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"BIG DATA" Revitalizing Librarianship: Impact On Librarians

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Introduction

The 4th Industrial Revolution era ushered in advanced technologies that has led to the growth of data. Hoy says “Everything is data, everything people do, say, observe creates more data” (Hoy, 2014), this is the picture of the 4th Industrial Revolution era. Data is growing in volume, velocity, and variety daily hence, it is referred to as Big Data (BD), and it has impacted almost every area of life. The term “Big Data” was first coined in 2001 by Laney but started gaining attention in every sphere of society in 2012. It is simply datasets that are increasingly available at a dynamic speed in a diverse format and need to be captured, processed, organised, analysed, and stored for future use. However, traditional data management systems cannot handle it because of its complex characteristics. Big Data has been characterised as data with huge volume, high velocity, high variety and low veracity. Data from unstructured varied sources such as social media, email, online search and others form Big Data, thus, posing challenges of acquisition, analysis, storage and preservation.

Today, Big Data is a red-hot topic and has been in many disciplines in different capacities. It has been used in industries, business, government and education, and its uses are numerous. It has impacted the educational system, and for the library to continue to be the heartbeat of educational institutions, it has to respond to and reflect changes in its services.

Big Data in the library improves library services; it helps the library to forecast users’ habits and patterns of use of systems and resources, as users’ reading habits and for decision-making as analysis of readers’ behaviour (Zhang and Xia Xu, 2019; Zhang, 2016 and Wu su and Deng, 2013). As a result, Big Data is gaining momentum in librarianship in recent times. However, Big Data in the library has brought some challenges, libraries are now brainstorming on their role in handling Big Data and how to use it in developing their services. How will the library manage and preserve Big Data? Do librarians equipped with the required skills to manage Big Data? These are some of the questions brought up by BD. Therefore, there is a need for a shift in paradigm from traditional to contemporary library infrastructure and librarians’ competencies (Jaiswal and Singh, 2020). This paper attempts to provide answers to these questions. Therefore, the paper seeks to discuss an overview of Big Data, Big Data in the library, and its implications for Librarians and Information professionals. The rest of the paper is organised in the following manner: the objective, an overview of Big Data, Big Data in the Library, Librarians’ role in BD, skills requirements for Big Data, Implications and Conclusion.

Objective

This paper attempts to examine the concept of Big Data in general, and in particular in the library. It discusses how big data is useful in libraries, the role of librarians and the skills requirements for librarians to function in a data-intensive environment and ethical considerations.

3. Literature review

3.1 Big Data: An Overview

Big Data" was first coined by Laney in 2001, and Hoy (2014) defined it as a massive data set that can yield surprising insights when analysed. Laney described that Big Data possesses certain distinct features that distinguish it from regular data, the 'V-characteristics' though, there is no single definition for it. It has been defined in various ways by different people. Big Data was defined as data that exceeds the users' ability to analyse in volume, velocity and variety (Olendorf and Wang 2017) because of its huge volume, high velocity and high variety. Furthermore, Jain (2016) and Kiran (2019) added low veracity/validity and high value to its features, and again, variability and visualization have been added (Impact, 2016).

Big data is characterised by "7Vs"; a huge volume of data beyond the regular data size to the extent that traditional software cannot handle it. Conventional data management software could manage megabyte and kilobyte-sized data not possible with terabyte and petabyte-sized datasets. There seems to be no definite or fixed data size because its size varies from discipline to discipline. It is of high velocity because the speed of its creation is dynamically fast, coming in at every second. Besides, Big data is known for its high variety because it is highly unstructured and retrieves from heterogeneous sources in diverse forms and formats, unlike regular data that is structured. Data sets from different formats, such as email messages, notes, Internet postings, Twitter messages, photographs and others (Ahmad and Rafi, 2019; Wang, et al 2016). It is of low veracity, and integrity/credibility is questionable. However, when BD is analysed, it is of high value. Users of analysed BD will be able to use it for valuable purposes. Big Data is of high variability because its meaning, value, validity and visualization will change after a while and thus have a huge effect on data homogenization. The last V is visualization - meaning that Big Data should be presented using charts and graphs to understand it explicitly (Panda, 2021).

3.2 Big Data in library environment

Big Data is different from discipline to discipline, BD in the library is different from BD in other disciplines, such as health, business and government. Big Data is relatively new, but it has permeated business, government, health and educational spheres. The first question to consider is what data do we have in libraries that can be referred to as Big Data? Looking at Big Data through the library lens is aptly emerging and gradually presents in libraries, especially academic and research libraries. Manasear, Alawneh and Asoudi (2019) believe that information resources in a varied format in the library, which continues to be pervasive in academic, research and data-driven decision-making are evolving as the basis of modern research are Big Data. However, the common factor about BD is its characteristics. There are data in the library that fit into the characteristics of BD, research data sets come to the library with dynamism as research is carried out, and various copies of data are on servers, and tapes in geographically distributed locations, which is the velocity of library datasets. Besides, the library collection comprises a high variety, such as books, journals, reports, notes, maps, films, pictures, audio and multimedia.

There are unstructured data, such as language-based data, notes, Twitter messages, Facebook and others. The non-language-based like pictures, slides, audio, and videos, and the digital research data in different shapes and forms such as negative photographs, and scans of

historical images. All these are a high variety of datasets in the library (Wang et al, 2016). In line with this, Ball (2019) submitted that there are Big Data in libraries because library work involves unstructured data such as texts, metadata, images, audio, videos, research data, 3D digital copies and software, indexing, referencing and others.

There is Big Data in the library because libraries have been known to be houses of varied resources; be it academic, recreational, social, cultural, health, or religious and these resources are in diverse formats. Big Data has been in libraries since cataloguing functions and circulation systems were automated through OCLC and other data-sharing organisations, the first example of Big data is WorldCat. WorldCat is the world's largest network of library content and services, and it supports knowledge discovery in several areas. Besides, the following constitutes Big Data in libraries; collecting data, reporting and analyses and compiling them into library statistics to assess the library resources and their usage; digitised images, research data, cloud services, indigenous knowledge collected and analysed and data processing technologies in the library (Gerrard, et al, 2018).

Wang et al (2016) opined that there are data sets in libraries that could be organised as Big Data, for instance, data schema could be created from the library collection. For example, from an information source, such as a book, relationships from co-authors, citations, geo-location, dates, named entries, subject classification, institutional affiliations and publishers could be extracted (Kaladhar, Doraswamy Naick and Somasekhara Rao, 2018). Libraries could also collate the data that users search and use daily, if it is done, such could have a volume similar to that of Twitter messages. They further averred that there are data in libraries that are less organised or unstructured which made it fit the unstructured characteristic of Big Data. Research data stored in libraries by researchers have different formats because individual researchers are used to their process, in addition, researches conducted lack a unified standard and format because it follows discipline specifics.

Few libraries have taken a giant initiative in implementing Big Data. The Library of Congress partnered with Twitter to archive every tweet ever tweeted. Another one is the creation of a metadatabase for Geophysical data in Australia, where librarians collaborated with geophysicists, geophysical data analysts and IT experts to create a metadatabase using geophysical data from the oil concern Shell. Besides, Harvard University Library made Big Data applications for information materials where metadata were created for over 12m materials such as videos, books, audio and others. There is also Library Data Labs Project jointly launched by Joint Information System Committee (JISC) and British Higher Education Statistics Agency (HESA) to provide higher education institutions and non-profit organisations with several tools to analyse massive amounts of data. Others are Brooklyn Public Library Big Data for the visualisation of user data and the Joint Big Data initiative among ten US libraries (Panda, 2021).

3.3 Benefits of big data in library

It is important to note that analysing Big Data will benefit various organisations in diverse ways, such benefits include making organisations abreast of the happenings all over the world, it will also widen organisations' perspectives towards any issue by analysing the data of social

media. Besides, it will give organisations a viable advantage, entice investors, aid in making decisions and bring satisfaction (Manaseer, Alawneh and Asoudi (2019).

Big Data has brought benefits to all sectors that implemented it. E-commerce has used BD to improve the sale of products and services to numerous customers, the Financial industry has employed BD to detect credit card fraud, and the government is using BD in telecommunication and financial data to track money fraudsters and terrorists.

Library BD will bring some tremendous benefits to librarianship. Wu, Su, and Deng (2013), emphasised that big data could be used for decision-making. For instance, analysis of readers' behaviour will help libraries understand the interests, preferences of their patrons, and borrowing patterns. The readers search queries will make libraries to take informed decisions about which books, journals, and other resources to acquire for their collections. Thus, ensuring they align with the needs and interests of their users, resource allocation, and service improvements (Borgman, 2015; Koltay, and Sándor, 2018).

Similarly, BD will make libraries to support research and scholarly activities. By analyzing research data, citations, and users behaviour, libraries can identify emerging research trends, develop targeted research guides, and provide access to relevant resources. This can assist scholars, researchers, and students in finding and accessing the information they need for their academic pursuits (Tenopir and King, 2013). It will help researchers to manage large data effectively, assist students, faculty and staff run statistics for projects, and librarians will mine users' behaviour, which will give an intuition for providing better services (Wang et al., 2016).

According to Ball (2019), analysed library big data will bring a better understanding of library users and the library will improve its services and offer new services. This will enhance users' experience because Big data can provide insights into user preferences and behaviours, allowing libraries to tailor their services and offerings accordingly. By analyzing the resources users frequently access, libraries can personalize their recommendations, create curated lists, and offer more relevant content to individual users, thus enhancing the user experience (Holley, 2017). Besides, by analyzing users' demographics and preferences, libraries can offer targeted workshops, courses, or events that cater to the specific interests of their community. This can cause increased user engagement and satisfaction. Big Data will enhance resource management in libraries. This is because BD enables libraries to gain a deeper understanding of resource utilization. By analyzing circulation data, libraries can identify underutilized resources and reallocate them more efficiently. This helps libraries optimize their collection, weed out outdated or rarely used materials, and invest in high-demand resources (Chen and Zhang, 2014).

Big data provides libraries with valuable insights into various metrics, such as resource usage, budget allocations, and user satisfaction. These insights can assist library managers in making data-driven decisions to improve operations, allocate resources effectively, and enhance overall library performance. In addition, it can also facilitate collaboration and knowledge sharing among libraries and other cultural institutions. By analyzing usage patterns and resource sharing data, libraries can identify potential partnerships, collaborate on joint programs, and share resources more efficiently. This promotes a stronger network within the library community, leading to enhanced services and increased access to a wider range of resources for library users.

Because of the above benefits of Big Data to libraries, many libraries are already using Big Data for managerial purposes, provision of library services, data management planning, data

collection data curation, and data archiving (Sugimoto et al., 2012; Zhang, 2016; Kamupunga and Chunting, 2019). Overall, big data offers libraries the opportunity to harness the power of data to better understand and serve their users, optimize resource allocation, and improve overall library operations.

3.4 Roles of Librarians in Big Data

Librarians and Information professionals (LIPs) have been collecting, processing and disseminating needed information to an enormous number of users, however, with Big Data the traditional ways of working with data have changed. LIPs have added roles to their traditional ones. Hoy (2014) highlighted four key ways librarians could be involved in Big Data. Collection development and preservation of Big data, he observed that users that are interested in working with Big data will need material and direction to work, therefore, librarians are to acquire and preserve materials on Big Data in their libraries and also help users to use those materials. Secondly, he noted that librarians are positioned to help users to understand where and how to find Big Data sets. Besides, librarians are to help with research data management in their institutions, especially recently when funding agencies have specified data retention guidelines that must be adhered to. Thus, at the research planning stage, it is expected that librarians appraise, and think about the preservation and archival options for the data sets, and should not wait for the products of research. Lastly, Hoy submitted that librarians should help their patrons understand what Big Data can and cannot do and how best to use it to achieve their research goals.

Other roles of librarians in the Big Data era discussed by Fakiragouda (2022) and Panda (2021) are assurance, analysis and integration. After the collection of data, there is a need to ensure the quality of collected data, analysis of data, organisation, categorisation and summary of data for better understanding and interpretation.

Besides, adequate documentation and metadata information for proper description is germane. Thereafter, archiving and preservation are other services to be rendered by librarians (Panda, 2021). According to Gordon-Murnane (2012), librarians are needed in four key areas; organisation, search and access of internal datasets, awareness of external data sources and serving as authorities in copyright and intellectual property issues. Librarians should create metadata schemes and taxonomies and design standard retrieval methods (Jharotia, 2016).

Thereafter, librarians need to help patrons to understand what Big Data is and how they can effectively use them to achieve their goals. Recently, many research grants required a data management plan as part of the application process, hence, librarians are expected to be involved at an early stage to create and provide data management services that meet the new grant specification. According to Wiffmann and Reinhalter (2014), other roles of librarians in the Big Data library environment are to collaborate with researchers in creating new models that will support the curation and visualization; they should recommend tools and strategies for data analysis; advise researchers on data management planning.

3.5 Required Skills for Big Data

The concern of libraries about Big Data is how to handle Big Data and make it useful in library services. Looking at the traditional role of libraries as institutions that identify, select valuable

resources, organise, describe, and preserve to provide access to patrons, but with the emergence of Big Data, there is new knowledge gained, new services and value added to the traditional ones. Big Data in the library has brought added services that require additional skills. Data are valueless without analysis, but many librarians and information professionals lack data skills to work confidently in a world of data-intensive workplaces.

In the first instance, librarians are to upgrade and equip themselves with the knowledge of Big Data; by understanding what constitutes Big Data in libraries and how to evaluate Big Data to improve library services and provide high-quality services. Thus Kirkwood (2016) submitted that librarians need to change their self-identification and philosophy and to re-skill. Wang et al (2016) submitted that librarians should develop additional disciplinary knowledge and data management skills, to make big datasets more useful, visible and accessible through Big Data analytics and usable for researchers.

According to Jaiswal (2020), for Librarians and Information Professionals to cope in this digital era, data science skills are germane. Skills like data management, warehousing, visualisation, machine language, and big data analytics. The study by Shahid and Parveen Siddiqui (2021) found data management skills, data cleaning and other technical skills required for librarians to work with Big Data. In addition, collaborative skill is required because librarians have to collaborate with other professionals like Data Scientists, Computer Scientists and others (Wiffmann and Reinhalter, 2014).

In conclusion, looking at the required skills from the perspectives of stages involved in big data processing, it is pertinent to note that skills in data extraction, transformation, loading, and visualization are needed to be suitably qualified to work with Big Data.

3.6 Introducing Big Data in Libraries

Panda (2021) highlighted steps in introducing Big Data in Library. The following are some of the steps:

3.6.1 Identification of the Framework

The first thing library should do in implementing Big Data is to identify the suitable framework, and should be done through the 7Vs characteristics of Big Data .as discussed above. The implication of this is that when it comes to Big Data implementation "one-cap-fit-all" is not applicable.

3.6.2 Need Analysis

The next step is to identify the library's current needs and the potential benefits of Big Data. It will make a library know if the benefits of Big Data will meet its current need.

3.6.3 Infrastructure and Manpower

Libraries should find out the estimated cost of implementation as regards equipment and manpower. Big Data requires high-performance computing and cyberinfrastructure Centers, servers, storage and database software, operating systems, and statistical and analysis software.

On the other hand, highly skilled data librarians and information technology personnel are needed. The library should take inventory to ensure that the required resources and manpower are available.

3.6.4 Administration

Having identified available resources, the library should compare them with the minimal required resources, get the difference and find a solution. Libraries need to provide an administrative layer for service-level data stores.

3.6.5 Policies

There is a need for policy statements that will guide the project. There must be documentation as regards the scope and guiding principle of its access and use. This is necessary to ascertain the focus, limitations, and specifics related to the type of data to be stored and its usage.

3.6.6 Analysis and visualization

The kind of analyses and visualizations that are desirable will inform the choice of software for analysis and visualization.

Having gone through the steps highlighted above, the library project committee is pleased with the situation as the implementation is finalised. If the required equipment and manpower are not met, the library could seek collaborations with other institutions.

Ethical Considerations

Ethical considerations in the context of big data in libraries revolve around issues of privacy, consent, data security, and bias. Here are some key ethical considerations:

1. **Privacy:** The collection and storage of large amounts of personal data raise concerns about privacy. Libraries handle vast amounts of sensitive user data. Big data analytics may require collection and analysis of personally identifiable information (PII), raising concerns about individual privacy and confidentiality. Safeguards should be put in place to protect user data and ensure compliance with relevant privacy laws. It is important to ensure that individuals' personal information is protected, and their consent is obtained for data usage (ALA Office for Intellectual Freedom, 2019; Reidenberg, 2019).
2. **Consent and Transparency:** Users should be adequately informed about how their data is being collected, used, and shared. Transparent data practices and obtaining explicit consent allow individuals to make informed decisions regarding their personal information. This ensures that individuals have knowledge about the purpose and scope of data collection and are able to make an informed decision (Obar and Oeldorf-Hirsch, 2017; Wachter-Boettcher, 2017).
3. **Data Ownership and Control:** Libraries should consider the ownership and control of the data they collect and analyze. There should be transparency about who has access to the data and how it is used. Libraries must respect individuals' rights to their data and ensure that it is not misused or sold without consent (Borgman, 2015; Calo, 2013).
4. **Data Security:** Libraries must ensure the secure storage and handling of big data to prevent unauthorized access, breaches, or misuse. Encryption, access controls, and data anonymization techniques can help protect sensitive information (Schneier, 2015; IFLA, 2018).

5. Bias and Fairness: Big data analytics can reflect and amplify existing societal biases, leading to discrimination or exclusion. Libraries should strive for fairness and inclusiveness by examining and mitigating biases in algorithms and data sets used for analysis (Crawford and Schultz, 2014; Noble, 2018).

6. Data Retention and Deletion: Libraries should establish policies and practices for data retention and deletion to ensure that collected data is not stored longer than necessary and is securely deleted (Data Protection Officer for the State of Baden-Württemberg, 2019; European Association for Library and Information Education and Research, 2019).

4. Implications

Big Data in the library has brought a crucial impact on librarianship in general. It is of necessity that Library and Information Science education needs serious upgrading, to meet up with the demand of the 4th Industrial Revolution era. The curriculum must be reviewed to provide the needed skills for the librarians and information professionals of the future. On the other hand, the current librarians need serious retraining to be able to cope with the data-intensive work requirements.

5. Conclusion

Big Data is an evolving concept which has attracted global attention and led to transmuting swiftly the way we think, live and work. Big Data in libraries has re-energised librarianship and created new roles for librarians. As a result, traditional librarianship skills are no longer adequate to work in data-intensive library environments, thus, there are new skills for librarians to function in making big datasets more useful, visible and accessible to users. Conclusively, librarians have to follow swift changes in society from time to time and be informed, prepared, trained and work effectively in the libraries of the future.

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