Chapter 3

Towards Digitally Enabled Libraries: The Fourth Industrial Revolution (4IR) in Libraries for Development in Botswana

Priti Jain
ORCID ID: https://orcid.org/0000-0002-7805-1196

Abstract

The COVID-19 pandemic has significantly accelerated the adoption of the fourth industrial revolution (4IR) technologies worldwide in most industries. Libraries and information centers are no exception, considering their aims of meeting the diverse needs of users. Achieving social, economic, and political development is dependent on access to information for research, development, and decision-making. All types of libraries are forced to re-examine their roles to conform to the ever-changing information environment. Despite the promising benefits of employing 4IR technologies towards transformation and development, no empirical study has been carried out in Botswana libraries. The purpose of this study was to assess the current digital transformation practices, prospects, and challenges faced in the adoption of 4IR technologies in libraries in Botswana to leverage the economic benefits of the technologies driven by 4IR. The data for this study was collected through an online survey tool (Google Forms) using a snowball sampling technique among academic librarians. The study revealed that Botswana libraries are not yet ready for 4IR technology implementation as they are not using AI, Blockchain, robotics, big data, and 3D-technology. However, the study identified the major opportunities as: access to digital information without any geographical barriers, knowledge sharing, and skill transfer, increased collaboration with peers and customers, economic/ national development through increased access to information, opportunity to promote literate, informed and participative societies and knowledge and

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augmentation of robots as humans for improved library services. The main challenges were found to include: financial constraints, lack of technological infrastructure and skills. The majority of the participants had soft skills and were aware of the opportunities offered by 4IR technologies, but were not able to use them. The study recommends adequate funding for building suitable technological infrastructure, implementation of 4IR in Library School curriculum, formulation of technology and digital literacy policy framework and Government support.

Keywords: Digital technologies, 4IR technology, coronavirus disease (COVID-19), libraries, Internet of Things, Big Data, Botswana.

1 Introduction

Transformation in all sectors is the key to development and ranks high in most government agendas. The fourth industrial revolution (4IR) has transformed the traditional methods of producing goods and providing services. It is also changing the day-to-day activities at workplaces with the use of disruptive technologies such as robotics, virtual reality, artificial intelligence and Internet of Things (Holland 2020). Today, the only organisations that flourish are the ones that re-design their production processes through cyber-physical technologies from mass production to customized products and services (Mamphiswana & Bekele 2020). The 4IR technologies have also transformed the education system, information access and dissemination of information and knowledge system and research. All of these are indicators of 4IR contribution towards development. According to World Economic Forum (2016) reports access to information is the key to development. So, libraries can play a key role in economic development if they are encouraged to adopt 4IR technologies. The 4IR era has affected the way library and information centers conduct their business leading to transformation and development. Both digitisation and the 4IR are a solution for libraries to continue service delivery uninterruptedly even during times of disruption (Botha 2021). Within libraries and other information management centers, the major changes brought about by 4IR are library automation and Artificial Intelligence (AI), open science, the use of social media platforms, and the changing roles of librarians. At Connecticut West Port Library, librarians teach AI to library users and libraries are collecting data using social media tools, drones, cameras, and other Industry 4.0 devices to

analyze and use it intelligently. The University of Pretoria employed Africa's first client service Robot employee Libby, to evolve with the 4IR. Libby's three key responsibilities are answering clients' basic queries regarding the library, marketing library resources and activities and conducting student surveys about the library's service delivery (Doyle 2019). However, Libby had to be removed from service during the Corona -19 pandemic, because the method to invoke a response is based on the physical touch of the robot's head, something that had to be avoided during the pandemic. The library's IT unit is in the process of introducing a Libby chat box to the library website (Matizamhuka 2022).

Despite the promising benefits of employing 4IR technologies, no empirical study has been carried out in Botswana; specifically, to determine the influence of 4IR technologies in motivating digital transformation. Hence this study sought to assess the current digital transformation practices in libraries in Botswana.

2 Purpose and Objectives of the Study

The purpose of this study was to assess the current digital transformation practices, prospects, and challenges faced in the adoption of 4IR technologies in libraries in Botswana. Specifically, the study sought to address the following objectives:

1. Examine the various 4IR technologies, that libraries in Botswana are using to manage information and knowledge.
2. Establish the 4IR skills that librarians already possess in libraries in Botswana.
3. Identify the opportunities the 4IR technologies offer to librarians.
4. Determine the challenges, librarians face in using 4IR technologies.
5. Recommend the strategies to enhance use of 4IR technologies in libraries in Botswana.

3 Literature Review

This section reviews relevant literature on the research topic.

3.1 Fourth Industrial Revolution

The term 4IR was first coined in 2016 by Klaus Schwab, the Executive Chairperson of the World Economic Forum. He referred to the 4th Industrial Revolu-

tion as building on the third Industrial revolution, and which is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres (Schwab 2016). The emerging 4IR technologies comprise robotics, 3D printing, Artificial Intelligence, Big data, Biotechnology, Blockchain, Cloud computing, Extended reality, Gamification, Internet of Things, Interoperability, Learning factories, Nano-technology, Quantum computing, Smart factories, Smart sensors, drones, Virtual Reality (VR), Augmented Reality (AR) and Teaching factories (Hawthorne 2018; Romanovs *et al.* 2019; Ally & Wark 2020). These tools and applications have the potential to boost productivity in libraries and can reduce costs as well as improve the quality of products and services (Chigwada & Chisita 2021). The surveyed literature revealed that the major drivers of the 4IR are: (1) Information communication infrastructure and emerging technologies; (2) Education and training; (3) Innovation; (4) Policy innovation; and (5) Responsive and context-specific strategies (Chigwada & Chisita 2021; Manda & Dhaou 2019).

3.2 Major 4IR Technologies in Libraries and the Opportunities they Offer

The following section discusses the major 4IR technologies that are used in libraries.

3.2.1 Internet of Things (IoT)

IoT refers to any device which can be linked to the internet. This includes mobile devices, wearable devices, washing machines etc. (Moos 2021). IoT can be used for self-checkout, inventory control, stock taking of information resources, access control in the physical building, tracking assets, monitoring the library network (Massis 2016; Wojick 2016). IoT maintains collection management, facilitates access to library and its resources, tells the customers about overdue books and any fines they owe to the library (Pujar & Satyanarayana 2015). It also enables innovative approaches such as a virtual library card, small digital shelve, cloud services, embedding of RFID tags into users' card for easy access to resources, fine collection management and improved inventory services (Pujar & Satyanarayana 2015). Other researchers that stressed the importance of IoT in libraries include Hahn (2017), and (Mohideen *et al.* 2017), who focused on library mobile applications, library automation, and mobility technology in Libraries. Kamalrudin *et al.* (2018) emphasized IoT being applicable in business applications and security concerns

in libraries. However, despite these benefits, IoT suffers from the following drawbacks; technological challenges, standardization challenges, financial challenges, and security challenges (Liang & Chen 2018).

3.2.2 Artificial Intelligence (AI)

AI is a programmable computer used to perform tasks usually undertaken by a human (Ayinde & Kirkwood 2020). With the emergence of 4IR technologies, robots are the recent trend in the application of artificial intelligence in libraries. Nwakunor (2021) views AI as the computer-controlled robots that think intelligently like human beings. These robots are controlled electronically with the aid of a computer that mimicks the competences of the human mind. For example; the University of Pretoria engaged Africa's first Robot librarian Libby, who is performing human duties to improve library services such as, answering clients' basic queries, marketing and conducting student surveys (Doyle 2019; Mafumana 2019). AI application has a long history in libraries and information services such as, subject indexing, abstracting, information discovery and retrieval, user voice interface and chatbots (Ayinde & Kirkwood 2020). AI is used in library management system to process digital information and to automate library information systems. Library management systems include: Natural Language Processing (NLP), Expert Systems, Pattern Recognition, Reference Service and Robotics (Sridevi & Shanmugam 2017). Libraries can use NLP 'to design intelligent expert reference system or information retrieval system, where users can interact directly with the system using natural languages' (Omame & Alex-Nmecha 2020: 127). An Expert System can be designed to handle subject indexing or reference services. These Expert Systems serve in several ways for example, in reference assistance, decision making, applying cataloguing rules, and, determine vendor assignments in acquiring library materials (Omame & Alex-Nmecha 2020). AI is used in automatic cataloguing and classification using optical character recognition, automatic indexing using Expert Systems, retrieval of audio-visual materials, Optical Character Recognition and Speech Recognition. AI is also used in interactive bibliographic instruction using various media.

3.2.3 Drones

Modern libraries particularly in developed countries have introduced drones.For example, Santa Clara Library in California provides tech clubs, a drone-flying club, and 3-D printing for youths. The library has also developed

programme that is used for drone movie making; whereby youths are taught how to fly drones with cameras and edit the footage to make a movie (Ayinde & Kirkwood 2020). Users are able to order books online, which a drone delivers within a few hours, saving the time of the users and the information professionals. The use of drone also bridges the gap between rural and urban literacies by providing information resources to remote areas with no access to education and electricity (Ayinde & Kirkwood 2020). Many libraries such as, in Dubai Rose Memorial Library, in New York Public Library and Florida Library are using drones for various services ranging from service delivery to security to deliver books from library to patrons and vice versa. For example, the 'flying book' system delivers ordered books to the customers at their door steps and save their time. Drones are very helpful in moving library books, furniture and other equipment with the help of technology equipped modern flying robots. It can also be used as a security tool within and outside library; the high pixel camera of modern drones helps in 24 hours' library surveillance (Vysakh & Babu 2019). Library drone delivery service can provide the circulation service to its patrons during times of epidemic such as the COVID Pandemic (Saloi 2021). In Canada, Edmonton Public Library launched four epl2go drones in 2019 to deliver the library materials to the cardholders (Saloi 2021).

3.2.4 Blockchain

Blockchain is one of the trending technologies with potential application to the library (Sanjay & Hasan 2020). Blockchain is like a ledger keeping a record of all transactions. An example is LibChain, which leverages on Blockchain technology in charging and discharging, where patrons do not have to return the book to the library to be issued to the next user. In LibChain's system, the user exchanges information via Blockchain and libraries can know who is holding the book at any time. Anyone desiring to borrow a book can find out in whose possession the book is at any time and can alert that person to pass it on to them after using it. (Ayinde & Kirkwood 2020). According to Meth (2019) to date, most of Blockchain applications are still in the conceptual stage. Since Blockchains are a type of informational ledger and do not require a centralized gatekeeping organisation, they can be used to build a truly distributed metadata system for libraries and other information centers. A Blockchain Online Computer Library Cente (OCLC) can be accessed by any organisation at no additional costs. This is an application for increased information access. Using

a Blockchain framework, libraries can partner with museums, universities and government agencies to share MAchine-Readable Cataloging (MARC) records, authority control, and user-generated content (San Jose State University iSchool 2020-2021). Potential uses for Blockchain includes creating time-stamped, verifiable versions of journal articles and digital rights management (Hoy 2017). Blockchain technology can also be used in library overdue payment, interlibrary loans, user to user loan, scholarly publications, library card, corporate library records keeping and archives/ special collections management.

In summary, as seen from the above discussion 4IR technologies offer the following opportunities to libraries: (1) Robots (machines) augments humans for better service; (2) business continuity during times of disruption; (3) increased access to the digital world; due to advent of technologies, library users can now have access to the digital world on a 24/7 basis as most libraries offer off and on campus services (Chigwada & Chisita 2021); (4) enhanced uses of e-resources. COVID-19 accelerated the speedy adoption of the 4IR with libraries shifting from physical information resources to online platforms. This resulted in increased use of, and reliance on, digital collections, and more interest in self-service and online programming (Cox & Felix 2021); (5) introduction of new products and services: libraries have introduced new products and services for efficient library services, including social media platforms to communicate with clients around the clock, online reference services, online renewal of library materials, and self-services at circulation points (Chigwada & Chisita 2021); (6) libraries become 4IR advocates: by virtue of their inherent skills and expertise librarians can be good advocates and facilitators of the 4IR technologies (Chigwada & Chisita 2021); (7) More opportunities for knowledge sharing and skills transfer

3.3 Skills Required by Information Professionals in the 4IR Era

Skills are methods of doing a job in the best way by using limited resources to achieve the organisational goals. Skills are indispensable in the information profession. The reviewed literature revealed several skills that are critical for 4IR. Ayinde and Kirkwood (2020) mentioned customers need skills such as, retrieving and searching skills, managerial and leadership skills, reference services skills, information technology skills necessary to survive in 4IR era. Marr and Ward (2019) published a book on ‘Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve

Problems'. In this book the following skills were deemed necessary for the 4IR revolution era; Creativity, Emotional intelligence (EQ), Analytical (critical) thinking, Active learning with a growth mind-set, Judgment and decision making, Interpersonal communication skills, Leadership skills, Diversity and cultural intelligence, Technology skills, and ability to embrace change. All these skills will prepare people to find rewarding jobs in future such as, advanced statistician, smart software developer, smart engineer, smart robotics expert, and scientific researcher (Ayinde & Kirkwood 2020). Basically, employees in the 4IR era will need to have basic 21st century competencies as skills in different categories; core skills, basic skills, transferable skills, generic skills, key skills, soft skills, behavioural competencies skills and cross-curricular skills (Bikse *et al.* 2022). Moreover, human creativity and innovation are the driving force behind 4IR Technologies (Jacobs 2021).

Tella (2020) asserts that LIS professionals need to acquire several new skills to fit into 4IR era including: information curation; big data management, research skills, digital scanning/ preservation, cloud data expansion, collaboration, teaching and facilitation, analytical thinking and innovation, active learning and learning strategies, creativity, originality and initiative; technology design and programming, critical thinking and analysis, problem solving, leadership, emotional intelligence, system analysis and evaluation. Building quality intellectual capital is at the core of 4IR, that would equip more people with learning, ideas and abilities for innovativeness (Osuigwe 2019).

3.4 Challenges Librarians Face in Using 4IR Technologies

Industry 4.0 has brought economic and social opportunities as well as challenges (Manda & Dhaou 2019). A review of available literature indicates that there are several challenges related to 4IR implementation. The major challenges identified in the reviewed literature are shown in Table 1 below.

Table 1: Challenges Posed by 4IR Technologies

Challenge	Description
Inadequate technological infrastructure	Poor ICT infrastructure in developing countries is one of the major challenges (Odeyemi 2019).

Job loses	According to World Economic Forum (2016:2), 'many of the major drivers of transformation currently affecting global industries are expected to have a significant impact on jobs, ranging from significant job creation to job displacement, and from heightened labour productivity to widening skills gaps'. As some of the tasks will be done by the new technologies and fewer librarians will be required to perform library work leading to higher unemployment rate and even poverty (Moos 2021).
Financial constraints	Most libraries face lack of funds to procure and manage 4IR technologies and train personnel (Tella *et al.* 2022a; Odeyemi 2019). Odeyemi (2019) further noted that due to inadequate finance Nigerian academic libraries may not catch up easily with their counterparts in developed countries.
Inadequate expertise	This refers to skills gap challenge for functionality in the 4IR era (Tella *et al.* 2022; Manda & Dhaou 2019). World Economic Forum (2016) identified skill challenges as: skills mismatches and skills redundancy due to the changing nature of jobs owing to advanced technologies. Human resources and requisite skills were found inadequate in academic libraries in Nigeria to provide effective library and information services using advanced digital technologies and automation (Odeyemi 2019; Mafumana 2019). There is a need for training and retraining of librarians and other information professionals with appropriate skills to enable them to adapt to the 4IR is a big challenge in most libraries in developing countries (Moos 2021).
Librarians' poor attitude toward new technologies	Often librarians have poor attitude to adopting new technologies. For example, refusal/reluctance to adopt the technology by technophobic personnel and adjusting to the new 4IR environment are challenges in Nigerian libraries (Tella *et al*. 2022). Moreover, Manda and Dhaou (2019) and

	Schwab (2016), echoed that technological tools and applications of Industry 4.0 can also disrupt society, business and government through its innovations.
Changing business model	The European Parliament (2016) identified the challenges experienced in Europe as: changing business models, skills mismatch, intellectual property issues, and the need for investment, data issues, standards, and legal questions of liability.
Societal challenge	4IR era also pauses societal challenges including job loss, disqualification, new kinds of stress, and increased social insecurity (Dregger *et al.* 2016). The increased automation requires greater investment and changing business models. 'Data management, legal questions of liability and intellectual property, standards, and skills mismatches are other significant issues' (Tella *et al.* 2022: 548).

4 Methodology

Data for this study was collected through an online survey tool 'Google forms'. The survey questionnaire comprised largely close-ended questions with only two questions that were open-ended. So the data collected was both quantitative and qualitative. Qualitative questions were used to provide opportunity to the respondents to express their views openly and to supplement quantitative data. For the sake of convenience and because the targeted population was spread out, the survey link was distributed via email and WhatsApp to enable remote access. Accessibility of the link was only limited to individuals within the researcher's digital circles and/ online community (thus convenient sampling was used to access librarians within the researcher's online connections). This survey also depended on snowball sampling (that is participants to whom the link was sent to, were requested to share it with their friends). The survey link was made available 2nd May to 29th May 2022 to all librarians working in any type of library in Botswana and who had library qualifications. A total of 112 responses were retrieved as shown in Figure 1. Quantitative data was analyzed using Microsoft Excel while qualitative data was analyzed manually. For anonymity purposes, qualitative responses were presented through alpha-

numeric coding. The participants were represented by the systematic number given to each questionnaire (e.g. questionnaire 80). Thus, each questionnaire was numbered by participants' number (e.g., Participant 80).

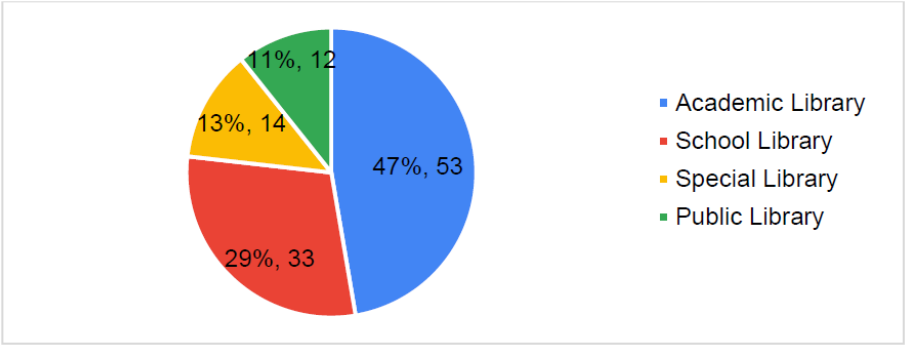
5 Findings

The findings of the study are presented in two parts: Part (A) provides background information of the respondents and Part (B) presents the major findings of the study.

Part A: Respondents Background Information

As shown on Figure 1, a total of 112 respondents working in different types of libraries in Botswana participated in the survey. The majority (n=53, 47%) of the participants were from academic libraries, followed by school libraries (n=33, 29%). Fourteen (n=14, 13%) respondents were from special libraries while twelve (n=12, 11%) were from public libraries.

Figure 1: Respondents' Distribution According to Type of Library (n=112)

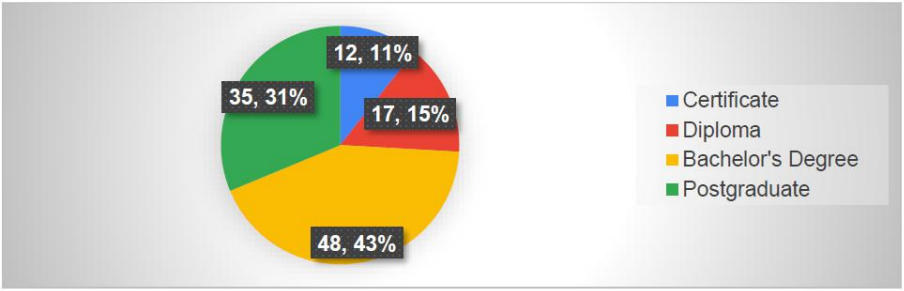


Source: Field data (2022)

Qualification: As presented in Figure (2), a majority (n=48, 43%) of the respondents had a bachelor's degree, followed by those who held postgraduate degrees (n=35, 17%). Of 112 participants, (n=17, 15%) had diplomas, and 12

(11%) librarians had certificates while one respondent specified that he/she had a teaching certification.

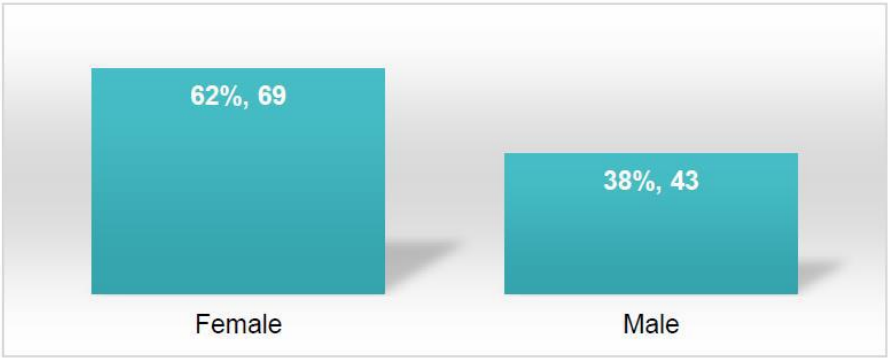
Figure 2: Respondents Qualification (n=112)



Source: Field data (2022)

Gender: Of 112 participants, the majority of (n=69, 62%) were female and (n=43, 38%) were male participants.

Figure 3: Gender Distribution (n=112)

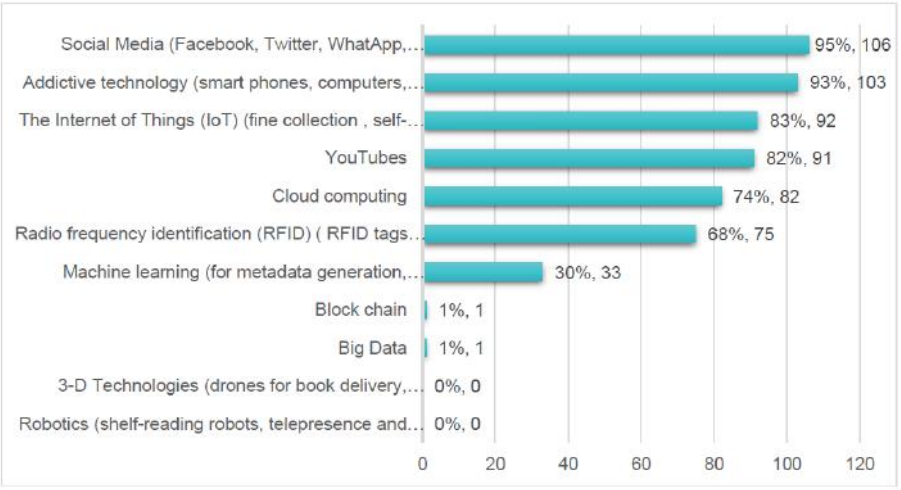


Source: Field data (2022)

Part B: Main Findings

Use of 4IR technologies: To address the first objective of the study, the respondents were asked to identify the 4IR technologies they use in providing library services. They were allowed to select different technologies that they used in the performance of their duties. The results are presented in Figure 4.

Figure 4: 4IR Technologies Used by Libraries in Botswana (n=111)

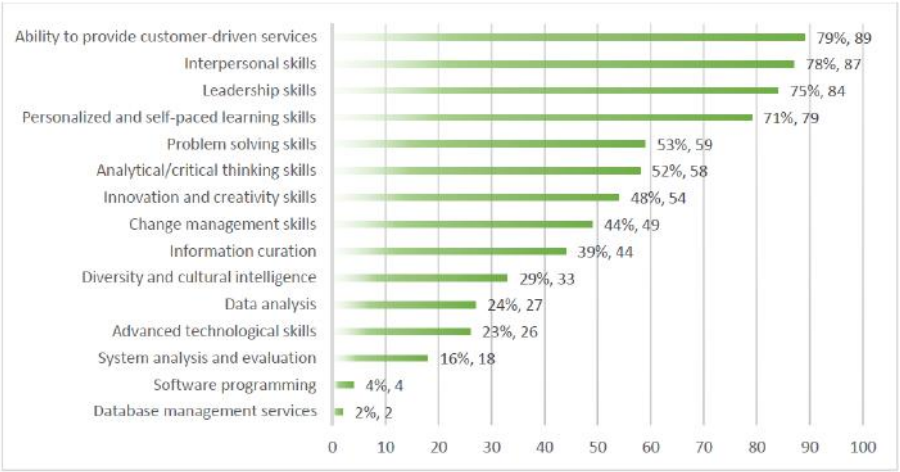


Source: Field data (2022)

As apparent from Figure (4), most of the respondents used 4IR technologies in Botswana libraries. Specifically, the findings indicated that Social Media applications were used by 106 (95%), followed by addictive technologies by 103 (93%), the Internet of Things by 92 (83%), and, YouTubes by 91 (82%) librarians, cloud computing 82 (74%) and RFID tags were used by 75 (68%) librarians. Machine learning technology for data generation was used only by 33 (30%) libraries and Blockchain and Big data were used only by one library each, while none of the libraries in Botswana use 3-D technologies or Robotics.

Participants' current skills: To accomplish objective (2), the participants were asked to indicate which 4IR skills they currently possessed, the results are displayed in Figure (5).

Figure 5: Skills Possessed (n=112)

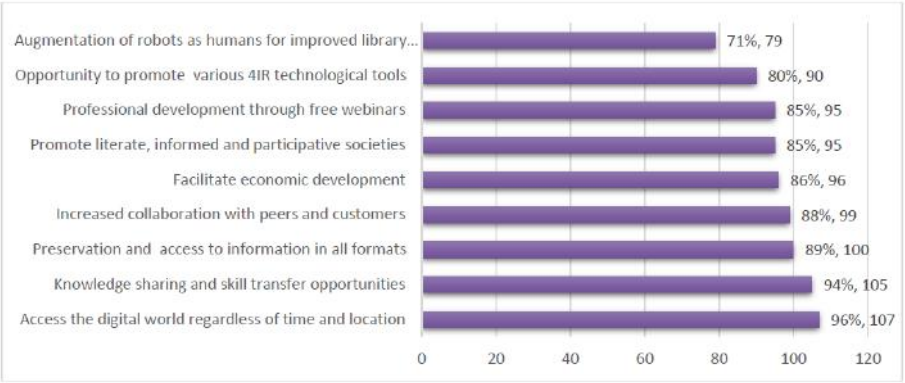


Source: Field data (2022)

As evident from Figure (5), 89 (79%) participants claimed to have ability to provide customer-driven services, followed by 87 (78%) with interpersonal skills, 84 (75%) had leadership skills and 79 (71%) had personalised and self-paced learning skills. Of 112 librarians, 59 (53%) had problem solving skills while 58 (52%) had analytical and critical thinking skills. Fewer than 50% indicated that they had other skills with 54 (48%) possessing innovative and creativity skills, 49 (44%) change management skills, and, 44 (39%) information curation skills. Thirty-three (29%) librarians possessed diversity and cultural intelligence skills, 27 (24%) data analysis skills, only 26 (23%) claimed to have advanced technological skills, 18 (16%) system analysis and evaluation skills, while only 4 (4%) possessed software programming and 2 (2%) database management services skills.

Opportunities: To meet the objective (3) of the study, the participants were asked to indicate which opportunities the 4IR technologies offered to librarians. The responses are presented in Figure (6).

Figure 6: Opportunities Provided by 4IR Technologies (n=112)



Source: Field data (2022)

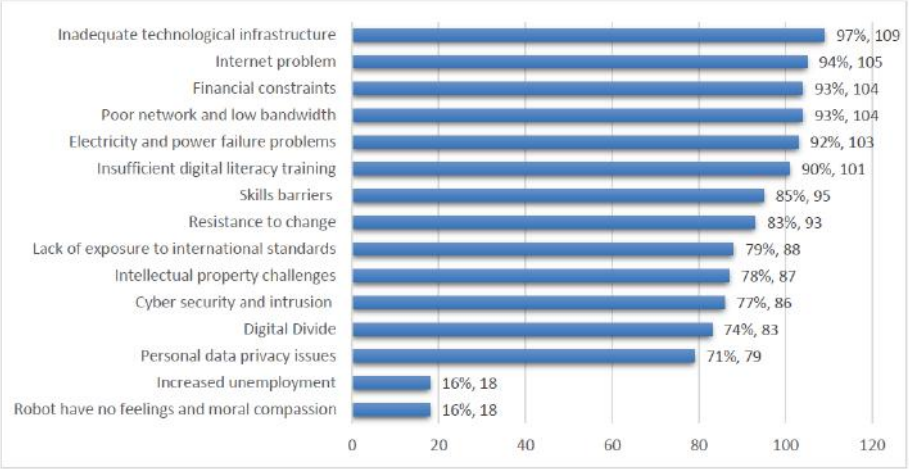
As evident in Figure above, of 112 librarians, the majority of 107 (96%) acknowledged the access to digital information without any geographical barriers as an opportunity, followed by knowledge sharing and skill transfer 105 (94%), preservation and access to information in all formats 100 (89%), increased collaboration with peers and customers by 99 (88%), and, facilitate economic development, 96 (86%) through increased access to information and knowledge were seen as opportunities by the participants. Other opportunities were identified as: the opportunity to promote literate, informed, and participative societies and professional development through free online webinars by 95 (85%) participants, and, the augmentation of robots as humans for improved library services 79 (71%) as an opportunity for the librarians.

Challenges: To accomplish objective (4), the participants were asked to point-out what challenges they faced in using 4IR technologies, and their responses are displayed in Figure (7):

As clearly shown in Figure 7 below, the most critical challenge faced by respondents who took part in the study was inadequate technological infrastructure (n=109, 97%) librarians. This was followed by internet problem (n=105, 94%), financial constraints and poor network and low bandwidth (n=104, 93%), electricity and power failure problems (n=103, 92%), inadequate digital literacy training (n=101, 90%). Other challenges mentioned were: skills

barriers 95 (85%), resistance to change 93 (83%), lack of exposure to international standards by 88 (79%), intellectual property challenges 87 (78%), cyber security and intrusion by 86 (77 digital divide 83 (74%) and personal data privacy issues 79 (71%), while increased unemployment and robots not having any feelings and moral compassion were found as challenges by an insignificant number 18 (16%) of participants.

Figure 7: Challenges Faced by Librarians when Using 4IR Technologies (n=112)



Source: Field data (2022)

To further understand the librarians' perspectives towards 4IR technologies and their impact on national development, they were given two open-ended questions. A majority (94%) of the respondents agreed that the 4IR technologies have impact on national development as they facilitate easy access, sharing and retrieval of information; provide improved library services; facilitate quality service delivery; improves efficiency and effectiveness in government transactions. These findings are evidenced by the quotes presented in Box 1.

Box 1
'4IR technologies have a huge impact on national development because access to quality information and knowledge is the essence of development.

Librarians can provide the right information at the right time using 4IR technologies without any time and geographical barriers. As a result, 4IR technologies contribute to national development' said Participant 3.
'Without technology, research and development will suffer. As a result, this will impact innovation and realisation of the SDGs' said Participant 111.
'4IR technologies cut across all industries not just the library. Hence, they have a huge impact on national development. For example; in agriculture, drones are used to collect data in the fields, which can be used for informed decision making' acknowledged Participant 100.
'4IR technologies impact positively on achievement of SDGs since they enhance access to information for all to ensure social educational inclusion for communities' commented Participant 11.
'4IR improves information service delivery and thus contributes towards national development' said Participant 29.
'The new techno-economic paradigm offers a window of opportunity for countries that are late to adopt new technology as they are leaping directly into using more advanced technologies. Instead of rebuilding old things, they'll build everything based on smart 4IR technical ideology' Participant 41 further explained.
'By providing easy and increased information to all citizens' Participant 99 appreciated the impact of 4IR on national development
'Through increased access to information improved efficiency and effectiveness in all aspects of the government transactions and thus national development' explained Participant 41.
'The 4IR technologies help the library staff to provide value-added library and information services and remote access to online information resources thus enhanced access to information leading towards economic development' alluded Participant 67.
'Access to information and knowledge is the key to sustainable development. 4IR facilitates access to information, knowledge and data and consequently contribute to national development' stated Participant 52.

Source: Field data (2022)

Lastly, participants were also asked to state how libraries can improve their services and products upon using 4IR technologies. Three main themes were derived from the qualitative data and the corresponding excerpts are presented as follows:

a. Adoption of standards and policies that support implementation and use of 4IR technologies:
Participant 5 stated that *'Libraries should improve standards on 4IR technologies by ensuring utilization of technologies that match today's information needs and digitization process*' while Participant 47 argued that. '*There is an urgent need to develop 4IR technology implementation policies*'.

b. Intensifying adoption of 4IR technologies in libraries:
Participant 20 posited that '*Libraries should consider it very vital to jump on the bandwagon and not be left behind because there are daily advancements in technology, and technology is the future of all working environments, and if anyone is left behind then they should consider facing their doom*'.

c. Training of librarians:
Participant 27 asserted that '*Training should be done on a regular basis and all librarians should be equipped with necessary skills to fit into 4IR era*'.

Participant 104 recommended the need for training staff '*Reskill personnel, provide more resources to match growing number of users, frequent training for patrons*', while Participant 109 further suggested that '*There is need for libraries to encourage re-skilling and up-skilling of the staff members through trainings, workshops, seminars, etc. These must be sponsored regularly'.*

6 Discussion

The results presented above have revealed that the most used technologies in Botswana libraries are Social Media applications including Facebook, Twitter, WhatsApp, addictive technologies such as smart phones, laptops, and tablets, the Internet of Things, YouTube, Cloud computing and RFID tags. This development is very promising and encouraging. However, machine learning

technology for data generation was used only by 30% libraries and only one library used Blockchain, while none of the libraries in Botswana used 3-D technologies and Robotics. The findings of the study confirm the findings of a recent study carried out by Tella *et al.* (2022), which found that none of the libraries in Nigeria was currently using robots, artificial intelligence, Internet of Things, virtual and augmented reality, and Blockchain. However, this is contrary to the findings by Botha (n.d.: 4) who elucidated that,

> The adoption and utilisation of 4IR-related technology (robotics, user-experience, ask-a-librarian, social media, reference management tools, e-Resources, Research Commons, WiFi access) by libraries in Africa are commendable and provide evidence of the growing commitment and intention of the LIS sector to become increasingly more mature in respect of adopting technology to address disruptive change and to realisation of SDGs.

This implies that Botswana libraries will remain behind as they are not harnessing the advantages of 4IR technologies. Without proper funding for 4IR technology implementation and appreciation of its benefit, Botswana libraries will continue to lag behind in innovation and realisation of hidden workforce capability which has the ability to digitally transform our information landscape. From the findings, it is also evident that Botswana libraries still have fractured ICT infrastructure which does not fully support innovation, growth, agile organisations, and a smart working environment. As a result, the lack of 4IR technology adoption by Botswana libraries leads to information scarcity, information deficiency, and delayed information access. For instance when Covid-19 was at its peak in Botswana, students from less privileged homes without internet access did not have access to library materials as majority of the library services are manually based. Therefore, this should have been enough motivation for libraries to harness 4IR technologies. For example, with the help of LibChain, a Distributed Library Management System based on Blockchain technology, library patrons can provide library books directly to other library users without bringing to the library, if they are library members. Thus, enhancing Inter-Library Loan (ILL) procedures or services among the member libraries of the Blockchain network (Ayinde & Kirkwood 2020; Suman & Patel 2021). Moreover, in Botswana, drones can be very useful for book delivery to transport information to remote areas, something which is currently

being undertaken through book box service by Botswana National Library Services (BNLS) but it is much slower. Therefore, using 4IR technologies in library services increasingly bridges the gap between rural and urban communities leading to inclusive socio-economic development through increased access to information and knowledge.

Skills possessed by librarians: The findings of the study established that more than 50% of the participants had soft skills such as ability to provide customer-driven services, interpersonal skills, leadership skills, personalised and self-paced learning skills, problem solving skills, and analytical and critical thinking skills. Soft skills are good as they allow organisations to build a healthy workforce that can effectively use their technical skills and knowledge without being hampered by interpersonal problems, thus, encouraging a productive work environment. Moreover, as Ayinde and Kirkwood (2020) have emphasized, problem solving, adaptability, collaboration, leadership, creativity, and innovation are crucial skills in the 4IR era. However, in this study it is disconcerting that librarians also had serious skills gap with regards to technological skills. such as innovative and creativity, change management, diversity and cultural intelligence, information curation, data analysis, system analysis and evaluation skills, software programming and database management skills. This is a clear indication that even if AI, robotics, IoT, machine learning and Blockchain technologies were to be implemented in Botswana, they would not be effectively utilised for information service delivery since librarians lack the key skills required to effectively manage and manipulate 4IR technologies. No wonder Ayinde and Kirkwood (2020) recommended that in order to respond to unpredicted circumstances such as Covid-19, information professionals need to have innovative and creative skills.

Opportunities: The findings of the study ascertained that most of the participants were aware of the opportunities offered by 4IR technologies. Majority of the respondents acknowledged that 4IR technologies offer access to digital information without any time and space obstructions, enhance knowledge sharing and skill transfer, support preservation and access to information in all formats, enhance collaboration with peers and customers and, facilitate economic development. Indeed, 4IR technologies have transformed the way information and knowledge is disseminated on a 24/7 basis without any geographical barriers. Information and knowledge are drivers of productivity

improvement and economic growth. For example, to facilitate economic development, librarians can disseminate agricultural related information with farmers on crop diseases, climate change, and seed prices through advanced automated Selective Dissemination of Information (SDI). Also, chatbots can be implemented in library systems for user queries. Using 4IR technological applications, librarians can send current information to politicians and policy-makers to make informed decisions on national policies and development. Thus, librarians have ample opportunities to contribute to economic development connecting the right people with the right information at the right time and in the right format.

Other opportunities for librarians are to promote literate, informed and participative societies by training library users in using 4IR technologies. Librarians can also develop professionally through free online webinars. Also, the augmentation of robots as humans facilitates better-quality library services However, this may not be possible when librarians lack technological skills. 'The advent of the Fourth Industrial Revolution has the potential to transform emerging economies to another developmental echelon by increasing productivity and improving future fluidity of innovation across various industries' (Nyagadza *et al.* 2022:1). The advent of the 4th Industrial Revolution promises several social and economic opportunities and challenges which demand that governments respond appropriately in supporting societal transformation (Manda & Dhaou 2019).

Challenges: The results of the study identified the most critical challenges as inadequate technological infrastructure (97%), internet problems (94%) and low bandwidth. The findings are similar to those of Odeyemi (2019) who conducted a study on robots in academic libraries in Nigeria which revealed that unreliable power supply, inadequate technology infrastructure, and technical skills, negative attitude towards advanced automation, lack of senior management support, technophobia faced by academic libraries were the major challenges encountered by users in that country. Like most developing countries, electricity and power failures are problems experienced in Botswana. Hence, with such a scant ICT infrastructure how can Botswana libraries harness 4IR technologies?

Financial constraints (93%), electricity and power failure (92%), and insufficient digital literacy training (90%) were other challenges identified by respondents in this study. These findings again corroborate a recent study by

Tella *et al.* (2022) which identified several hurdles for libraries in Nigeria in the 4IR era including funding and financial constraints, inadequate expertise, limited power supply and frequent power outages, poor attitude of librarians toward new technologies among others. It is, therefore, vital for policymakers to actively seek solutions to these problems as failure to do so will hinder development and Botswana will continue to be a laggard. For instance, financial constraints have implications for the provision of 4IR infrastructure and staff training. Lack of exposure to 4IR international standards and intellectual property rights are other issues the current study identified. It is critical for librarians to be aware of international standards to motivate them to aspire to these, where relevant.

7 Conclusion and Recommendations

The purpose of this study was to assess the current digital transformation practices, prospects, and challenges of 4IR in libraries in Botswana and determine their role in national development. The study concludes that Botswana libraries are nowhere near to harnessing 4IR technologies as there is no evidence of the adoption of AI, Blockchain, robotics, big data, and 3D technology. It is also evident that even if Botswana libraries know where to implement 4IR technologies, they would not be utilised effectively and efficiently and institutions will not have maximum benefit from these technologies as the majority of the participants do not have the technological skills needed to manipulate 4IR technologies. On a positive note, the majority of the participants only had soft skills, which is also a good starting point for building a conducive working culture and productive workforce. The study further concludes that Botswana librarians are aware of and seem to appreciate the opportunities offered by 4IR technologies. Hence, practitioners and policymakers should advocate for the implementation of these technologies, the acceptance rate is likely to be high as the majority of the participants had a positive mindset toward 4IR technologies.

It is with a bleeding heart that the researcher concludes that Botswana libraries are not yet ready for 4IR technology implementation. This is based on the numerous challenges cited in this study including the lack of technological skills and the scarce technological infrastructure that does not support 4IR technologies. However, it is important to note that the disparity in technology implementation levels varies greatly among different types of libraries. This

shows that despite several initiatives by the Government of Botswana towards digital transformation, libraries in Botswana have a long way to go, in order to fit into 4IR era. Therefore, the chapter concludes with the words of Dr. Deonie Botha (2021: 6), Research and Innovation Specialist, National Library of South Africa: 'Fortunately, the 4IR has created an environment where reading and learning is no longer confined to a physical location but can be accessed in a highly personalised manner and according to the language preference of the client by means of one-touch'. So, Botswana libraries should use this opportunity and ride the bandwagon of digital transformation and 4IR to contribute towards research and national development by providing universal access to information and knowledge to all stakeholders at the right time in the right format and right language.

Based on the findings of this study and the author's own observations the following recommendations are put forward to overcome some of the challenges discussed in this chapter:

- **Allocate adequate budget for building a suitable technological infrastructure:** A robust ICT infrastructure, including high-speed Internet connection/bandwidth, high-performance computing facilities, and data services is necessary for digital transformation and reducing the digital divide, and this comes with a considerable cost.

- **Benchmarking with developed countries and providing new learning opportunities:** By benchmarking with developed countries, institutions should provide new learning opportunities to librarians to make them keep learning, unlearning, and relearning through continuous training.

- **Implementation of 4IR in Library School curriculum:** It is vital to provide the skills to future librarians that are required in the 4th IR era. The LIS curriculum offered by the University of Botswana, the Institute of Development Management (IDM) and other private training institutions should embed technical and practical skills such as SW programming, databased design and management, data analysis, machine learning and change management skills. Botswana Qualifications Authority (BQA) should monitor and review the LIS curriculum in various institutions to ensure that it suits the 4IR era.

- **Technology and digital literacy policy framework:** As most participants lacked the skills to fully fit into the 4IR era, libraries and parent institutions

should develop a digital literacy framework as a guide towards digital transformation.

- **Vigorous training of librarians:** There is a need for ICT training to equip librarians with skills to operate in the 4IR era. If the librarians do not know how to exploit 4IR technologies for improved information service provision, they cannot benefit from 4IR technologies to their fullest potential.
- **Government support:** To make technology, information, and knowledge accessible to everyone, the Government has a key role to play. Government should be committed to adequate funding for the required ICT infrastructure and high-speed telecommunication and Internet to overcome the digital divide and facilitate the adoption of 4IR to leverage economic development. 4IR international standards and policy implementation at the national level are critical. For example, the Maitlamo ICT policy should be reviewed and monitored to ensure that there is no digital divide and adequate ICT resources have been provided to all communities.

Further Study

The aim of the study was to establish a general view of the 4IR landscape in Botswana libraries. There is a need for further studies on specific types of libraries, such as academic libraries, public libraries, school libraries. This would give a comprehensive picture of each type of library in Botswana.

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Professor Priti Jain
Department of Library and Information Studies
University of Botswana
Gaborone, Botswana
Jainp@ub.ac.bw