

Opportunities and Challenges of Providing Library and Information Services in the Fourth Industrial Revolution Era

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Abstract

The landscape of library and information service delivery is currently being faced with the challenges and opportunities enveloping the global space. This present scenario places an urgent demand on librarians to respond positively for the profession to still take its place in the scheme of things. The paper highlights the prospects of a fourth industrial revolution (4IR) in librarianship which include changes in societal perception and acceptability of the profession, collaborative initiatives and exploration of existing synergy between the profession and allied disciplines, improved quality of service and increase in innovative capacity. It is recognized that there will be a dimensional shift in the provision of library services in the 4IR era such as higher level of productivity and efficiency, creation of new job opportunities, improved quality of service delivery as well as skills set disruption. This paper articulates the skills required to cope with challenges of a fourth industrial revolution such as basic digital skills and cross-functional skills. The challenges to conquer in libraries and information centres are unavailability of infrastructure, low level of digital literacy among users, low level of innovative capacity among librarians; fear of job replacement among others. Strategies for driving the library environment and overcoming challenges in the era of 4IR are basically engaging in re-skilling programmes, acquisition of digital infrastructures, adequate funding of libraries and continuing professional development of library professionals.

Keywords: Fourth industrial revolution, industrial revolution, information services, library services

Introduction

The global environment is undergoing changes driven by the penetrating influence of technology. Librarians as a matter of urgency must embrace these changes. However, notable among these changes is the reality that library and information professionals are enmeshed in the web of a fourth industrial revolution (4IR) that is currently reshaping the entire global space. It is not surprising that rapid advances in emerging technologies are significantly transforming the landscape of librarianship, as most routine library activities are being automated, and others digitised. However, coping with these changes requires distinct knowledge and skills that expose the profession to new challenges.

In contemporary society, diverse technologies are being integrated into professional library practices, requiring library and information professionals to keep abreast of new developments. New technologies if embraced and integrated into library service delivery, undeniably have the capability to change the economics of librarianship. The development of these new technologies triggers improvements in the quality of information services and changes in approach to information service delivery. However, the changes witnessed in the profession within the global space are not unconnected with the wind of the new revolution tagged “Fourth Industrial Revolution”. Library and information professionals must therefore show readiness to act and align with the trends of 4IR.

It is pertinent that librarians must strategise to put libraries at the forefront of the information industry, especially in this new era. According to Schiuma (2017), the successful organisation of the digital age will be by those who recognise that as much as there will continue to be advancements in technology, people will still be at the heart of organisational life and that the most human distinguishing factors will become even more fundamental for the creation and delivery of value. In other words, if threats and opportunities of the 4IR are to be taken adequately into account in information service provision, then a thorough understanding of the implications of the 4IR for the profession is necessary.

As noted by Hussain (2019), the fourth industrial revolution will have implications for how people live and work, as every sector in both developed and developing countries will be affected positively by the revolution. It is expected to bring about substantial changes (Kuruczleki *et al*, 2016), because the digital technologies of the 4IR are fast becoming the engine of change throughout all sectors of the global economy (WEF, 2018).

The advent of the fourth industrial revolution promises significant social and economic opportunities and challenges which demand that governments respond appropriately in supporting the transformation of the society (Manda & Dhaou, 2019). The idea of 4IR is that all facilities in the factory (machines, robots, devices, products, and computers) and people communicate with each other, mostly wirelessly (Dimitrieska, Stankovska & Efremova, 2018). Employees and future employees need to take into account that work arrangements are much more diverse and that working in a standardised form may no longer be dominant in the future (Man & Man, 2019).

The digital transformation to industry in the fourth industrial revolution brings with it both new opportunities and risks (Adeniran, 2016). Librarianship from documented history has been the driving force behind educational activities. This fast-changing era is propelled by technology driven transformation, and the impact is felt by individuals, corporations, industries and society itself (Mdluli & Makhupe, 2017). The 4IR is not only posing challenges, but also opening up new prospects for librarianship as a profession. The continuous rapid succession of technological advancement in the areas of robotics, artificial intelligence (AI), big data, machine learning, cloud computing etc, is gradually transforming how library and information services are provided, with enhanced and visible levels of high productivity. The digital revolution has brought about new types of library and information services and products, such that there are new ways of providing existing information services in the various libraries.

The 4IR from an institutional point of view is bringing opportunities and challenges. The opportunities are related to the possibility of gains in efficiency and productivity that will open new markets and drive economic growth (Lee *et al*, 2018). According to Elliot (2016 as cited in Frederick, 2016), the fourth industrial revolution brings both promise and perils for humanity. The 4IR is a fundamental shift in the way that technology, communications, data, and analytics impact almost all aspects of library and information services.

The landscape of library and information service delivery is currently being faced with the challenges and opportunities that are all-encompassing in the global space. The 4th industrial revolution is creating a demand for new jobs in libraries and information centres. Technologies are dramatically affecting the pattern of library practices. Provision of library and information services have been made much easier, and efficient information service provision is now a reality in libraries. 4IR is fundamentally transforming modern library practices; in other words, Librarians are in the era of “cutting edge” technology. New technologies are emerging faster and they are

being adopted more quickly and delivering greater impact than ever before. The landscape of librarianship is currently under the overwhelming influence of technological disruption. Therefore, with the 4IR, there would be a change in the conduct of library and information services. If libraries are to survive in this digital age and remain relevant in the scheme of things, they must have to do things differently, one of which is embracing the reality of the fourth industrial revolution in library services.

The present scenario places an urgent demand on librarians to respond positively for the profession to still take its place in the scheme of things. Industrial revolution is fast changing the way products are designed and manufactured, by connecting different sensors and systems together (Asghar *et al*, 2020). This paper generally presents a discourse on opportunities and challenges of providing library and information services in the fourth industrial revolution era. The specific objectives are:

- i. Present an overview of industrial revolution and fourth industrial revolution; ii. Describe the various components of the fourth industrial revolution;
- ii. Discuss skills requirements for librarians to handle new technologies in the fourth industrial revolution;
- iv. Highlight the prospects of the fourth industrial revolution in librarianship;
- v. Identify the challenges to overcome in library and information centres in readiness for the fourth industrial revolution era
- vi. Highlight the strategies for driving the library environment and overcoming challenges.

Industrial Revolution And Fourth Industrial Revolution: An Overview

The term “industrial revolution” is used to refer to the transformation of the social and technological economic systems in industry, focusing in particular on changes in living conditions, circumstances of work, and economic wealth (Dombrowski & Wagner, 2014 as cited in Adendorff, Lutshaba & Shelver, 2018). The industrial revolution simply describes an era marked by a technological revolution where new and rapidly advancing technologies merge with human, physical, mechanical, and biological systems, leading to an extraordinary transformation of the social, economic, and political status quo (Uzochukwu, Alloysius & Olohi, 2019).

Industrial revolution is a period in which machines bring significant changes to the people's way of life, especially in the area of manufacturing. Industrial revolution history is the main turning point where almost every aspect of everyday life is influenced by it (Technical Education and Skills Development Authority, 2016; Mahmood & Hussin, 2018). Industrial revolution is a concept and a development that has fundamentally changed society and world economies (Bloem et al, 2015). It is a rapid change in the economy that is marked by the general introduction of power-driven machinery or by an important change in the prevailing types and methods of use of such machines (Adeniran, 2016). Industrial revolutions have always been at the heart of major changes that impact severely on the society (Dallal, 2019). It is a world phenomenon that has metamorphosed from the first industrial revolution all through to the second, third, and now the fourth industrial revolution.

Fourth Industrial Revolution

Definitions abound, but the change the fourth industrial revolution portends at its core, is the marriage between the physical and digital technologies such as analytics, artificial intelligence, cognitive technologies and the internet of things (IoT). The fourth industrial revolution is a term coined by Professor Klaus Schwab, founder and Executive Chairman of the World Economic Forum, who described it as a current and developing environment in which disruptive technologies and trends such as the internet of things, robotics, virtual reality, and Artificial Intelligence are changing the way people live and work. The 4IR as a new concept of economic development, will improve living standards by integrating production, marketing, and consumers with the best communication technologies (Dimitrieska, Stankovska & Efremova, 2018).

The fourth industrial revolution is an outcome of artificial intelligence and many trades and industries have been affected (Hussain 2019). Kodanna (2017, as cited in Nkosi, *et al.*, 2020) defines 4IR as a worldwide infrastructure for info civilization, allowing progressive facilities by intersecting (bodily and computer-generated) things built on current and developing interoperable ICT. The fourth industrial revolution is a term representing the new industrial age information and communication technology. It is not only about embracing new disruptive digital-based technologies and learning machines, but also about shaping organizational environments that let people express their real potentials and be in touch with their positive emotions (Schiuma, 2017). Rashid (n.d.) describes 4IR as referring to a set of highly disruptive technologies such as artificial

intelligence, (AI), robotics, block chain and 3D printing, that are transforming social, economic and environment eco-systems and putting huge pressure on leaders and policy makers to respond Mahmood & Hussin (2018) on the other hand see 4IR as the digital industry which involves the internet of things (IoT) in almost all aspects of everyday life and is different from the first to third industrial revolutions.

Components Of The Fourth Industrial Revolution

Intelligent information technologies of the current industrial revolution include artificial intelligence, internet of things, cloud computing, big data and mobile convergence on existing industries and services (Jee, 2017). Several components of the 4IRs are explained below:

Internet Of Things (IOT). The Internet of Things (IoT) is the internet networking of physical devices. Internet of things (IoT) is part of 4IR and revolutionises information sources within the organisation; thus, the adaptation of the organisation and the professional working in it becomes inevitable (Chusniyal *et al*, 2019). The IoT is one of the important pillars of the 4IR. This technology involves connecting a range of smart sensors that gather data, and process it into prescribed form according to need (Dallah, 2019). The application of IoT, in which objects equipped with electronic sensors and actuators are connected to the internet, allowing them to capture, filter, and exchange data about themselves and their environment (and/or to each other) is expected to further automate people's daily activities (Dadios *et al*, 2018).

Internet of things (IoT) application in librarianship enables activities and objects to be monitored and controlled remotely using established communications networks, opening the potential in computerised and digital systems, increasing efficiency, accuracy and productivity while reducing human interactions (Dadios *et al*, 2018). The various technologies in libraries can be connected with each other, and controlled by a remote control, smart phone or computer. This has been made easier with the advancement of wireless connectivity with the IoT. Gadgets are connected that enable monitoring, detection, control, and automation. Adendorff, Lutshaba & Shelver (2018) defined IoT as the pervasive presence of a variety of things or objects such as Radio Frequency Identification (RFID) tags, sensors, actuators, mobile phones etc, which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbours to reach common goals.

Robotics. Robots can be deployed in doing work that are time consuming and dirty. In contemporary society, industry without robots is now almost inconceivable, especially in

developed countries. Robots do everything covered by the three Ds: dirty, dangerous and dull work. Robots do it tirelessly, and function with unprecedented precision and often power (Bloem, *et al*, 2015). There are different generations of robots namely first (1st) generation robot also called industrial robot (manufacturing, automation), they are robust, fast and precise. Second (2nd) generation robots are known as service robots, and they are used in private and public services. They are intelligent, interactive and mobile. Third (3rd) generation robots also known as ubiquitous robot are applied in u-services. They are networked, calm, seamless and context aware. Fourth (4th) generation robots (Genetic Robot) are used in artificial species, while the fifth (5th) generation robots or Bio Robot are deployed in high quality of life and symbiosis.

Big Data. There is no universal consensus on what big data means, but many would refer to it as the digital data sets that are so large either in terms of scale, i.e. “volume”, or streams across time i.e. ‘velocity’, or complex in terms of variety (Dadios *et al*, 2018). Big data is one of the most important technologies adopted in the fourth industrial revolution. It is related to the large collection, processing and analysis of structured and unstructured data with intelligent algorithms.

Artificial Intelligence (AI). There is no universally accepted definition of AI. AI is the driving force behind the 4IR (Mahomed, 2018). Artificial intelligence describes the work processes of machines that would require intelligence if performed by humans. AI therefore offers librarians opportunity to provide services efficiently, as it can prevent human error from occurring in library practices. Artificial intelligence and automation processes are change agents in the fourth industrial revolution which will make certain employees redundant and replace them with new workers with the needed skills (Hussain, 2019), or with machines that do the job cheaper. AI as a device, perceives its environment and takes actions that maximize its chances of successfully achieving its goals. It is not restricted only to informing decisions, but to making them as well (Dallah, 2019). It is usually associated with high-tech robotics automation and science fiction and can seem daunting to some (Mahomed, 2018).

5G Technology. The fifth generation of mobile technology greatly expands the promise of faster, more reliable cellular and internet connectivity. 5G will signal a digital transformation in librarianship that will culminate in undeniable changes in the efficiency of information services delivered through the internet connectivity.

Cyber Physical Systems (CPS). According to Asghar *et al* (2020), CPS is the foundation store for 4IR on which all the rest of the other components of the 4IR depends. CPS is what

connects all the physical components, data and cyber components to one another. They work by maintaining a cyber-copy of the physical systems that help in running the factories autonomously.

3D Printing. 3D printing includes a group of technologies and processes that use a digital file to build a physical three-dimensional object using additive manufacturing. 3D printing could augment productivity in a variety of ways.

Cloud Computing. Cloud computing is a model that allows for on-demand network access that is ubiquitous and easy to deploy on a shared pool of configurable computing resources. It can be quickly provisioned and deployed with minimal administrative effort (Hahm, 2018). Cloud computing allows greater flexibility and thus allows organizations to expand fast enough to meet growing demands. Cloud computing allows managing huge data volumes in open systems and ensuring real-time communication for production systems. In cloud computing, the role of service providers is of two types - the infrastructure providers and the service providers. The infrastructure providers are responsible for providing central processing unit (CPU) and storage etc., whereas the service providers rent or lease resources for the infrastructure providers and provide these services to the end users (Asghar *et al*, 2020).

Automation. Automation has made significant inroads in the delivery of library and information services. As noted by Adendorff (2018, cited in Adendorff, Lutshaba & Shelper, 2018), automation certainly has positive effects, such as an ordinary system of high-volume processes which skilled employees are required to perform complex manual tasks with and still manage and control the processes and machines.

Skills Requirement For Librarians To Handle New Technologies In The Fourth Industrial Revolution

In the digital era with hyper connectivity and machine and human interactions, employees need to constantly keep up to date with their knowledge and develop new skills related to using new technology (Man & Man, 2019). According to Xing & Marwala (n.d.), the period of the 4IR requires certain skills that are not exactly the same as the skills that were required in the third industrial revolution where information technology was the key driver. Yusuf, Walters & Sailin (2020) articulated the skills required by future workers to meet the challenges encountered with the technologies to include:

Abilities. This is the capacity to act mentally and physically. Cognitive abilities require having a flexible mind-set, logical reasoning, problem sensitivity, creativity, and mathematical

reasoning. Physical ability requires having mental and physical alertness, as well as manual dexterity and precision

Basic Skills. This skill set can be differentiated into content skill and process skill. Content skills require active learning, ICT literacy, reading comprehension, oral and written expression. Process skills require active listening, critical thinking, monitoring self and others.

Cross-Functional Skills. The cross functional skill set cuts across other skill sets dimensions, like social skills, technical skills, system skills, complex problem-solving skills, and resource management skills

Prospects Of Fourth Industrial Revolution In Librarianship

The prospect of industrial development is hinged on the development of science and technology which has resulted in the growth and spread of heavy industries (Ndagi & Salihu, 2018). The 4IR presents technological breakthrough in robotics and artificial intelligence which call for both public and private sector to reduce human labour (Hofisi & Shava, 2017). According to Adeniran (2016), 4IR covers three fundamental aspects and these can be applicable to the library environment. The three aspects are digitisation and increased integration of vertical and horizontal value chains, digitisation of product and service offerings, and introduction of innovative digital business models.

1. Digitisation and increased integration of vertical and horizontal value chains: this involves development of custom products, customers' digital orders, automatic data transfer, and integrated customer service systems.
2. Digitisation of product and service offerings: this is complete description of the product and its related services through intelligent networks
3. Introduction of innovative digital business models: the high level of interaction between systems and technology opportunities develops new and integrated digital solutions. The basis of industrial internet is the integrated and real-time availability and control of systems across the enterprise.

Every revolution comes with its prospects and problems. The 4IRs is not an exception. The 4IR will create new opportunities for library and information professionals to harness. According to Manda and Dhaou (2009), this revolution creates new opportunities, such that developing

countries can leap frog stages of development and align with developed markets. Outlined below are the prospects of 4IR:

- Change in societal perception and acceptability of the profession: there are controversies in certain quarters of the possibility of the library science profession going extinct. However, pragmatic steps towards preparing the libraries for the 4IR is one of the ways through which the societal perception of the profession can be changed, especially in developing countries. If library and information professionals embrace the changes associated with the 4IRs, it will help in changing societal perception of the library profession.
- Collaborative initiatives and exploration of existing synergy between the profession and allied disciplines: there is already a synergy between librarianship and other disciplines, library and information professionals can leverage on this existing synergy to reposition libraries for effective service delivery in the 4IR era. Library and information professionals can leverage on the multidisciplinary nature of the revolution and reposition the profession in the context of 4IR.
- Improved quality of service delivery: when library and information services are transformed through the integration of technologies, the quality of services will improve. - Increase in innovative capacity: One of the unique facts about 4IR is the ability to bring innovative and creative skills embedded in most librarians. This means that there will be increase in innovative capacity of library and information professionals. Indeed, in the 4IR, libraries will be increasingly challenged to develop a capacity for change and innovation. The pace of change and the disruptive nature of innovations will require that organisations become more and more agile, intuitive, imaginative, and open to change (Schiuma, 2017).
- Higher level of productivity and efficiency: aligning with 4IR will lead to higher level of productivity and efficiency in information service delivery in library and information centres. - Creation of new job opportunities: if libraries embrace 4IR, it will bring about new job creation in the information sector.
- Skills set disruption: the introduction of radical change in technology in librarianship will ultimately result in skills set disruption.

Challenges To Conquer In Libraries And Information Centres In Readiness For The Fourth Industrial Revolution Era

Although the prospects are high for the profession, regrettably, the challenges are numerous as well. Some of the challenges library and information practitioners must conquer in order to remain relevant in the scheme of things in this digital era are articulated as follows:

a. **Unavailability of infrastructure:** The 4IR era thrives on the wing of digital infrastructure. As noted by Nkosi *et al* (2020), characterisation of educational infrastructure differs across context. Some are classified as physical and surface influence, and in another context, as hardware and software. Libraries must have infrastructure for it to remain relevant as an institution in the 4IR age. Libraries in developing countries are still under the siege of infrastructural challenges. Manda and Dhaou (2019) posit that developing countries are not only confronted by societal challenges but technological and infrastructural challenges. If libraries are to integrate fully into the web of 4IR, the challenges of infrastructure, which is the hub of this revolution must be overcome.

b. **Funding:** The acquisition of necessary infrastructure for the smooth drive of 4IR is near impossible in the absence of adequate funding. Furthermore, the acquisition of requisite skills requires funding. Notably, insufficient funding of educational institutions has been a key problem in most developing countries. Nkosi *et al* (2020) citing Bray (2002) affirmed that the lack of sufficient funds is the key issue in the growth of education. This to him is the reason behind shortage of university structure, learning apparatus and libraries, etc. This further inhibits the attainment of expected outcome.

c. **Low level of innovative capacity:** The level of innovative capacity among library and information professionals is at the lowest ebb. Most librarians still live in the notion that librarianship is all about charging and discharging of books, especially in the developing countries.

d. **Job losses:** The fear of job destruction due to possible labour substitution in the event of technological change has always been present in periods typified by radical technological changes, such as in the first, second and third industrial revolutions (TESDA, 2016). Manda and Dhaou (2019) affirmed that the increased use of technology in the fourth industrial revolution has renewed fears of massive job losses. Questions remain as to whether librarians are ready to embrace the expected notable changes, and how well they will cope with the inevitable job losses resulting from a paradigm shift.

Strategies For Overcoming Challenges In The Context Of Fourth Industrial Revolution In Librarianship

Library and information professionals can adopt the following strategies in order to overcome the identified challenges

- Continuing professional development: There is the need for training and re-training in preparation for the fourth industrial revolution. Library and information professionals should embark on professional development programmes relevant to the needs and demands of this age. To be at the cutting edge, librarians must acquire new skills in the area of application of information and communication technologies to library practices. According to Hussain (2019), the challenges of the fourth industrial revolution can be overcome by continuous professional development. Coping with any industrial revolution requires the creation of training systems which are capable of developing new skills (TESDA, 2016). As rightly captured by Akpom, Benson and Enem (2020), if librarians must really promote library services, there is need for acquisition of new skills. Also, training and re-training of librarians on current trends in librarianship provides a fertile soil for innovative and creative thinking aimed at improving library and information service delivery. Nevertheless, library and information professionals must effectively embrace re-skilling programmes and initiatives to ensure that technology supplements best global practices, instead of job replacement.

- Adequate funding of libraries and information centres: funding is a cardinal factor in the provision of library and information services. Provision of adequate funding will help in the acquisition of digital infrastructure as well as the acquisition of new skills. However, library and information professionals, especially heads of libraries and information centres must be proactive and pragmatic in their approach to sourcing for fund. It is expected that lobbying and advocacy is adopted as strategic approach in attracting funds for provision of effective library services.

- Engagement in strong partnership initiatives: Library and information professionals must be intentional in their approach to collaborative initiatives. They must be willing and ready to collaborate with stakeholders in the information industry. For instance, technical support can be sourced from expertise in the areas of computer engineering and system analytics. If a strong partnership is maintained, it can become a platform upon which library staff can build capacity in such areas.

- Acquisition of digital infrastructure: Heads of libraries and information centres should ensure that relevant digital infrastructure necessary for the provision of optimal services are provided. It has been acknowledged that digital infrastructure remains the hub upon which the pivot of fourth industrial revolution rotates. Therefore, it is imperative that heads of libraries liaise with their parent institution to ensure that the library is fully equipped with functional technologies that meet the demands of the present age.

Conclusion

From the review provided herein, the discussion proves that there are opportunities as well as challenges to the provision of library and information services in the fourth industrial revolution era. Consequently, it was noted that 4IR will bring about changes in societal perception and acceptability of the profession, collaborative initiatives, exploring existing synergy between the library profession and allied disciplines, enhanced quality services and increased innovative capacity among library and information practitioners. However, it seems that the provision of library and information services in the 4IR age is challenged by unavailability of infrastructure, low level of digital literacy among users, low level of innovative capacity among librarians, fear of job replacement, etc. Nevertheless, the strategies for driving the library environment and overcoming the challenges include engaging in re-skilling programmes, acquisition of digital infrastructure, adequate funding of libraries and continuous professional development programmes.

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