Fourth Industrial Revolution (4IR): Need for Current Information and Services in Cutting-Edge 21st-Century India

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ABSTRACT
This article examines the potential and difficulties that the fourth industrial revolution presents to libraries in providing library services. Libraries have been profoundly affected by the 4th Industrial Revolution (4IR), which has changed their function from being conventional book repositories to being centres for digital literacy, technological access, and information sharing.
The goal and services provided by libraries have been redefined as a result of the quick developments in artificial intelligence (AI) and the Internet of Things, in addition to information analytics. It shows that the need for current information and services has the greatest impact on libraries. However, the fourth industrial revolution has revealed several shortcomings in libraries, including weak ICT policy, low financing, and a lack of staff orientation. The study comes to the conclusion that in order for libraries to offer effective and efficient services, they must adjust to the realities of the Fourth Industrial Revolution. In addition to discussing the potential for libraries to take advantage of emerging technology, the essay underlines the difficulties libraries have in adjusting to the 4IR and provides instances of successful digital transformations from real-world settings. It also covers issues with data security and privacy. The recommendations include adequate financing to supply library facilities and ongoing staff training on how to use and operate these resources.
Keywords: ***Library Services, Emerging Technology, Digital Transformations, Fourth Industrial Revolution,***

INTRODUCTION
The Fourth Industrial Revolution (4IR) makes library collections easily accessible to everyone with a single click, which is in line with the Sustainable Development Goals (SDGs). The Fourth Industrial Revolution (4IR's) inclusiveness and integration, along with the publishing & library industries, help achieve multiple SDGs and improve Africa's reading ecosystem. Big data, which encompasses both digital and conventional sources, is a source of constant analysis and discovery and is an overflow of information. The transition to digitalization, automation, & virtualization in many aspects of life is known as the 4th Industrial Revolution (4IR). This age will disrupt future employment and skill sets, but it will also create new opportunities. However, the educational system fails to adequately equip professionals in library and information science. The inadequate curriculum they received has left these graduates without the skills necessary for the workforce of the twenty-first century.

The Fourth Industrial Revolution (4IR) calls for interdisciplinary and collaborative skills and challenges established fields. The curriculum should include cross-curricular knowledge and transferable skills to prepare students for new or unimagined occupations. It is important to promote technology-enhanced and online instruction, particularly for LIS practitioners. This study proposes that curriculum design should emphasize explaining conditions based on the Fourth Industrial Revolution (4IR), ensuring the sustainability & usefulness of library and information science education, and developing skills suitable for Fourth Industrial Revolution

(4IR) employment and jobs. Implementing these modalities will prepare students for the future workforce operating in the Fourth Industrial Revolution (4IR).

Figure: Fourth Industrial Revolution (4IR)

The smooth integration of various devices into a cloud ecosystem is a key component of the 4th Industrial Revolution (4IR), which facilitates the flow of big data for well-informed decision-making. Using the Internet of Things & gadgets, hardware, software, living things, and individuals are all interconnected, allowing for real-time process insight and well-informed decision-making.

HISTORICAL CONTEXT OF THE FOURTH INDUSTRIAL REVOLUTION (4IR)

Simply put, industrial evolutionism refers to periods that saw the introduction and development of technology related to digital transformation. In the 18th century, the United Kingdom saw the beginning of the first industrial revolution. Mechanical manufacturing and steam pressure were introduced. Nicholas and Phil beck, 2019). However, this resulted in a modification of the outcome. Increased production resulted in urbanization and the importance of democratic governance utilizing the middle class in the Western Hemisphere (Macpherson, 1962). The IIR presented a vision for a new curriculum in the educational industry that focused on a variety of degree alternatives along with new general education courses that provided in-depth understanding of emerging fields. A further wave of systemic change that gave rise to the belief that science and technology were the path to a better living was the second industrial revolution, which took place between 1867 and 1914.

Standardization, technical complexity, and manufacturing precision all underwent significant changes as a result of the revolution, along with the development of extensive technological infrastructure like electricity and new internal combustion-based public transit options. Additionally, inventions such as mass production, gas turbines, steamships, telephones, and artificial intelligence emerged during this period. It introduced new, potent technologies to the education sector, which led to the emergence of numerous creative, cutting-edge educational establishments. The purpose of this age was to facilitate the industrial classes and create chances for universal access to education. The 1950s saw the start of the third industrial revolution, which resulted in the development of computers and the internet. This revolution is characterized by computerization and web-based interconnection, which led to the globalization of academic research and increased relevance of educational access and expansion. To accomplish the vast development of the economy followed by manufacturing that emerged in the twentieth century, as well as to upgrade the workforce's potential, new educational institutions and curricula were duplicated during the first two industrial revolutions. The third industrial revolution changed the educational landscape by bringing about instantaneous and open access to knowledge. This resulted in a shift in focus toward active learning pedagogies that prioritize peer learning environments and collaboration

among various teams (**Mazur 2019).** Innovative technologies and trends are transforming the way we live and work in the 4IR, a prominent and evolving environment. It is still unclear how the technologies of the Fourth Industrial Revolution (4IR) will impact various aspects of life. It will undoubtedly result in a significant shift in all facets of human endeavour. It is imperative that library and information professions adapt to it. Students will have the chance to build their skills in the rapidly developing field.

The Industrial Revolution

Industry refers to the production of goods or associated services within an economy. The indicator of the industry in which an association or company operates is its primary source of income. When a large group generates income from multiple sources, it is considered operating in numerous industries. During the Industrial Revolution, manufacturing emerged as a major labour and production sector in many nations, upending earlier feudal and mercantile economies. This growth caused from many consecutive, swift technological advancements, including the creation of machine tools, textiles, steel, glass, mining, coal, and agricultural products.

The Industrial Revolution was a significant historical turning point that affected nearly every element of our everyday lives, primarily the general public's standard of living, which started to steadily rise and see significant advancements until the late 19th and early 20th centuries. But the shift to new industrial techniques during the roughly 1760–1820–1840 timeframe was known as the Industrial Revolution. This shift includes the switch from manual to machine production, the invention of new processes for the production of iron and chemicals, the growing use of hydraulic power for the creation of machine tools, and the emergence of the industrial framework. In the categories of employment, output value, and capital invested, the textile sector dominated the Industrial Revolution. Additionally, the textile sector was the first to employ contemporary production techniques. Many of the scientific advancements that sparked the Industrial Revolution originated in Great Britain. With conquests in North America and even the Caribbean, a global trading empire, and some political sway over the Indian subcontinent thanks to the East India Company, Britain was the world's most powerful commercial nation by the middle of the 18th century. One of the primary factors about the Industrial Revolution was the growth of trade and business.

INDUSTRIAL REVOLUTION NEED

Industry 4.0 is a quickly developing technology that is changing how we manufacture goods and opening up new production possibilities. A variety of industrial devices across international industries use it to enhance value, quality, volume, accuracy, rapid identification, and real-time process optimization. LISC specialists and information centres and libraries (ICLs) are essential to the gathering, storing, and sharing of data. The foundation of Industry 4.0 is a value chain organization that makes use of the Internet of Things (IoT) and the power source, the Internet of Services (IoS), to connect the virtual and physical worlds. We anticipate a 38% expansion in the industrial gadget connectivity market over the next five years. Advanced prediction technologies are essential for making educated decisions, clarifying uncertainties, and systematically converting data into knowledge.

The rapidly developing concept of "Industry 4.0" aims to transform how various industries operate and adapt to new systems. Entails integrating different tools, hardware, software, methods, and technologies, changing how customers and manufacturers communicate with one another. By embracing Health 4.0, which entails new duties and responsibilities beyond typical manufacturing items, the healthcare and medical sectors are shifting from a manufacturing to a service sector. High-quality, high-mix production is necessary for product-specific device customization, and the I-4.0 model makes such integration possible. To communicate with more intelligent machines and facilitate self-management and optimization, physical objects moving within production processes will include embedded software & computing power (CPS). A robust Industrial Information System (IIS) serves as essential for competitive advantages, and industries must make the shift from conventional production systems to contemporary I-4.0. A robust IIS is necessary in the healthcare & medical sectors to enable I-4.0 and give users targeted information.

Emerging Digital Gadgets are making it easier to manufacture and produce goods in large quantities with high quality; thus, it is imperative that industries adjust to this new idea. In terms of cost, quality, quantity, profit margins, & speed, Industry 4.0 (I-4.0) manufacturers of devices encounter a growing number of updates, opportunities, and difficulties. Technology is crucial for meeting the demands of contemporary society and conquering obstacles in the marketplace. The availability, cost, & adoption of I-4.0 must be defined, clarified, and assessed. The methodical development of CPS as a result of recent manufacturing advancements will increase the effectiveness and quality of the final product. Implementing I-4.0 will have a significant positive impact on the industrial system, especially in the pharmaceutical sector. Many industries use big data, CPS, robots, AI, CC, information and communication technology, and Library and Information Science tools to provide customized goods and services. Healthcare services that depend on information and data in real time are made possible by these technologies, which depend on the principles of digitization, automation, and virtualization.

OBJECTIVES AND PURPOSE OF THE STUDY

Assessing the present digital transformation processes, opportunities, and difficulties associated with the use of Fourth Industrial Revolution (4IR) technologies in Botswana's libraries was the aim of this study. The study specifically aimed to accomplish the following goals:

1. Examine the many Fourth Industrial Revolution (4IR) technologies used by Botswana's libraries to handle knowledge and information.
2. Identify the Fourth Industrial Revolution (4IR) competencies already held by librarians in Botswana's libraries.
3. Determine the prospects that librarians may take advantage of with Fourth Industrial Revolution (4IR) technologies.
4. Identify the difficulties librarians encounter when utilizing Fourth Industrial Revolution (4IR) technologies.
5. Make recommendations for how to improve the use of Fourth Industrial Revolution (4IR) technology in Botswana's libraries.

THE EDUCATION 4.0 AND THE FOURTH INDUSTRIAL REVOLUTION (4IR)

Computer-based learning approaches are changing the educational system. Advancements such as artificial intelligence (AI), vast amounts of data and research, online networks, and the internet of things have been made possible by the fourth industrial revolution. Virtual reality and virtual augmented digital entertainment are currently gaining popularity. Information and communication technology must be applied in library schools through both traditional and online means to enhance students' learning abilities. In today's world, human development that enhances knowledge and expertise is essential. As a result, the learning and reading habits will shift from the conventional approach to new, clever teaching and learning techniques (Sharma, 2019). Education 4.0 requires library schools to incorporate innovative programs into their curriculum. Students will probably be ready for industry 4.0, have multiple, valuable, sustainable careers, and contribute to global society as a result of this (Salmon, 2019). Additionally, the report provided various strategies and methods that universities can use to align their programs and services with the goal of better preparing their graduates for the workforce (Hussin, 2018). It will transform the delivery of lectures and the provision of interactive learning environments, educational tools, and services. The 4IR's Education 4.0 makes sure that learning is stimulating in the workplace. It represents a more practical method of instruction and learning that will provide pupils outstanding outcomes at work. Utilizing digital technology is necessary for its efficiency, efficacy, engagement, and communication, but most importantly, for genuine and worthwhile educational experiences (Admiraal et al., 2019).

CUTTING-EDGE FOURTH INDUSTRIAL REVOLUTION TECHNOLOGIES

The Fourth Industrial Revolution has already begun in the US and Europe. The first is that it will result in joblessness. Biotechnologies, robots, and artificial intelligence will eventually replace humans in the workplace. According to Frey & Osborne's (2013) research, 47% of US occupations may soon be facing the risk of automation. Many roles that we currently consider part of the labour force in large corporations will disappear as a result of this. The way user’s access information from centres and libraries has changed due to emerging

technology. (West, David, 2021). NUC must react quickly by putting a new curriculum into place. It would make sense to make significant adjustments concerning the library and information science curriculum to enable students to gain proficiency in the quickly developing fields of data science, artificial intelligence, robotics, etc.

Similarly, as a means of achieving Fourth Industrial Revolution (4IR) literacy, focus should be made on computer applications, the use of computers for programming, software development, JavaScript, and network systems, among other things. A paradigm shift in teaching will also be brought about by the new developing technologies; as online learning and artificial intelligence advance, new standards are required to give digital pedagogy a theoretical foundation. As it alters the workings of space & produces new learning systems that challenge our conceptions of what it is to be human, it highlights that digital education is not simply a technological issue (Bayne and Jandric, 2017). Industries employing robots may have both positive and harmful impacts on human life (Zeruodi, 2020). On the shortcoming, robots may be considered a danger to human labour because they drastically lower labour costs and lower the possibility of human error occurring. Robots may increase productivity, earnings, and overall labour demand, according to studies, but primarily for the benefit of highly trained individuals. However, people must take advantage of their comparative advantages, particularly their cognitive abilities and capacity for creative problem-solving, in order to handle complex situations. These abilities may be greatly enhanced by curricula in nations where people work with robots, as these nations have a higher and easier rate of automation adaptation than other nations.

SIGNIFICANT TECHNOLOGICAL DEVELOPMENTS LINKED TO THE 4IR

The Fourth Industrial Revolution (4IR), also known as Industry 4.0, can be described by the way digital technologies are incorporated into all facets of life, radically altering how people communicate, work, and live. These interrelated technology developments have the power to transform entire sectors, open up fresh business prospects, and solve difficult global issues. Among the significant technological developments linked to the Fourth Industrial Revolution (4IR) are:

INTERNET OF THINGS (IoT): IoT, or the Internet of Things, enables data collection and exchange by linking everyday items and devices to the internet. Applications for this technology can be found in sectors like industry, healthcare, and agriculture. This concept outlines the process of connecting commonplace physical objects, or "things," to the internet, enabling them to collect, share, and transmit data. The Internet of Things (IoT) expands the capabilities of connecting to the internet beyond conventional computing devices like PCs and smartphones to encompass a vast array of objects that are integrated with sensors, software, and networking hardware. The following are some important IoT features:

- **Interconnected Devices:** The Internet of Things (IoT) entails linking a wide range of tangible items to the internet. These items could be anything from infrastructure and structures to wearable technology, industrial machinery, automobiles, household appliances, and environmental sensors.
- **Data Collection:** A variety of internet of Things devices gather information about their environment. In addition to many other things, these sensors may detect motion, light, temperature, humidity, and location. For analysis, the gathered data is sent to the cloud or a central system.
- **Connectivity:** To connect to the internet, IoT devices use a variety of communication protocols and technologies. Depending on the particular use case, these may include Bluetooth, cellular networks, Wi-Fi, RFID (Radio-Frequency Identification), LPWAN (Low-Power Wide-Area Network), or more.
- **Data analysis:** Once gathered, we can examine the data to extract crucial insights. Data machine learning and analytics approaches are frequently used to find trends, abnormalities, and patterns in the massive volumes of data that IoT devices produce.
- **Automation and operation:** The Internet of Things makes it possible to automate and remotely operate systems and devices. For instance, based on customer preferences and current meteorological data, smart thermostats may automatically modify the temperature in a house.
- All in all, the concept of the Internet of Things represents a significant shift in how we utilize and interact with technology. It is an enormous advantage in the modern era because it may spur innovation, boost productivity, and improve quality of life in a variety of fields.

MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE (AI): AI is the replication of human intellect in computers, allowing them to carry out operations like decision-making and problem-solving that normally call for human intelligence. The creation of algorithms that enable them to learn from and develop predictions or judgments based on data is known as machine learning, an element of artificial intelligence.

The goal of the multidisciplinary computer science discipline of artificial intelligence (AI) is to build machines and systems that are able to carry out tasks that normally call for human intelligence. These tasks involve perception, learning, interpreting natural language, problem-solving, and decision-making. The large discipline of computer science known as artificial intelligence (AI) aims to build machines and systems that can perform operations typically requiring human intelligence. Creating intelligent agents who can sense their surroundings, reason about them, make decisions, and act to accomplish particular objectives is the most important objective of artificial intelligence. Here are some important AI-related ideas:

- **Deep Learning:** A kind of machine learning called "deep learning" uses multi-layered artificial neural networks, or "deep neural networks." It has demonstrated exceptional performance in tasks such as speech and picture recognition. The goal of the artificial intelligence field of natural language processing, or NLP, is to make it possible for robots to comprehend, interpret, and produce human language. Applications such as sentiment analysis, language translation, and chatbots use it.
- **Computer Vision:** This branch of artificial intelligence allows machines to decipher and comprehend visual data from pictures and movies. It is employed in tasks like object detection and facial recognition.
- **Expert Systems:** AI programs created to simulate human experts' decision-making in particular fields are known as expert systems. They employ rule-based reasoning and knowledge representation.
- **Cognitive Computing:** The goal of cognitive computing is to build systems that can think, solve problems, and learn like humans. One example of cognitive computing is IBM's Watson. A branch of artificial intelligence called machine learning is concerned with creating statistical models and algorithms that let computers learn from historical information and create predictions or judgments. Instead of being explicitly coded, machine learning systems are made to perform better on a given task through experience. The following are some essential machine learning concepts:
- **Training Data:** A dataset that is utilized for teaching machine learning models is known as training data. Usually, the dataset consists of input attributes along with matching target labels or results. Machine learning (ML) models have been developed using labelled data in supervised learning, where the right output and label are known. The model gains the ability to forecast using input-output pairings.
- **Regression vs. Classification:** Machine learning tasks can be divided into two groups: regression, which aims to predict a continuous numerical value, and classification, which assigns data points to discrete groupings or categories.
- **Testing and Validation:** ML models are assessed using testing datasets to gauge their generalization performance and validation datasets to adjust parameters.
- **Reinforcement Learning:** In this kind of machine learning, agents pick up new skills by interacting with their surroundings and getting rewards or punishments according to their behaviour. It is employed in fields like gaming and robotics. Machine learning is a subset of artificial intelligence (AI) that focuses on creating algorithms that can learn from historical information and make predictions or judgments. AI is a larger topic that includes various technologies and concepts. A key element of AI is machine learning, which allows AI systems to evolve and perform better over time.

BIG DATA & DATA ANALYTICS: Due to the huge amount, speed, and variety of Big Data, typical data analysis techniques are insufficient; hence, Big Data and statistical analytics are closely related. Big Data insights are frequently extracted using advanced analytics, such as machine learning, which aids businesses in improving operations, gaining a competitive edge, and making data-driven decisions. Big data technologies enable the collection, storage, and analysis of vast datasets, generating insights that guide scientific research, corporate decisions, and other undertakings. Large and complicated datasets whose contents are too numerous, diverse, & dynamic to be handled and examined with conventional data administration and processing techniques are referred to as "big data." The following characteristics define large data:

- **Volume:** Large volumes of data, usually in the terabyte to Exabyte range, are frequently involved with big data. Numerous sources, such as social media, sensors, transactions, and more, may provide this data.

- **Velocity:** Data is created and gathered quickly, frequently in real-time or almost real-time. Social media networks, for instance, produce a constant flow of data.
- **Variety:** Big Data encompasses a broad range of data types, including unstructured data (text, photos, videos), semi-structured data (JSON, XML), and structured data (databases).
- **Veracity:** Data quality varies greatly, and big data may be noisy & untrustworthy. When working with big data, cleaning and validating it is a crucial step.
- **Value:** Finding insightful patterns, trends, and insights that can guide decisions and influence business results is the main objective of big data analysis. Analytics is the methodical process of looking at, analysing, and turning data into information, insights, and practical suggestions. For obtaining knowledge from data, various methods and instruments are employed. Here are a few important categories of analytics:
- **Descriptive analytics:** The main goal of descriptive analytics is to summarize historical data to comprehend past events. To shed light on trends and patterns, it uses data visualization and simple statistical analysis.
- **Diagnostic Analytics:** By looking more closely at past data, diagnostic analytics seeks to explain why something occurred. It entails determining the contributing elements to particular results or occurrences as well as doing root cause analysis.
- **Predictive analytics:** Using past data, predictive analytics forecasts future events using both machine learning and statistical approaches. It assists businesses in anticipating trends and making well-informed decisions.
- **Prescriptive analytics:** This type of analysis goes beyond forecasts to offer suggestions for how to best achieve future results. Predictive models recommend the optimal course of action. Analytics is the process of drawing insightful conclusions from data, whereas big data refers to the enormous, varied, and rapidly changing datasets. Organizations may use big datasets to solve complex problems, inform decisions, and spur innovation across a range of industries by integrating analytics and big data.

BLOCKCHAIN: This technology allows for the distributed, decentralized, transparent, and safe recording of transactions. Digital identity verification, supply chain management, and finance are among the fields where block chain finds its applications. Block chain, a ground-breaking and transformative technology, serves as the foundation for cryptocurrencies such as Bitcoin and finds its application in various sectors beyond finance. Fundamentally, block chain is a distributed, decentralized digital ledger that keeps track of transactions across several computers while guaranteeing the data's security, integrity, and transparency. We break down the main ideas and elements of block chain as follows:

- **Decentralization:** Unlike conventional centralized systems, where a single entity controls data and transactions, block chain operates on an autonomous system of computers. This decentralization enhances transparency and security.
- **Security:** A block chain employs cryptographic methods to safeguard transactions. The mechanism is tamper-resistant since it is very difficult to change or remove a transaction after it has been put to a block.
- **Transparency:** Usually, everyone in the network may access the ledger. The transaction history is accessible to anyone, encouraging openness and confidence between parties.
- **Immutability:** Data cannot be changed once it has been introduced to a block chain; this feature is known as immutability. This immutability guarantees data integrity. Block chain is a transparent, safe, and decentralized ledger technology that might upend several sectors outside of banking. It has a permanent record of transactions and is being studied for public and private sector uses.

AUTOMATION AND ROBOTICS: By increasing accuracy and efficiency, developments in automation and robotics are revolutionizing entire industries. Libraries, manufacturing, shipping, and even healthcare are using robots and automated systems. Automation and robotics are closely related fields that focus on utilizing technology, software, and robots to perform tasks with minimal human assistance. The design, building, use, and maintenance of robots are the main topics of the multidisciplinary scientific and engineering discipline of robotics. Robots constitute mechanical or electromechanical machines that can carry out tasks either fully or partially on their own. The following are some essential robotics concepts:

- **Automation:** Robotics frequently entails automation, in which devices are configured to perform activities on their own. Robots can work in places that humans might consider dangerous or inaccessible.

- **Sensors:** To sense their environment and collect information for navigation and decision-making, robots are outfitted with various sensors, including cameras, touch sensors, and proximity sensors.
- **Actuators**: Actuators, such as motors and pneumatic systems, allow robots to move, manipulate items, and carry out actions in order that they can communicate with the physical world.
- **Control Systems:** Algorithms and software are used to govern the behaviour of robots. It is possible to program these control systems to react to various inputs and adjust to shifting circumstances. Automation is the method and technology of employing computers, control systems, and machines to complete activities with little assistance from humans. The following are some essential ideas in automation:
- **Process Automation:** Automation is frequently used in several industrial processes, including logistics, manufacturing, and energy production. It frequently uses sensors and programmable logic controllers (PLCs).
- **Data-Driven Automation:** Automation can leverage real-time information and data. For instance, supply chain management and demand forecasting systems use data to automate logistics and inventory control.
- **Robotic Process Automation (RPA):** Robotic Process Automation (RPA) is the process of automating repetitive, rule-based business process tasks, like data entry and extraction, using software robots, or "bots." Automation and robotics are essential for raising efficiency, safety, and production in a variety of sectors. Automation and robotics significantly affect how we perform our jobs and live, as they involve using technology to carry out tasks either fully or partially autonomously.

VIRTUAL REALITY (VR) AND AUGMENTED REALITY (AR): AR superimposes digital data on the physical world, whereas VR transports viewers to a virtual setting. Applications for these technologies can be found in domains like training, education, and gaming. Immersion technologies, such as virtual reality (VR) and augmented reality (AR), transform our perception and interaction with both the real and virtual realms. Despite certain similarities, they have different ideas and uses: Virtual reality (VR) is a technology that allows users to explore and interact with a computer-generated, immersive, and interactive three-dimensional environment. It seeks to totally substitute a virtual digital environment for the real one. The following are some essential VR concepts:

- **Immersion Environment:** Virtual reality (VR) gives consumers the impression that they are physically there in the virtual world. Headsets that include the user's range of vision and usually incorporate spatial audio are used to accomplish this. Interaction: Controllers and hand gestures, with a few even using full-body tracking, are ways that users can engage with the virtual environment. Such functionality enables them to move about the digital environment and manipulate objects.
- **Head-Mounted Display (HMD):** Virtual Reality (VR) headsets, sometimes referred to as head-mounted gadgets, are worn on the head and usually include audio equipment, sensors to track head motions, and screens for each eye. The technology known as augmented reality (AR) superimposes digital data, including sounds, images, and other information, on top of the physical world. Through the addition of virtual features to their surroundings, it improves the user's experience of reality. The following are some essential ideas in AR:
- **Real-Time Integration:** augmented reality systems allow for the smooth real-time integration of digital and physical content. Users have simultaneous access to the augmented technological components and the real-world surroundings. Comparing marker-based and marker less augmented reality, the former uses pre-established markers such as QR codes to activate digital overlays. Computer vision & recognition technologies are used by marker less AR to locate surfaces and objects for augmentation.
- **Wearable technology and smartphones:** AR glasses, smartphones, and tablets can all be used to deliver AR experiences, giving people access to augmented material through commonplace gadgets. While AR superimposes digital content on the actual world to improve the user's impression of reality, VR transports them to a completely simulated digital environment. Both technologies continue to develop with improvements in both the software and the hardware and have a broad range of applications in several industries, including gaming, education, healthcare, and navigation.

THE IMPORTANCE OF LIBRARIES IN THE ERA OF RAPID TECHNOLOGICAL ADVANCEMENT

The value of libraries in an age of swift technological advancement goes much beyond their conventional functions. By adjusting to new technological developments and satisfying the changing requirements of their communities, libraries play a vital and dynamic position in the Fourth Industrial Revolution. Here are some ways that libraries are still important in this age of rapid technology advancement:

- **Supporting Digital Equity and Advancing Digital Literacy:** Navigating and comprehending digital platforms is crucial as technology becomes more and more ingrained in daily life. Libraries act as hubs for teaching digital literacy, providing instruction in subjects like data privacy, online research, and fundamental computer skills. Libraries enable people to engage in the digital world with confidence by providing them with these skills. Libraries are outspoken supporters of digital equity, working to enact laws and programs that guarantee everyone in society has equitable access to knowledge and technology.
- **Equitable Access to Hubs for Innovation and Information:** One major issue facing our contemporary civilization is the digital gap. Libraries help close this gap by giving people who might not have access to computers, the internet, and digital materials at home free of charge. Everyone will be able to take advantage of the 4th Industrial Revolution because of this access to technology and knowledge. Libraries have evolved into centers of innovation, offering areas for people to test out cutting-edge technologies like robots, virtual reality, and 3D printing. These areas promote innovation, entrepreneurship, and experimentation with cutting-edge equipment.
- **Supporting Lifelong Learning and Conserving and Curating Digital Content:** Libraries are essential to the preservation and curation of digital content in an era where a large portion of our cultural legacy is preserved online. Libraries ensure the preservation and accessibility of valuable digital assets, such as websites, online journals, and multimedia items, for future generations. The Fourth Industrial Revolution emphasizes the significance of ongoing education and skill development. Libraries include a range of tools that promote lifelong academic achievement and personal development, such as e-books, online courses, and instructional materials.
- **Access to Digital Resources and Directed Information Search**: Numerous digital resources, such as electronic books, internet-based publications, and academic databases, are accessible through libraries. Libraries are essential for scholars, researchers, and students because of these resources, which facilitate both professional and scholarly study. Misinformation and information overload may result from the vast amount of information that is readily available online. In the digital world, libraries act as trustworthy resources, assisting users in locating trustworthy sources, assessing material critically, and differentiating between trustworthy and deceptive content.
- **Community Involvement and Assistance for Small Businesses and Entrepreneurs:** Libraries remain important places for community involvement and interaction. They organize technology-related lectures, workshops, and events that encourage community people to have educated conversations about how technology affects society. Libraries provide small company owners and entrepreneurs with resources and advice. By encouraging creativity and entrepreneurship, libraries help local economic growth through anything from market assessment databases to company planning workshops. Libraries essentially act as navigational aids in the quickly changing technology environment. They embrace the resources along with the possibilities of the Fourth Industrial Revolution to improve the lives of their communities while upholding their conventional principles of education, diversity, and information sharing.

THE IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION ON LIBRARIES AND INFORMATION SERVICES

The Fourth Industrial Revolution (4IR) is bringing about notable changes to library and information services, including automation and artificial intelligence (AI), a varied user base, embedded librarianship, open-source science, online social networking platforms, and the evolving responsibilities of librarians. Some librarians consider themselves endangered by the revolution because they believe that new employees with the necessary skills or machines may replace certain categories of staff. To guarantee that users can access and utilize information through a variety of platforms, libraries are now encouraging digital literacy.

Advanced robotic conveyers, artificial intelligence (AI) instruction, and data collection via social media platforms, drones, and cameras are just a few of the industry 4.0 applications and tools that some libraries have

embraced. To adapt to the 4IR, the University of Pretoria hired Libby, a user service robot, in May 2019. In order to assist users in accessing and assessing information resources, librarians are increasingly assuming new tasks and duties, including research, teaching & learning, as well as teaching information literacy.

According to the design objectives and principles of the 4IR, libraries must envision, plan, and implement it in a comprehensive and sustainable manner. When implementing an information and communication technology approach related to the 4IR, countries must take into account all aspects of their book publishing & LIS ecosystem. The ecosystem can produce big data and connect disparate technologies through the integration of different nodes.

LIBRARY DIFFICULTIES IN THE 4.0 INDUSTRIAL REVOLUTION

Due to the demands of the Industrial Revolution 4.0, Library 4.0 faced numerous obstacles in addition to its opportunities. Despite having a long history, the library's function appears to have faded. Furthermore, most people only have a hazy understanding of what "information service" is. Unquestionably, the Industrial Revolution 4.0 drastically changed every facet of existence, which implies that technological advancement will proceed at an even faster rate. Libraries must update their operations and service delivery methods to avoid falling behind and losing the ability to successfully carry out their purpose of disseminating knowledge and information (Duong, D.T., 2018).

Due to its significance and application, data is practically the lifeblood within the Industry Revolution 4.0 age. A library may not be promoted to Library 4.0 without any data. As a result, a library must improve its information resources, particularly by creating databases with metadata that can accommodate the wide range of user needs. Since data is accessible everywhere, the fourth industrial revolution has increased the issues associated with information security and safety. Finding a way to ensure that information flows between the systems is a major challenge for all libraries.

Additionally, maintaining data transparency and quality is a challenge (Vu, D.T.N., 2018). In addition to the standard library skills, a modern library demands that its librarians possess enough and relevant attributes, credentials, and abilities. It is well known that Industry Revolution 4.0 is making it increasingly difficult to distinguish between libraries because they all use an identical data source and library linkage systems are growing in popularity. Thus, the information and library sector must create a suitable and equitable system for connecting and exchanging materials amongst libraries.

Several types of software do not identify the records as the primary cataloguing program to process data sent to World Cat Discovery, demonstrating how the current uneven data structure affects data transfers among libraries worldwide. For long-term usage of digital data, libraries must update and adhere to international standards for data storage and preservation.

Data Source Development Trends during the Industrial Revolution 4.0

Libraries, believed to contain all of humanity's information, must possess everything a user could possibly require. To satisfy patrons' demands, a library must provide an adequate and comprehensive data source that is ready for usage. Therefore, the data source can be regarded as the fundamental basis for carrying out any library activity, since it is the primary influencing factor. As a result, the primary focus of influence is the source, which serves as the crucial basis for carrying out the library's operations.

The current sources are unique in that they encompass all the scientific literature in a comprehensive connection, forming a big data block as a single information space. There are no papers in that sizable data block that are entirely distinct from one another; instead, they all display a date link that illustrates the quote relationships between them. Big data is the process of connecting data so that databases always supply user’s access to citation indexes, impact factors, and several more statistics on scientific journals, publications, and other scientific topics. Extensive research in the field of library information has identified Big Data as a defining characteristic of libraries. It encourages libraries to share vast amounts of information and reuse scientific information sources

in collaboration with academics, publishers, data centres, and journals. These days, libraries are creating data sources to give patrons services that are simple to use and take advantage of on mobile devices.

Library 4.0's development platform within the framework of the ongoing 4.0 industrial revolution, Library 4.0 represents the next wave of libraries designed to meet patron demands. It is built upon the foundation of the information and communication technology system, of which web 4.0 technology is an essential component. The fourth generation of the internet, known as Web 4.0, builds on the successes of the first three and is currently in widespread use. Web 4.0 is sometimes referred to as the "web of intelligence connections" or the "web of connecting things." Web 4.0 implements the symbiotic relationship between computers and humans. The line between "physical libraries" and "digital space" is blurred because of Web 4.0, which makes the globe seem to always be connected and offering ever-better facilities and services.

Web 4.0 uses artificial intelligence and self-learning technologies to help users understand complex information. The way individuals connect with one another is also how Web 4.0 communicates with its users. It would be an open, intelligent, linked website with hitherto unheard-of speed and dependability. Furthermore, the development of Library 4.0 requires the server system, internet broadcast line, information storage system, software system, and other auxiliary equipment to be capable (Huynh, M.D., 2018).

LIBRARY OPPORTUNITIES IN THE 4.0 INDUSTRIAL REVOLUTION

Library generations have evolved from 1.0, 2.0, 3.0, and the current 4.0 with the capacity to bridge the gap between the virtual and physical worlds, in tandem with the growth of web generations (Phan, X. D., 2018). Library 1.0 is the term for the original library generation, which had a single bibliographic database and the Online Public Access Catalogue (OPAC). The term "library 2.0" describes the integration of web 2.0 with library services, which entails incorporating web-based multimedia tools, interactivity, and collaboration technologies. To satisfy the demands and expectations of its patrons, Library 2.0 offers a wide range of services that guarantee the unhindered availability of knowledge and resources anywhere, at any time. Library 2.0 simplifies everything and encourages cooperation, engagement, and participation from technical partners, the web management department, and the general public.

Library 2.0 is based on the ideas of being user-centred and facilitating easy communication between libraries and their patrons through the use of tools like blogs, RSS, wikis, and more. Library 3.0 is the term used to describe the library system of new technological applications like mobile devices, cloud computing, and the semantic web, as well as the system of tools like affiliate pursuit systems that facilitate the creation, arrangement, and dissemination of user-generated content by facilitating smooth communication between users, experts, and libraries. Web 4.0 is comparable to Library 4.0 in that both use many of the same ideas and technology.

Based on Web 4.0, Library 4.0 constitutes an intelligent library that incorporates the automatic analysis system of the most recent findings in addition to existing conclusions and studies. It can be thought of as a combined ecosystem of different platforms, services, and content that enables mutual reading, writing, execution, and unification amongst librarians, users, and machines.

Additionally, Library 4.0 serves as a platform for reasoning that supports decision-making, critical thinking, and the delivery of library services. Library 4.0 benefits substantially from Web 4.0's many advantages when it comes to information technology adoption. The resources available in each library are virtually limitless in Library 4.0, and patrons including those with disabilities are permitted to access the vast global library in addition to using the information from their library as members. More significantly, no money will be spent on document duplication when libraries are linked to share resources. According to Duong (2018), such an arrangement significantly lowers expenditures on investments for libraries and helps resolve financial issues.

INFORMATION AVAILABILITY

By giving people access to technology and information that they might not otherwise have at home or elsewhere, libraries are helping to close the digital divide. They are making a concerted effort to guarantee that every community member has an equal chance to interact using the digital world. Libraries are contributing to this effort in several ways:

- **Mobile Libraries, Digital Resources, and assistance with remote learning:** Digital resources, including electronic books, e-magazines, internet-based databases, and other educational platforms, are accessible through libraries. Even without personal devices, patrons can borrow and utilize these resources remotely. Some libraries run bookmobiles or mobile libraries that reach out to isolated populations by bringing resources and technology to underprivileged areas. Through the provision of virtual textbooks, academic databases, and instructional platforms, libraries assist distant learners. Libraries provide public computers with productivity tools so that people can prepare documents, view online job applications, and carry out other duties that call for computer access. They also offer computer training & technology workshops. Libraries offer classes and computer literacy training that teach fundamental skills, including email, internet navigation, and productivity software use. Libraries introduce people to new skills and technologies through technology seminars on subjects including digital photography, robotics, coding, and more.
- **Free Internet Access, Help with Online Services, and Access for Vulnerable Populations:** Libraries provide free internet access via computers and Wi-Fi, enabling people to interact, surf the web, and access online resources even if they don't have dependable internet connections at home. Libraries help people access social services, online job sites, and government services. Employees can guide users through online applications and forms. Libraries make sure that low-income people, seniors, and refugees, among other vulnerable groups, have access to digital resources and technology.
- **Language Literacy Support and Digital Literacy Programs:** Libraries provide digital literacy programs that instruct users on how to assess online content, use technology efficiently, and stay safe online. Libraries help people learn new languages or increase their literacy by offering digital materials and language-learning platforms. Libraries work with government organizations, educational institutions, and community groups to create digital inclusion initiatives that cater to particular needs and difficulties.
- **Community participation and educational support:** Technology-related events, workshops, and seminars that encourage open discussions about technology integration and access to libraries foster community participation. People can charge their laptops, tablets, and smartphones at the public charging stations that libraries offer. Libraries provide resources and technology to meet the educational needs of students, guaranteeing that every student has access to learning and research aids. By providing these programs and services, libraries enable people of all backgrounds and socioeconomic statuses to fully engage within the digital age by equipping them with the expertise, resources, and instruments they need.

MODEL 7-A

This model, which is composed of the acronyms of English words like Archive, Accredit, Actualize, Analyse, Affirm, Associate, and Animate, represents the primary operations of the digital library.

- **Archive (resources):** This function involves keeping information sources to supply the effective provision of relevant data, which is entirely consistent with the fundamental purpose of all libraries, which is to store collections of knowledge resources and, more completely, to enable access, exploitation, and use of those resources. The purpose of this function is to make information sources more easily accessible and valuable to users in accordance with their individual rights and responsibilities.
- **Obtain accreditation for the data:** The purpose of information authentication is to raise the degree of authenticity (as measured by the content's worth) of digital libraries. The purpose of the authentication mechanism is to formally acknowledge a digital library as the same as a company capable of providing trustworthy specialist information that aids in identifying trustworthy sources of knowledge. The library's policy for developing information resources also determines this.
- **Actualize (knowledge):** This is the process of updating knowledge to keep libraries current and provide the most recent information to satisfy the needs of all types of users. This is also well recognized because nearly all libraries, especially university and science libraries, have adopted current knowledge dissemination products and services, including recently released directories and up-to-date directories.
- **Analyse (data):** Data analysis is the process that provides individuals with a comprehensive understanding of information archives. Users can thoroughly examine the archives' data content with the data analysis feature. Digital libraries support understanding events, comparing resources, creating references, and searching information. Even though not every library has done so, it is evident that many large libraries worldwide have successfully connected and shared information resources, laying the

groundwork for users to use and access a vast repository of knowledge encompassing all of humanity's intellectual accomplishments.

- **Affirm (an identity):** The function that defines an entity (the term document, a source of information, etc.) to represent the fundamental principles of any library is called "affirm (an identity)." The term "core value" refers to all of the fundamental elements that communicate to the community the worth and efficacy of the library, such as its information resources (the collections' reserves and properties), system of goods and services, facilities, methods, partners and experts, notable accomplishments, and historical traditions. The defining function aids in identifying and validating a library's worth and identity.
- **Associate:** Depending on their interests, individuals can join specific social networks by using the associate function. The various forums, whether individually or collectively, demonstrate their role in advancing general knowledge. This is a service that is becoming more and more significant for university and research libraries since it facilitates the efficient conduct of scientific exchanges.
- **Animate:** This feature piques consumers' curiosity in order to draw them in with the creation of virtual events. The purpose of this function is to encourage users to use the library resources and services offered by digital libraries to create and share knowledge.

MODEL 5-S

Accordingly, the five Ss in the 5-S paradigm stand for Society, Scenarios, Spaces, structures, & Streams. In accordance with Shen, R., Goncalves, M.A., Fox, E.A. (2013), and other scholars, a digital library is a sophisticated information system that carries out the following tasks, which are described in terms of the five S's (Vu, D.H., 2018):

- **Society:** Digital libraries aim to meet the overall demands of users, specifically their information-searching needs.
- **Scenarios:** The purpose of a digital library is to serve users' needs by offering services such as particular activities that are planned in a predetermined order to fulfill a request. Numerous studies conducted in the past have discovered that the intended situation under which the search is conducted serves as a representation of the information-searching tactics. This phenomenon can also be seen as one of the main reasons writers find digital libraries useful for delivering news services and implementing scenarios.
- **Spaces:** This procedure involves describing information in accordance with the library's functional spaces and presenting and supplying it in ways that are appropriate for the needs of the patrons.
- **Structure:** The process involves arranging and organizing information based on what users need, including using metadata to create suitable information structures that meet the requirements for searching and using data effectively.
- **Streams:** The purpose of creating information streams is to connect, share, and exchange data amongst people and communities.

SKILLS FOR INFORMATION PROFESSIONALS IN THE FOURTH INDUSTRIAL REVOLUTION (4IR)

Era skills are strategies for completing tasks as efficiently as possible while utilizing few resources to meet organizational objectives. In the information industry, skills are essential. The evaluated literature identified a number of essential skills for Fourth Industrial Revolution (4IR). According to Ayinde and Kirkwood (2020), to thrive in the 4IR era, customers require a variety of skills, including the ability to retrieve and search, manage and lead, use reference services, and use information technology. The book "Artificial Intelligence in Practice: How 50 Successful Companies Used Artificial Intelligence and Machine Learning to Solve 47 Problems for Digitally Enabled Libraries" was released by Marr and Ward in 2019. Innovative thinking, emotional intelligence (EQ), scientific (critical) thinking and acting, engagement with learning with a growth mind-set, judgment and decision-making, interpersonal communication abilities, leadership skills, diversity along with cultural intelligence, technological expertise, and the capacity to accept change are described in this book as being essential for the 4IR revolution era. All of these abilities will position people for fulfilling careers in the future, including scientific research, sophisticated statistics, smart software development, smart engineering, and smart robots (Ayinde and Kirkwood 2020). According to Bikse et al. (2022), employees in the 4IR period will essentially need to possess fundamental 21st-century competences in various skill categories, including core, basic, transferable, generic, key, soft, behavioural, and cross-curricular abilities. Furthermore, human

ingenuity and imagination power 4IR technologies (Jacobs 2021). LIS professionals need to learn new skills for the 4IR era, such as managing information, handling big data, conducting research, preserving digital content, using cloud data, working together, teaching, thinking analytically and creatively, designing technology, solving problems, leading, understanding emotions, and evaluating systems, according to Tella (2020). The foundation of 4IR is the development of high-quality intellectual capital, which would enable more individuals to acquire knowledge, concepts, and innovative skills (Osuigwe 2019).

SECURITY AND PRIVACY OF DATA

As people engage with various online platforms and share significant personal information online, worries over data security and privacy have grown in importance in the digital age. To guarantee that users feel safe and secure when utilizing their resources and services, libraries have a need to resolve these issues. Libraries can address data security and privacy concerns in the following ways:

- **Clear and Open Data Retention and Privacy Policies:** Libraries ought to have transparent and unambiguous privacy policies that describe the procedures for gathering, using, and safeguarding patron data. Customers should be able to quickly access and comprehend these policies. To reduce the danger of data breaches, libraries should set clear guidelines for keeping patron data and promptly deleting those that aren't needed. Libraries must conduct regular audits of their data collection and storage procedures to ensure compliance with privacy laws and identify areas that require improvement.
- **Encryption and Data Minimization:** Libraries should only gather the bare minimum of information required to deliver services. Libraries should only gather personal data for its intended use and only with express consent. Libraries should use strong encryption techniques to protect private user data, including login passwords and personal information, during network transfers. We should prioritize regular software updates, secure Wi-Fi, and cybersecurity training. Library employees should be trained in cybersecurity best practices, which include identifying potential security threats and phishing attempts. Libraries can collaborate with cybersecurity professionals to assess their systems, identify vulnerabilities, and implement robust security measures.
- To avoid unwanted access and data interception, libraries that provide Wi-Fi should ensure that their networks are safe and protected. Libraries should maintain the most recent security patches installed on their systems and software to avoid risk factors that cyberattacks could exploit. To safeguard sensitive and historical data, libraries that house digital archives should establish access controls and secure storage options.

Tools for user education, membership security, privacy, and anonymity: Libraries can teach patrons about internet safety by offering advice on how to safeguard private data, spot frauds, and behave responsibly online. For extra protection, libraries that allow user accounts should advise users to make secure passwords and contemplate introducing multi-factor authentication. Libraries should create an incident response strategy that specifies what to do in the event of a security issue or data breach, including alerting authorities and impacted patrons. Library users can have access to tools that enhance online privacy, such as web browsers that block tracking cookies and plugins that encrypt internet connections. Libraries should emphasize the value of preserving individual security in the digital age by supporting strict data privacy legislation and regulations at the municipal and federal levels. Libraries can build a secure and reliable digital environment for their patrons and encourage confidence in their services by being proactive and giving data security and privacy first priority.

COOPERATION AND PARTNERSHIP BETWEEN LIBRARIES AND OTHER SECTORS

To remain relevant in the quickly evolving world of today, libraries are working with a variety of sectors and organizations. Through these partnerships, libraries are able to reach a wider audience, provide new services, and access knowledge from various sectors. To stay relevant, libraries are forming collaborations in the following ways:

- **Professional associations and educational institutions:** Schools, colleges, and universities work with libraries to facilitate student's access to materials, help with research, and provide study areas. Collaborative workshops, information literacy initiatives, and shared access to digital collections promote a smooth learning environment. Libraries engage in partnerships with various professional associations to offer resources, research materials, and networking opportunities to community professionals.

- **Community Organizations, Cultural Institutions, and Aging Centres:** To meet the specific needs of various demographic groups, libraries collaborate with neighbourhood non-profits, social assistance organizations, and community organizations. These collaborations yield services, workshops, and programs tailored to the community's needs. Libraries can organize collaborative exhibitions, talks, and activities that enhance their communities' cultural experiences through partnerships with museums, art galleries, & cultural organizations. Libraries are able to offer resources, tech support, and programming that address the needs of senior citizens through partnerships with aging & senior centres.
- **Public Services, And Opportunities for Civic Engagement:** Libraries can provide information on government programs, public services, and opportunities for civic engagement by collaborating with governmental organizations, campaigns for digital inclusion, and civic advocacy groups. Libraries act as central locations for the dissemination of information about social services, healthcare, and elections. Libraries work with organizations that promote digital inclusion to close the digital divide and provide marginalized people access to technology, training, and resources. Libraries collaborate with advocacy and civic groups to promote dialogue on significant social issues. They offer venues for open forums, discussions, and arguments that support responsible citizenship.
- **Start-ups and Tech Companies Business and Entrepreneurship Centres:** Libraries work with start-ups and tech firms to provide training, mentorship, and programming pertaining to technology. Libraries offer useful venues for innovative hackathons, coding classes, and tech meetings. To assist local start-ups & small enterprises, libraries work with entrepreneurship centres and business associations. Networking events, market research, and company development workshops foster local economies.
- **Healthcare Providers, STEM, and Environmental Organizations:** Libraries collaborate with healthcare organizations to provide wellness initiatives, workshops on subjects including mental health and healthy living, and health information resources. Libraries collaborate with groups focused on STEM (science, technology, engineering, and mathematics) to provide visitors of all ages with STEM-related events, workshops, and interactive activities. Libraries and environmental organizations work together to provide knowledge on conservation, climate change, and sustainability. They might hold talks on environmental issues, film screenings, and workshops.
- **Local Authors, Artists, and Media Outlets:** To advertise their programs, events, and services, libraries collaborate with local media outlets. This partnership promotes community involvement and increases visibility. Libraries are able to host readings, workshops & exhibitions that highlight regional talent and encourage creativity through partnerships with local authors and artists. These partnerships not only increase the significance of library services; they also establish libraries as vibrant community centres that adapt to changing demands. Libraries continue to be at the forefront of knowledge dissemination and community engagement by utilizing the resources and experience of diverse sectors.

LIBRARY CASE STUDIES AND THE FOURTH INDUSTRIAL REVOLUTION

Examples of Libraries in the Real World That Have Successfully Adopted the Fourth Industrial Revolution (4IR) Worldwide Here are a few actual instances of libraries worldwide that have effectively embraced the Fourth Industrial Revolution:

- **The Edge, Queensland State Library, and Australia:** The Edge has emerged as a digital culture hub of the Queensland State Library that emphasizes innovation, technology, and creativity. Among its many amenities is a fabrication facility, which includes three-dimensional printers and laser cutters, along with additional maker equipment. The Edge gives the community the chance to investigate and test out new technologies through workshops, coding residences, and various other events.
- **Mexico City's Biblioteca Vasconcelos:** This cutting-edge library prioritizes technological integration and has a gorgeous modern style. The library now features touch-screen interfaces for browsing and locating materials, an internet-based catalogue system, and robots that retrieve volumes. The library's technologically advanced environment encourages patrons to interact with resources and knowledge in novel ways. DOKK1 in Aarhus, Denmark, is a library and cultural hub that embraces the internet era. Self-service kiosks, virtual displays, and digital archives are just a few of the many digital services it provides. The library encourages creativity and digital literacy by holding workshops on digital design, virtual reality, and coding. The Central Library of Helsinki, Finland, Oodi, is renowned for its dedication to innovation, technology, and contemporary architecture. It gives users access to sewing machines, music recording studios, and 3D

printers. To appeal to the hobbies of a tech-savvy community, the library also has a virtual reality area and a digital game zone.

- **United Kingdom's Birmingham Central Library & Birmingham Library:** With cutting-edge amenities like recording studios, a video editing lab, and a performance area, Birmingham Central Library has evolved into a multimedia hub. The library encourages the production of digital content and interacts with the local creative community. The Studio, a room featuring the newest technology for artistic pursuits, is available at the Library of Birmingham. Visitors can produce digital content by experimenting using green screens, recording devices, and editing software.
- **BiblioTech and the San Antonio Library System in Bexar County, USA:** With the advent of "Digital Library through Google Go," the San Antonio Public Library made e-books, audiobooks, and digital magazines accessible. Additionally, the library provides workshops and technology training courses on subjects including social networking, digital design, and coding. The United States' first fully digital public library is called BiblioTech. It provides patrons with access to computers, e-books, and digital magazines. By giving everyone access to technology, the library hopes to close the digital gap and reach underprivileged populations. **Public Libraries in Singapore:** To improve user experiences, Singapore's public library systems have adopted technology. They provide self-checkout kiosks, virtual storytelling experiences for kids, and a smartphone application for accessing library materials. The Singapore National Library Board extensively promotes digital literacy through events and courses.
- **BiblioLab, South Korea's Seongdong District:** A digital catalogue system, interactive touchscreens, and smart shelving are all characteristics of the futuristic library BiblioLab. The library's main goal is to give users access to a technologically advanced environment where they can explore and find content. Libraries are accepting technology, encouraging innovation, and providing a variety of services to meet the needs of the communities they serve during the Fourth Industrial Revolution, as demonstrated by these examples. Libraries continue to be essential for community participation, education, and culture by embracing new technologies and designing dynamic environments.

SUCCESSFULLY ADAPTED TO THE 4TH INDUSTRIAL REVOLUTION IN AFRICAN LIBRARIES REAL-WORLD CONTEXTS

Here are examples of African libraries that have successfully adapted to the 4th Industrial Revolution in real-world contexts. African libraries are embracing technology, innovation, & community involvement as part of their active adaptation to the Fourth Industrial Revolution (4IR). Although the continent is still undergoing a digital change, there are a few notable instances of libraries that have managed this shift well:

- **South Africa, the Stellenbosch University Library:** In South Africa, the Stellenbosch University Library continues to lead the way in integrating technology into its library services. They provide access to numerous internet databases, e-books, and digital collections. By giving users access to cutting-edge technologies, virtual reality experiences, & 3D printing, their MakerSpace promotes creativity and innovation.
- **University of Nairobi Library, Kenya:** To conserve and make accessible priceless historical records and manuscripts, the University of Nairobi Library has undertaken digitization programs. They provide e-resources and online databases, which improve students' and researchers' capacity for study. Ghana's Ashesi University Library implemented technology to improve research and learning for students. They offer e-books, digital resources, and MOOC (Massive Open Online Course) access. To enhance digital literacy, the library also provides technological training courses. Uganda's Makerere University Library created an Innovation Hub to inspire teachers and students to investigate cutting-edge technologies. The hub provides robotics, 3D printing, and programming and coding instruction. The Botswana National Library Service is aggressively promoting digital literacy and information access in distant locations. To bridge the digital divide, they have implemented mobile libraries equipped with electronic books and internet connectivity.
- **Kenya National Library Service:** The institution has introduced digital libraries all around the nation, giving users access to online courses, e-books, and e-journals. Students and scholars benefit from these digital tools, especially those in underprivileged locations.
- **South Africa's Cape Town Central Library:** The Cape Town Central Library provides the public with free computer use, Wi-Fi, and instruction in digital skills. To encourage the development of digital literacy and skills, they hold coding workshops and other technology-related events.

- **Ghana's Kwame Nkrumah University Library of Science and Technology:** Kwame Nkrumah University's library has adopted digital cataloguing and automation technologies, which facilitate resource access and search. They also provide research assistance services and e-journals.
- **Rwanda Library Products and Services:** Rwanda continues to make investments in its technological training facilities and digital libraries. The goal of these initiatives is to improve digital literacy and education across the country. By embracing innovation, supplying digital resources, and offering technological training, these examples show how libraries throughout Africa are adjusting to the 4IR. They are essential to the region's efforts to advance community development, digital inclusion, and education.

SUCCESSFUL REAL-WORLD ADAPTATIONS OF 4IR IN NIGERIA'S LIBRARIES

- **Nigerian Libraries' Successful Real-World Adaptations to the Fourth Industrial Revolution (4IR):** Nigerian libraries are utilizing creativity, technology, and community involvement to actively adjust to the 4IR. Many libraries in Nigeria are demonstrating significant progress in adopting the digital age, even if the move toward digital libraries is still ongoing. Here are a few instances from real life: The Covenant University Library in Ota, Nigeria, is renowned for its dedication to integrating technology. They have a Virtual Knowledge Centre with multimedia resources, electronic books, and e-journals. Additionally, the library uses training courses and workshops to encourage digital literacy. The Nigerian University of Lagos Library demonstrates a commitment to automation and digital resources. The University of Lagos Library provides a digital repository, electronic theses and dissertations, and various other electronic resources. Scholarly journals and online databases are also accessible through the library. The University of Nigeria's Nnamdi Azikiwe Library has adopted contemporary technological solutions, such as electronic resource access and automated cataloguing systems. They take an active part in digitalization initiatives aimed at preserving and making historical items accessible. Digital resources and services are the main focus of the Pan-African University Library in Lagos, Nigeria. They provide access to research databases, e-books, and e-journals. The library promotes group research projects and holds workshops on digital literacy.
- **American Corner, Lagos State Central Library:** Computers and high-speed internet are among the contemporary technologies available at the American Corner in Lagos State Central Library. It acts as a hub for training, courses, and events cantered around technology. Nigeria's Digital Bridge Institute Library: The Digital Bridge Institute Library is a specialist library devoted to information technology, or ICT, instruction. They provide information on upcoming technologies, ICT policy, and telecommunications. The library helps the ICT industry develop its capacity.
- **Nigeria's National Library, Abuja:** To preserve Nigeria's cultural legacy, the National Library has started digitization initiatives. They encourage the digitization of old records and manuscripts and provide access to digitized materials. The Library of the Federal University of Technology, Akure actively supports digital research and e-learning initiatives. The library provides users with access to academic databases, digital libraries, and research assistance programs. The library also hosts workshops on research tools and digital literacy.
- **Nigerian Virtual Library:** This nationwide project aims to make digital resources accessible to everyone in the nation. It provides access to research databases, e-books, and instructional resources to advance learning and digital literacy. These illustrations show how Nigerian libraries are embracing innovation, providing digital resources, and promoting digital literacy to comply with the 4IR. They are essential to the nation's advancement in research, education, and technological access.

DISCUSSIONS

The outcomes of the research showed that over half of the people who participated had soft skills, including the capacity to deliver customer-driven services, interpersonal and leadership abilities, the capacity for individualized and self-paced learning, the capacity for problem-solving, and the capacity for analytical and critical thought. Soft skills are beneficial because they enable businesses to have a healthy workforce that can use their technical expertise and knowledge without being constrained by interpersonal issues, which promotes a productive workplace. Furthermore, in the Fourth Industrial Revolution (4IR) era, problem-solving, flexibility, teamwork, leadership, creativity, and innovation are essential competencies, as highlighted by Ayinde and Kirkwood (2020). It is noteworthy, nonetheless, that this survey also found a significant technological skills gap among librarians. Such as creativity and innovation, change management, diversity & cultural intelligence, data

analysis, information curation, software development, database management, and system analysis and evaluation abilities. Given that librarians lack the essential skills needed to effectively manage and manipulate Fourth Industrial Revolution (4IR) technologies, it is certain that if AI, robotics, IoT, machine learning, and block chain technologies were implemented in Botswana, they couldn't be efficiently used for information service delivery. It is understandable why Ayinde & Kirkwood (2020) suggested that information professionals possess unique and creative talents to respond to unforeseen situations like COVID-19.

The following suggestions are made to address some of the issues covered in this stage in light of the study's results and the author's personal observations:

- Set aside a sufficient amount of money to construct a proper technological infrastructure: Digital transformation and closing the digital divide require a strong ICT infrastructure, which is expensive and includes high-speed Internet access and bandwidth, high-performance computer facilities, and data services.
- Institutions should compare themselves with industrialized nations and provide new educational opportunities. Institutions should compare with industrialized nations and offer librarians new learning opportunities so they may continue to learn, unlearn, and relearn through ongoing training.

Including Fourth Industrial Revolution (4IR) in the Curriculum of Library Universities: Future librarians must be equipped with the skills needed in the fourth information age. The LIS curriculum provided by the University of Botswana, the Institute of Development Management (IDM), and other private training establishments should incorporate technical and practical skills such as SW programming, data-based design and management, machine learning, data analysis, and change management. The Botswana Qualifications Authority (BQA) should monitor and evaluate the LIS curricula in different institutions to ensure they are suitable for the 4IR age.

- **Policy framework for technology and digital literacy:** Libraries, along with parent institutions, should create a digital literacy paradigm as a roadmap for digital transformation since the majority of participants lacked the necessary abilities to properly integrate into the 4IR era.
- **Thorough training for librarians:** To provide librarians the skills they need to function in the 4IR era, ICT training is required. Librarians can't fully benefit from 4IR tech if they don't know how to use it to improve information services.

Assistance from the government: The government has a crucial role to play in ensuring that everyone has access to technology, information, and knowledge. To bridge the digital gap and enable the deployment of 4IR to boost economic development, the government should be dedicated to providing sufficient funds for the necessary ICT infrastructure, high-speed telephony, and Internet. It is crucial to implement the Fourth Industrial Revolution (4IR) national policy and adhere to international standards. To guarantee that there is no digital gap and that all communities have access to sufficient ICT resources, for instance, the Maitlamo policy on information and communication technologies must be examined and closely watched.

LIBRARIES' ROLE IN THE FUTURE AS TECHNOLOGY DEVELOPS

Libraries will become even more vital and vibrant in society as technology develops further. The following are some forecasts for the future functions of libraries:

- **Digital Hub:** Libraries will develop into digital hubs that offer access to a wide range of digital resources, such as electronic books, augmented and virtual reality online courses, and digital archives, in addition to providing citizenship education. For people of all ages, they will act as entry points to the digital world. Libraries will teach users about ethical behaviour, internet privacy, and how to assess digital content critically as part of responsible digital citizenship. They will contribute to the development of responsible and knowledgeable digital citizens.
- **Innovation and Creativity Centres:** Libraries will continue to provide areas for creativity, innovation, and experiential learning through their Innovation and Creativity Centres. Maker spaces with cutting-edge equipment, such as robotics, 3D printers, and virtual reality setups, will proliferate and inspire users to create and experiment. Libraries will serve as hubs for lifelong learning, offering a variety of educational materials and initiatives to individuals at every level of development. They will provide possibilities for professional growth, individualized learning pathways, and skill development to adjust to shifting labour markets.
- **Virtual Services:** Virtual services, community gathering places, and increased remote access to services and resources will all be provided by libraries, enabling users to interact with their collections from any location. Workshops, reference services, and virtual events will become commonplace. Libraries will

continue to be essential hubs for community gatherings, providing areas for people to congregate, work together, and have conversations about a variety of subjects. These areas will promote social cohesiveness, inclusion, and cross-cultural interaction.

- **Data Literacy and Tailored Services:** Libraries will help people develop their data literacy abilities so they can comprehend and make data-driven decisions. They will offer tools and instruction for navigating the big data & analytics landscape. Artificial intelligence will be used by libraries to provide individualized services, including interactive learning opportunities, personalized learning plans, and reading recommendations.
- **Green and Sustainable Spaces:** Libraries will integrate eco-friendly projects, energy efficiency, and green architecture as well as sustainable technologies and practices. They will act as prototypes for ecologically mindful public areas.
- **Industry and Multidisciplinary Collaboration:** To provide resources, knowledge, and an environment for innovation, libraries will work closely with businesses, start-ups, and industries. They will promote regional economic development and act as incubators for innovation. Libraries will work with a variety of disciplines, including science, technology, health, and the arts, to offer programs, services, and resources that span discipline and address a range of interests. Libraries will promote digital equity to bridge the digital divide and ensure that everyone in society has access to knowledge and technological resources.
- **Preservation of Culture and Ongoing Adaptation:** Libraries will remain stewards of cultural history, conserving digital and tangible items for coming generations. To guarantee the longevity and accessibility of historic materials, they will digitize & archive them. In a consistently digital and linked world, libraries will continue to be flexible and nimble, embracing new technology and constantly changing to satisfy the shifting requirements of their communities.

All things considered, libraries of the next generation are expected to be dynamic, technologically advanced, and community-focused establishments that support lifelong learning, empower people, and make creative contributions to the spread of knowledge and culture.

CONCLUSION

Driven by technological advancements, the Fourth Industrial Revolution (4IR) represents a profound shift in our relationships, jobs, and lives. It creates tremendous success by combining the digital, biological, and physical realms. More than just technological change, the revolution presents a chance to assist everyone in utilizing convergent technologies to build a future that is inclusive and focused on people. Initiatives in South Africa are utilizing innovation and technology to deliver library services. To boost competitiveness through technology adoption, support new firms with digital infrastructure, and offer transparent procurement platforms, the Gauteng Provincial government introduced a Fourth Industrial Revolution (4IR) innovation strategy in August 2021. The approach also seeks to determine the skills needed for social innovation and future workplace digitization. A study conducted in Botswana evaluated the opportunities, difficulties, and actual digital transformation methods of Fourth Industrial Revolution (4IR) in libraries. The study ultimately arrived at the conclusion that because of a lack of technological expertise and limited infrastructure, Botswana libraries have yet to prepare for the use of Fourth Industrial Revolution (4IR) technology. The Government of Botswana has taken several steps; however, libraries still need to adapt to the Fourth Industrial Revolution (4IR) era. Libraries in Botswana should take advantage of this chance to support research and the country's growth by giving everyone access to knowledge and information. Rapid technological breakthroughs and digital change are hallmarks of the Fourth Industrial Revolution (4IR), in which libraries are playing a pivotal role. By giving people from all backgrounds fair access to technology, digital resources, and information, they close the digital gap. Libraries promote community involvement and lifelong learning by serving as hubs for diversity, knowledge sharing, and technological empowerment. Libraries are utilizing and adjusting to technology as it develops further to improve their offerings, encourage creativity, and advance digital literacy. I-4.0 in the Fourth Industrial Revolution (4IR) tackles global issues like production, energy and effectiveness of resources, and population-based issues. Using technologies like the Internet of Things, robotics, information and communication technology, big data, computing in the cloud, artificial intelligence (AI), and data interchange in industrial technologies, and providing users with accurate information, it also aids in early defect detection. Supporting I-4.0 and providing them with new knowledge and abilities requires the active participation of LISc professionals and ICLs. Cloud computing, a recent development in libraries, has the potential to enhance

services and relevance in the current information age if libraries embrace it for the benefit of their patrons. Libraries can enhance their reputation and benefit the user base by utilizing cloud computing technology.

FURTHER STUDY

The study's objective was to provide a broad overview of the Fourth Industrial Revolution (4IR) environment in Botswana libraries. Additional research on particular library types, such as academic, public, and school libraries, is required. The results would provide a thorough overview of Botswana's many library types.

REFERENCES

1. Atiku, S. O., and Boateng, F. (2019) rethink the education system for the fourth industrial revolution. The article was retrieved from www.igi-global.com/chapter/rethinking-educationsystemforthe-fourth-industrial-revolution/237039?
2. Baldw (2019). The Globotics Upheaval: Globalization, Robotics, and the Future of Work, New York, NY: Oxford University Press.
3. Bayani, M.; Segura, A.; Alvarado, M. & Loaiza, M. (2018). IoT-Based Library Automation and Monitoring System: Developing an Implementation Framework of Implementation. The article was published in the journal eCiencias de la Information, 8(1). DOI: https://doi.org/10.15517/eci.v8i1.30010
4. Bayne, S., and P. Ndric. (2017). the article discusses the transition from anthropocentric humanism to critical posthumanism. The article was published in the journal "Digital Education Knowledge Cultures," 21(5), 197-216.
5. Becker, S., Horning, E., & Woessmann, L. (2011). The economics of the Industrial Revolution focuses on education and catching up. Journal of Microeconomics. 3(3), 92–126.
6. Belzi. (2018). the article titled "Core Competencies for 21st Century CARL Librarians" was published in Library Management, 22(7), 270-277.
7. Cao, M.K., (2019), "Several trends of new technology affecting library information operation", 17th Conference of Vietnam Library Consortium on e-Resources, Phu Yen, Vietnam.
8. David-West, B. T. (2021). Knowledge Management and Information Professionals in 21st-Century Academic Libraries in Nigeria. Library Progress (International), 41 (1), 72-78.
9. Dempsey, L. & Malpas, C. (2018). The future of academic libraries in a diversified university system is a topic of discussion.
10. Goldberg, M.; Olivares, M.; Li, Z. & Klein, A.G. (2014). The article discusses the importance of MAMA's GIS data libraries in the context of big data cloud computing. Journal of Map & Geography Libraries. 10 (1), 100-122.
11. Grim, B. (2020). Automation technology is a topic that spans across the professional fields of electrical vehicles, information, and metal technology. Journal of Learning and Teaching, 137(1), 6-12.
12. Hanoi, Vietnam. Echedom, A. U. & Okuonghae, O. (2021). This review paper discusses the opportunities and challenges of transforming academic library operations in Africa using artificial intelligence. New Review of Academic Librarianship, 1-14.
13. Hoy (2017). An Introduction to the Blockchain and Its Implications for Libraries and Medicine. Medical Reference Services Quarterly. 36(3), 273–279. https://doi.org/10.1080/02763869.2017.1332261
14. Hussin, 2018). The article titled "Education 4.0 Made Simple: Ideas for Teaching" was published in the International Journal of Education and Literacy Studies, 6(3), 93–98. DOI: 10.7575/aiac.ids.v.bn.3p-92.
15. Huynh, M.D., (2018), "The impact of Industrial Revolution 4.0 on university libraries in Vietnam", Proceedings of the Conference "Development of Electronic Library in Vietnam Meeting the Needs of the Industrial Revolution 4.0", Hanoi, Vietnam.
16. McKie, McKie, & Narayan, B. (2019). Enhancing the academic library experience with chatbots: An exploration of research and implications for practice. Journal of the Australian Library and Information Association, 68(3), 268-277. https://doi.org/10.1080/24750158.2019.1611694
17. Noh, Y. (2022). Noh, Yining Library 4.0: Creating a Model for Future Libraries. The Journal of Academic Librarianship, 41(6), 786-797.
18. Oyelude, C. O. & Adeniran, A. E. (2021). The article "Improving services in a hybrid academic library system" was published in Library Hi Tech News in 2021. DOI: 10.1DOI: 10.1108/LHTN-11-2020-0101

19. Pera (2019). The OCLC Symposium on Libraries and the Internet of Things highlights the benefits and raises important questions. Available at: http://americanlibrariesmagazine.org/blogs/thescoop/librariesand-the-internet-of-things/
20. Philbeck, Nicholas, D. (2019). Fourth industrial revolution: Shaping a new era. Journal of International Affairs, 72, 17-22. https://www.jstor.org/stable/10-230726588339
21. Salmon, 2019). May the Fourth be with you: Creating education 4.0? Journal of Learning for Development, 6 (2), 95-115.
22. Sharma, Priya (2019). The article titled "Digital Revolution of Education 4.0" was published in the International Journal of Engineering and Advanced Technology, 9(2), 3558-3564.
23. Shen, R., Goncalves, M.A., Fox, E.A. (Eds.), (2013), Key Issues Regarding Digital Libraries: Evaluation and Integration, Carolina: Morgan and Claypool Publishers.
24. Spotti, G & Windelband, L (2020). The 4th Industrial Revolution: It's Impact on Vocational Skills. Journal of Education and Work, 34 (1), 29–52.
25. Tella, A. (2020). Repackaging LIS professionals and libraries for the Fourth Industrial Revolution. Library Hi Tech News.
26. Unnikrishnan, S. & Ashwani, S. (2018). Industry 4.0: A Glimpse. Procedia Manufacturing. 20(3), 233-238.
27. Vu, D.H., (2018), "The impact of the 4th Industrial Revolution on Science and Technology Information" by Vietnam Association for Science and Technology Information, Hanoi, Vietnam. http://lib.tlu.edu.vn/tin-tuc-noi-bat/thu-vientrong-cach-mang-cong- nghiep-4-0-13157.
28. Wojcik, M. (2016). Internet of Things: Potential for Libraries. Library Hi Tech, 34 (2), 404 -420.
29. Zervoudi, E. (2020). Fourth Industrial Revolution: Opportunities, Challenges, and Proposed Policies. Intechopen DOI: 10-5772/intechopen9442. The book titled "Robotics New Paradigms" is authored by Antoni Grau and Zhupiny Way.