agenda which is taking a far more ambitious approach than the Millennium Development Goals (MDGs)

Figure 1 below shows a summary of the SDGs

Source: http://www.un.org/sustainabledevelopment/sustainable-development-goals/

To achieve the above agenda, it was recognized that access to information was key and that tapping into new data sources, algorithms and technologies are necessary to complement traditional methodologies (IFLA, 2015; United Nations, 2015; 2016). In addition, (Banisa, 2015) postulated that, once well analyzed, big data has the potential to promote participatory development, empowering all people to exercise their rights and address their own development challenges. In addition, the International Council for Science (ICSU) argues that, the scientific opportunities of this data-rich world lie in discovering patterns that have hitherto been beyond our

reach for instance in weather and climate forecasting, in the behavior of the global economy, in evaluating agricultural productivity and in many of contemporary global challenges such as those of environmental change, infectious disease and mass migration that require combined insights and data from many disciplines (International Council for Science (ICSU), 2014: p.2).

Big data

The meaning of the concept "big data" is rather misleading that one might think that it is all about very large volumes of data. On that note, literature indicates an on-going debate over its meaning (Bradley, 2016; Chen, Chiang, & Storey, 2012; Diebold, 2012; Gandomi & Haider, 2015; Kwon, Lee, & Shin, 2014; Kshetri, 2014; Laney, 2001; Lohr, 2013; OED, 2016). Oxford English Dictionary included the term 'big data' in its online update for the first time in 2013 to refer to extremely large data sets that may be analyzed computationally to reveal patterns, trends and associations especially relating to human behavior and interactions (OED, 2016). Boyd & Crawford, (2012) looks at big data a as a cultural, technological, and scholarly phenomenon that rests on the interplay of: (1) Technology: maximizing computation power and algorithmic accuracy to gather, analyze, link and compare large data sets (2) Analysis: drawing on large data sets to identify patterns in order to make economic, social, technical, and legal claims (3) Mythology: the widespread belief that large data sets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity and accuracy. However, Douglas Laney's 2001 big data framework based on the three V's (volume, variety and velocity) seems more befitting considering that these characteristics reflect large amounts of different types of data, both structured and unstructured, arriving at a fast and constant pace, requiring real-time analytics to derive meaningful information and knowledge (Laney, 2001). Other studies such as (Chen, Chiang, & Storey, 2012; De Mauro, Greco, & Grimaldi, 2016; ICSU, 2014; Kwon, Lee, & Shin, 2014) support this definition. For instance, De Mauro, Greco, and Grimaldi analyzed an amount of industry and academia articles on big data and found out that the main themes of big data were "information, technology, methods and impact" and thus defined the term as the information asset characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value" (De Mauro, Greco, & Grimaldi, 2016). In this study the concept "big data" is defined as datasets of large volume, velocity and variety that require more complex real time analytical tools to derive meaningful information and knowledge that supports timely decision making.

Methodology

This paper is based on literature review on the concept big data and its implications on the role of libraries in the global development agenda. Literature reviewed was selected from Academic Journal Databases popularly known to contain Library and Information Science publications (Elsevier, Emerald, Sage and Ebsco Host), International Federation of Library Associations (IFLA) and United Nations Global Pulse websites as well as Google Scholar.

Big data and its role in the realization of SDGs

The role of big data analytics in realization of SDGs has been well documented and its potential in attaining global development agenda is no longer questionable (Bays, 2014; Chunara, Andrews & Brownstein, 2012; Global Pulse, 2016; Greeley, Lucas, Chai, & Cummins, 2013; IBM, 2013; Koo, Piratla, Kalyan, & Mathews, 2015; Papadopoulos, Gunasekaran, Dubey, Altay, Childe, & Fosso-Wamba, 2017; Raghupathi & Raghupathi, 2014; Siedner, Lankowsk, Tsai, & Muzoora, 2013; United Nations, 2015; Verhulst, 2016). For instance, twitter messages were analyzed to reveal the spread of the 2010 Haitian cholera outbreak two weeks earlier than official statistics (Chunara, Andrews, & Brownstein, 2012). Moreover (Greeley, Lucas, Chai, & Cummins, 2013) reveal that use of real time digital information for monitoring mHealth and eHealth has been remarkable. In Uganda, big data is being used to monitor HIV clinic absenteeism by patients accessing care in rural, resource-limited settings using a GPS (Siedner, Lankowsk, Tsai, & Muzoora, 2013). Retail companies use big data to improve services and products through customer analytics, customer behavior, sentiment analysis, profiling and segmentation. Governments use big data analytics to gain insight into citizen activities and requirements, detect fraud or abuse of services, focus "nudging" on specific behavior, strengthen national security and better allocate government resources. Financial institutions are using big data to better identify their customer markets and assess risks, including creditworthiness and default rates. In Sudan, big data was used to monitor poverty trends using satellite imagery and image processing software to count roofs and identify the type of material they are constructed from (Global Pulse, 2016). In the U.S, an internet of things application was developed to leverage all data into a big data water usage and achieve high levels of sustainability in water supply which has positive implications on incomes and livelihoods (Koo, Piratla, Kalyan, & Mathews, 2015). In Napal, (Papadopoulos, Gunasekaran, Dubey, Altay, Childe, & Fosso-Wamba, 2017) explain how use of un structured big data from tweets, news, facebook, word press, istogram, google+ and youtube combined with structured data via responses from 205 managers in the aftermath of Napal earthquake in 2015 contributed timely information to enhance disaster planning and management. In Indonesia, Pulse Lab Jakarta lab in 2016 began to extract useful information from social and combine the signals with other sources of digital data for real time insights on disaster impact and human well-being (United Nations, 2015). Below are more examples where big data has been harnessed to contribute towards realization of SDGs.

Figure 2 below shows examples where big data has been harnessed to contribute towards realization of SDGs

Related SDG(s)	Project	Partners	Data Type	Country	Lab
FOOD AND AGRICULTURE					
2	Mobility Profiles for Food Security and Livelihoods	WFP	Mobile	Senegal	Kampala
2	Crowdsourcing High-Frequency Food Price Data	FAO, WFP	Crowdsourcing	Indonesia	Jakarta
ECONOMIC WELL BEING					
1 8 9	Estimating Economic Activity from Postal Data	Universal Postal Union (UPU)	Postal	Global	New York
1	Roof Counting as a Proxy of Poverty Trends	Uganda Bureau of Statistics, UNDP	Satellite imagery	Uganda	Kampala
10 11 16	Citizen Feedback for Enhanced Local Government Decision-Making	LAPOR! (Office of the President)	Government data collection systems	Indonesia	Jakarta
1	Using Airtime Purchases to Detect Economic Shocks		Airtime credit	Uganda	Kampala
9 12	Analysing Public Perceptions of Fuel Subsidy Reform	Ministry of National Development Planning (Bappenas)	Social media	Indonesia	Jakarta
16	Improving Knowledge Sharing on Peace and Governance	Government of Ghana, UNDP	Governance and Peace (GaP) poll	Ghana	Kampala
8	Reflections on Unemployment	UNICEF	Social media	Indonesia	Jakarta
3 9 12	Understanding Changes in Perceptions on Biofuels	David and Lucile Packard Foundation	Social media	UK, Germany, the Netherlands	New York
CLIMATE AND RESILIENCE					
3 11 13	Supporting Forest and Peat Fire Management	UNORCID	Social media	Indonesia	Jakarta
PUBLIC HEALTH					
3 16	Supporting Response to Infectious Disease Outbreaks	Ministry of Health, WHO	HMIS, DHIS2	Uganda	Kampala
3	Real-Time Monitoring of HIV Treatment Protocols	Ministry of Health, UNAIDS	Health data	Uganda	Kampala
3 10	Informing Communication Campaigns Around HIV and Discrimination	Ministry of Health, UNAIDS	Social media	Brazil	New York
3 16	Understanding Awareness and Sentiment on Immunisation	Bill & Melinda Gates Foundation	Social media, news outlets	Nigeria, Pakista	New York
DATA PRIVACY AND DATA PROTECTION					
3 9 16	Mapping the Risk-Utility of Mobile Data for Sustainable Development	Massachusetts Institute of Technology (MIT)	Mobile	Global	New York
GENDER					
5 10 16	Gaining Insights on Child Marriage from Social Media	David and Lucile Packard Foundation	Web searches, speeches	Global	New York

Source: UN Global Pulse Annual Report, 2015

Role of libraries towards realization of SDGs

The role of libraries in the global development agenda had been well documented (Amunga, 2011; Bell, 2016; Bradley, 2016; Chigbu & Nkechi, 2013; Dada, 2016; Frederick, 2016; Greyling & Zulu, 2010; Huwe, 2014; IFLA, 2014; 2015; 2016; Kwanya, 2016; Sabaratnam & Ong, 2016; United Nations, 2015). IFLA is consistent in its position that access to information is essential in achieving the

SDGs**,** and that, libraries are not only key partners for governments but are already contributing to progress towards the achievement of the 17 Goals. For instance, library services contribute to improved outcomes across the SDGs by supporting their implementation in regards to providing access to information, literacy and ICT skills and access to community space (Namhila & Niskala, 2013).

At the international level, information professional organizations such as, IFLA and EIFL have for some time funded libraries in developing countries especially Africa to conduct ICT skills trainings and access to electronic resources. For instance (Elbert, Fuegi, & Lipeikaite, 2012) reveal that EIFL Public Library Innovation Program awards grants to public libraries globally to address a range of social-economic issues facing their communities including projects in Kenya, Ghana and Zambia among others. In addition, the United States former President Barack Obama on a visit to Anacostia Neighborhood Library on April 30 2015 announced two new initiatives (ConnectED Library and eBooks initiatives) that promised to rally America's libraries, publishers and non-profit organizations to strengthen learning opportunities for all children particularly in low-income communities (Peet, 2015).

In Singapore, the nation's libraries came up with new ways serve the needs of their communities through library innovations paying particular attention to digital products and services that include library management systems, e-resources, digital devices as well as the utilization of social media to engage users (Sabaratnam & Ong, 2016). Many librarians across the globe are currently leveraging social networking and social media to provide dynamic library services (Mabweazara & Zinn, 2016; Maidul & Umme, 2015).

In Nigeria, (Chigbu & Nkechi, 2013) reveals that the realization of a country's vision is knowledge driven and librarians are active players in identifying, maintaining and making available knowledge assets. The library is seen as an agency for findings, discovery, innovation, vocational skills repository, scholarship and research (Adeleke, Okusaga & Lateef, 2002; Dada, 2016). Libraries and information professionals help to leverage knowledge assets through the provision of world class information, manpower training and capacity building all of which can impact on realization of SDGs.

In South Africa, the National Library of South Africa (NLSA) provides a network of delivery sites for government programmes and services, serving at the heart of the research and academic community and preservation of national heritage. NLSA is responsible for preserving the cultural heritage of the people of South Africa and fostering social cohesion (Maepa & Marumo, 2016). It also runs a number of programmes that contribute directly or indirectly to the attainment of Sustainable Development Goals. NLSA contributes immensely to the education of young adults through provision of free access to ICT's, reading and research spaces and workshops aimed at preparing young people for the job market; provides relevant information that relates to some of the Goals, such as information on climate

change to support researchers and providing health-related information, as well as information on how to access government services.

In Botswana, public libraries have taken large strides toward supporting government objectives including introducing ICT access, improving computer skills of library users and enabling users to be successful in business, education and employment (Bradley, 2016; IFLA, 2015). Aside from that, the Botswana Library Association developed a strategy to support the Government's vision 2016 in seminars, conferences, and symposium for institutional capacity of libraries by encouraging all citizens to discuss as stakeholders in inclusive and sustainable growth, energy and infrastructure development in the attainment of sustainable development in the education sector. Kenya libraries also offer information literacy training (Amunga, 2011).

In Uganda, the National Library of Uganda (NLU) provides ICT training to female farmers to access weather forecast, crop prices and online markets in their local languages which increase the economic wellbeing of women through technology skills (IFLA, 2015). NLU is also developing a programme to "help pregnant teenagers learn to use technology to access information that will help them improve their health and livelihoods". Kitengesa Community Library runs similar programmes. In addition, Makerere University has been at the fore front in providing health information literacy to health professionals and local communities (Musoke, 2014).

Literature reviewed reveals that libraries and information professionals play a very key role in the realization of the 2030 global development agenda. However, the present digital environment has brought a lot of changes not only on the library and information services but also on the roles and expectations of information professionals. The next part is a review of literature on the implications of big data on the role of libraries.

Implications of big data on the role of libraries in realization of SDGs

There are many areas where the role of libraries is changing due to the big data revolution.

A new role in research data management

It is stated that the data deluge made possible by the ubiquity and data power of computation and networks was beginning to overwhelm traditional methods of data storage and management which forced libraries to begin redefining their role and place in the digital scholarly communication ecosystem (Rambo, 2015). Patrick Morehead an industry analyst with Futurum Research and Analysis says that given the shortage of data scientists, it is clear that organizations of all sizes need to find ways to pool big data resources but the real challenge is that even when those big data analytics resources are found, making sense of all the data an organization has, takes time (Vizard, 2016). Libraries however have one big advantage relating to any big data analytics applications because they are familiar with the ontology

work associated with creating the metadata that drives those applications. For instance, Purdue University's library in collaboration with information technology research department created a data repository (Purdue University Research Repository) and was at the forefront of data instruction and reference while also providing guidance metadata standards (Witt, 2012). In addition, (Kelley, 2013) reveals that Roger Brisson the head of metadata services at Boston University Libraries has been deeply immersed in the cloud-based library services platform Alma from Ex Libris which he says is addressing the challenges that have emerged from the dramatic growth in scholarly research and scholarly communication.

Data curation

The emergence of linked data has simultaneously created a broad spectrum of new cases for library data changing the role of libraries for instance, IFLA reveals that library catalogues now incorporate links to external datasets and integrate those datasets in new applications which means that activities like digitization, digital preservation, online resource management, web archiving, text and data mining all create new types of data that libraries both consume and curate (IFLA, 2016). Big data technologies like data virtualization, parallel computing, predictive analytics and machine learning bring the promise of improved performances and smart tools thus empowering libraries to consume and curate data of all kinds in new and innovative ways. Huwe, (2014) in his paper "big data and the library; a natural fit" revealed three key big data projects he thought most likely to occupy librarians; (1)user studies (2) collections use analysis (3) cross-disciplinary comparative studies which he said all lend themselves to using big data. Indeed in the U.S, ten libraries already use a shared big data analytics service that applies fuzzy logic technology to card catalog data to identify usage patterns and trends which are very useful for decision making, planning and accountability (Vizard, 2016).

The Las Vegas-Clark County Library District Foundation uses analytics via CIVIC technologies service to gain a deeper understanding of the demography it is serving. In the same library, big data analytics service uncovered that 76% of the community is made up of 21 district types of households which information has changed both the offline and online resources the library promotes to various segments of the overall community (Vizard, 2016).

Developing taxonomies

Sugimoto, Ding & Thelwall, (2013) reveal that the complexity of data from digitization initiatives, digital research and the social web have created a situation in which scholars are now gaining access to huge quantities of data on an unprecedented scale. Jeanne Holm, Evangelist, Data.gov, U.S. General Services Administration, emphatically agrees that librarians should participate in the process perhaps in regards to developing taxonomies.

Libraries as centers of innovation

According to (Rodgers, 2016), libraries have begun to adopt new innovations such as makerspaces that center the libraries' role as a place of creation and innovation thus addressing SDG goal 9. Hunt Library of North Carolina State University in the

United States for instance serves a unique role in its community as a technology incubator in the region with specialized spaces designed specifically for 3-D computing, advanced visualization and gaming research and development. In addition, the Los Angeles Public Library (LAPL) hosted the civic innovation Lab's Immigration Hackthon an initiative where more than 100 programmers, activists, politicians, policy makers, students and residents turned out to "hack away" to create applications and web interfaces designed to help immigrants meet the challenges of naturalization (Warburton, 2016).

In transforming communities by harnessing technology's power, the Institute of Museum and Library Services (IMLS) invested in an e-reader app as well as tools and services to help the public more easily access ebooks and other digital content (Bieraugel, 2013). In advancing digital inclusion through access to ICTs, Literacy Bridge adopted the Talking Book, a "low cost audio computer" in agricultural projects to address literacy and gender gaps by providing women and illiterate farmers, as well as others, with access to information on agricultural technologies on demand (World Bank, 2012). In the area of food security, (O'Connor & Kelly, 2017) acknowledges that a facilitated knowledge management process that utilizes filtered big data can help Small Business Enterprises (SMEs) to overcome the barriers in big data usage because explicit and tacit knowledge can be enhanced when SMEs have access to a facilitated programme that analyses, packages and explains big data consumer analytics captured for instance by a large pillar firm in a food network. This is something that can effectively be done by libraries.

In the field of education, higher education in the drive to respond to calls for greater accountability will look to big data to make the case that it is worth the costs. Due to this, there is a growing interest in crunching circulation numbers, database logins, and other transactional data in order to connect it to student success as evidenced by top grades or positive retention outcomes. In doing so, it has the potential to both improve student learning outcomes and expand access to high quality education opportunities in ways that would have been unimaginable even a decade ago (World Economic Forum, 2014). This is the work that information professionals are good at, for instance Metropolitan Community College has been has been experimenting with big data methods in combination with student analytic tools found in Blackboard analytics to pull out key admission, enrollment and building utilization metrics which are crucial for planning and resource utilization. IFLA, (2016) revealed that the modern digital library has moved beyond its traditional focus on metadata, bibliographic and authority data and now manages or works with a broad set of data types, leveraging an ever expanding set of tools and techniques to do so (IFLA, 2016). Those tools also mean that even traditional data logs can be analyzed to improve the services librarians and libraries offer.

Since government hold vast amounts of data on the general populations, (Young, 2012) on libraries and big data argues that, public libraries which hold the public's trust, even above governments and corporations can help individuals understand this new digital realm by bridging what she sees as a persistent disconnect between

the general population and the knowledge of what happens with data collected on them and how it can be used.

Open data and open access initiatives

Libraries and librarians' ability to quickly grasp and gain comfort with new technology trends have embraced open data initiatives geared towards fulfilling goal 4 & 16 (action 10). For instance (Schwartz, 2013) reveals that when President Obama signed an open data executive order, libraries welcomed it enthusiastically. IBMS's data expert Jeff Jonas says that you need to let the data "speak to you" when referring to the ability to analyze vast amounts of data about an aspect of life and be able to establish correlations rather than a continuing quest for elusive causality so as to predict the future which is important for decision and policy makers (Mayer & Cukier, 2013).

Challenges of big data on libraries in developing countries

Big data poses serious security threats to individuals, companies and even governments because it involves collection of personal data and information. Sabiti reveals that data protection and privacy, important elements of big data are still underdeveloped in most developing countries like Africa. Most countries still do not have Data protection and privacy laws in place and given that most governments are hybrid regimes with authoritarian and semi-democratic tendencies, there is a danger that big data may be exploited to the detriment of rights of citizens (Sabiti, 2016).

Data curation and processing are also a challenge because of poor infrastructure especially in most developing countries like Africa. Hilbert, (2013) argues that, while an unprecedented amount of cost-effective data can be exploited to inform decision-making in areas that are crucial to many aspects of development, such as health care, security, economic productivity, and disaster and resource management, among others; and the extraction of actionable knowledge from the vast amounts of available digital information seems to be the natural next step in the ongoing evolution from the "Information Age" to the "Knowledge Age"; on the other hand, it runs through a slow and unequal diffusion process that is compromised by the lack of infrastructure, human capital, economic resource availability and institutional frameworks in developing countries which inevitably creates a new dimension of the digital divide.

Scholars such as (Greyling & Zulu, 2010; Kwanya, 2014) reveal that African libraries and information centers are poorly equipped to make a meaningful contribution to the current global digital knowledge economy. In addition, real time monitoring initiatives involve partnerships between the state, civil society, donors and the private sector whose varying interests often result in differences in understanding objectives, in adoption of specific technology-driven approaches since profit-making is a part of the equation for some partners.

It is also reported in (Schwartz, 2013) that the kind of expertise needed to manage data are just beginning to emerge from within librarians' ranks. On the other hand, Kwanya, (2014) argues that in spite of the many challenges libraries face in their efforts to support implementation of Vision 2030, their greatest impedance seems to be the laid-back and passive attitude of librarians. This could be a combination of issues ranging from lack of motivation in all its forms, the nature of government policies on the role of libraries that disconnects libraries from being active participants in government initiatives, financial constraints that hinder information literacy training programs and public relations/community outreach programs rendering libraries to remain passive.

Conclusion

From the literature reviewed, it is clear that although big data has great potential to contribute to the realization of SDGs, its implication on the role of libraries has yet to be appreciated in scholarly literature. There is inadequate academic and scholarly literature on how big data affects the role of libraries in the global development agenda yet the implications of this data revolution on libraries cannot be denied since libraries are always at the center of provision of access to information and knowledge that is required to drive nations' development agendas. However, it is also clear that libraries and information professionals as early adopters of technology are uniquely suited to deliver the most valuable resource "information and knowledge" that drives decisions for sustainable development. Literate reveals a gap between the developed world and developing countries in terms of big data initiatives uptake with libraries in developed countries more engaged in big data initiatives because big data is dependent on hardware and software for storage and analysis yet technology infrastructure in developing countries like Africa is still underdeveloped. This necessities cooperation among all stakeholders in collection, developing tools and strategies that allow the use of big data for attainment SDGs. Literature also indicates that the kind of expertise needed to manage data are just beginning to emerge within librarians' ranks which means that there is need for continuous professional development.

Recommendations

Building partnerships

African libraries should partner with technologists in investigating approaches to build trust and privacy adequately into big data technology focusing on striking the delicate balance between the people's right to privacy and the need to extract additional knowledge, patterns and value from personal data. In addition, big data is dependent on hardware and software for storage and analysis yet technology infrastructure in developing countries like Africa is still underdeveloped so there is need for cooperation among all stakeholders in collection, developing tools and strategies that allow the use of big data for attainment SDGs.

Aggressive campaigns and advocacy

Librarians in the developing countries, in particular those in Africa have always stated that governments do not take them and their work seriously as they deserve (Ojo, Sotunsa, & Traore, 2016). The modern librarianship demands change in information professionals' philosophy and practices to cope with the demands of big data deluge. For this reason, libraries information professionals need to play an aggressive role in being change agents. By demonstrating the contribution libraries make across the goal framework through campaigns and meetings with government officials, libraries will be in the best position to partner with government and others to implement national strategies and programmes that benefit the user communities. Libraries are known to be organs that have public trust so they should intensify their advocacy for freedom of access to information balanced against protecting human privacy. Libraries will be able to identify, select, and acquire large datasets of valuable information without cost or copyright restrictions.

Implement big data and open data policies

Laws and policy framework governing use of big data are not yet implemented in some countries even where they exist especially in Africa, they are not functional. Librarians have always remained custodians of data, so they can become essential partners for metadata standards, metadata creation, preservation and managing the whole information life cycle. However, there is there is need for policy reform to address the issues that have come up due to advances in information technology in particular, big data revolution. So governments especially those in developing countries like Africa should proactively implement open government initiatives jointly involving information professionals to allow people access government information in real time.

Continuous professional development

As librarians are increasingly involved in promoting and supporting the sharing of open data, managing repositories and curating research data, professional development will need to keep up. This requires continuous study and research by information professionals to upgrade and update skill sets required for the new roles such digital archivists, data curators and other types of librarians who need to advise their organizations on storage and accessibility of big data sets.

Review and upgrade Library and Information Science curriculum

Therefore there is need for reviewing the current Library and Information Science Curriculum (LIS) curriculum in LIS schools in developing countries especially Africa to ensure LIS graduates who have not only the technological skills but also the policy perspective that views data as a collection.

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