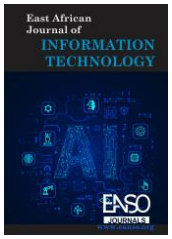


East African Journal of Information Technology
eajit.eanso.org
Volume 8, Issue 1, 2025
Print ISSN: 2707-5346 | Online ISSN: 2707-5354
Title DOI: https://doi.org/10.37284/2707-5354

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Adoption of the Fourth Industrial Revolution in the Library and Information Services Sector: Implications and Prospects for Uganda

Alice Gitta Kutyamukama[1*], *Andrew Ojulong*[2], *Alice Endra Ezuru*[1,3,4] & *Mary Nalumansi*[1]

[1] Makerere University, P. O. Box 7062, Kampala, Uganda.
[2] Lira University, P. O. Box 1035, Lira, Uganda.
[3] National Agricultural Research Organization, P. O. Box 295, Entebbe, Uganda.
[4] National Fisheries Resources Research Institute, P. O. Box 343, Jinja, Uganda.
[*] Author for Correspondence Email: alicekutyamukama@gmail.com

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

Date Published:

05 August 2025

Keywords:

Fourth Industrial Revolution, Library Services, Digital Transformation, Digital Divide, Uganda.

ABSTRACT

The Fourth Industrial Revolution (4IR) is characterised by advancements in the business models, transforming library and information services. To systematically explore the impact of the 4IR on library and information services, a comprehensive literature review was conducted employing predictive analysis. This methodology involved a multi-step process beginning with the identification of relevant literature through My LOFT, Research4Life, and Google Scholar. Keywords related to the Fourth Industrial Revolution, library services, big data, artificial intelligence, and digital transformation were used to filter sources. This approach enabled the identification of key patterns, potential impacts, and future directions in the integration of 4IR technologies within libraries. Through this rigorous analysis, the review aimed to provide a detailed and predictive understanding of how libraries can adapt to and leverage these emerging technologies to enhance their service delivery and operational efficiency. Findings suggest that the 4IR technological disruption is distinct in its speed, scope, and impact on systems. Libraries from low-resource settings face unique challenges in adopting these technologies due to the digital divide perpetrated by economic constraints and infrastructural limitations. However, they have the opportunity to narrow the divide and enhance service delivery through innovative use of 4IR technologies. Despite the magnificent possibilities, there are some sceptics raising privacy concerns, job displacement, and the need for significant investment in human capital and technology. However, this study recommends that libraries must adapt by embracing flexible work models, leveraging mobile apps, employing AI and robotics where affordable, and investing in high-speed internet. The Fourth Industrial Revolution compels libraries to reimagine their roles, ensuring they remain vital in the trending digital dispensation. As such, library professionals in Uganda must stay abreast of technological trends, continuously update their skills, and foster an inclusive approach to technology adoption to navigate and thrive in this new era.

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

APA CITATION

Kutyamukama, A. G., Ojulong, A., Ezuru, A. E. & Nalumansi, M. (2025). Adoption of the Fourth Industrial Revolution in the Library and Information Services Sector: Implications and Prospects for Uganda. *East African Journal of Information Technology*, *8*(1), 382-395. https://doi.org/10.37284/eajit.8.1.3436.

CHICAGO CITATION

Kutyamukama, Alice Gitta, Andrew Ojulong, Alice Endra Ezuru and Mary Nalumansi. "Adoption of the Fourth Industrial Revolution in the Library and Information Services Sector: Implications and Prospects for Uganda". *East African Journal of Information Technology* 8 (1), 382-395. https://doi.org/10.37284/eajit.8.1.3436.

HARVARD CITATION

Kutyamukama, A. G., Ojulong, A., Ezuru, A. E. & Nalumansi, M. (2025) "Adoption of the Fourth Industrial Revolution in the Library and Information Services Sector: Implications and Prospects for Uganda", *East African Journal of Information Technology*, 8(1), pp. 382-395. doi: 10.37284/eajit.8.1.3436.

IEEE CITATION

A. G. Kutyamukama, A. Ojulong, A. E. Ezuru & M. Nalumansi "Adoption of the Fourth Industrial Revolution in the Library and Information Services Sector: Implications and Prospects for Uganda", *EAJIT*, vol. 8, no. 1, pp. 382-395, Aug. 2025.

MLA CITATION

Kutyamukama, Alice Gitta, Andrew Ojulong, Alice Endra Ezuru & Mary Nalumansi. "Adoption of the Fourth Industrial Revolution in the Library and Information Services Sector: Implications and Prospects for Uganda". *East African Journal of Information Technology*, Vol. 8, no. 1, Aug. 2025, pp. 382-395, doi:10.37284/eajit.8.1.3436.

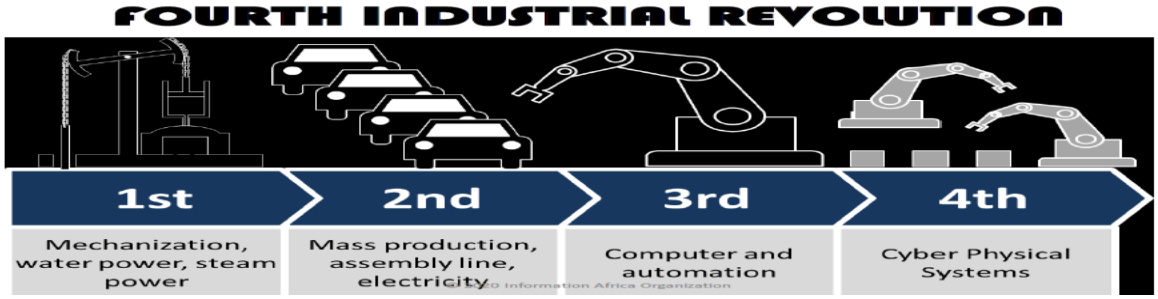
INTRODUCTION

Several changes have taken place within the library and information services and operations around the world. However, it is more important than ever to understand the impact of technological revolutions on the library and information services. As described by the World Economic Forum (2015), the fourth industrial revolution is here and is changing business models across every sector. For example, artificial intelligence (AI) technology has been adopted for official use in many libraries, especially those that have understood the tremendous power of AI to accomplish tasks quickly and amaze users. According to Schwab (2017), the fourth industrial revolution (4IR) refers to the evolution of information technology towards greater automation and interconnectedness. The 4IR incorporates artificial intelligence, blockchain, advanced robotics, the Internet of Things, autonomous vehicles, virtual reality, 3D printing, nanotechnology, and quantum computing. The World Economic Forum (2016) asserts the introduction of innovative solutions where technology and humanity unite as cyber-physical systems, leveraging distributed ledger technology as part of cryptographically secure and decentralised infrastructure.

Reflecting on transitions, the 1IR used water and steam power to mechanise production. The Second used electric power to create mass production. The Third used electronics and information technology to automate production. Today, the 4IR builds on the 3IR that brought about the digital revolution in the mid-20th century. The 4IR is distorting the lines between the physical, digital, and biological spheres, characterised by a fusion of technologies (The World Economic Forum, 2016).

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

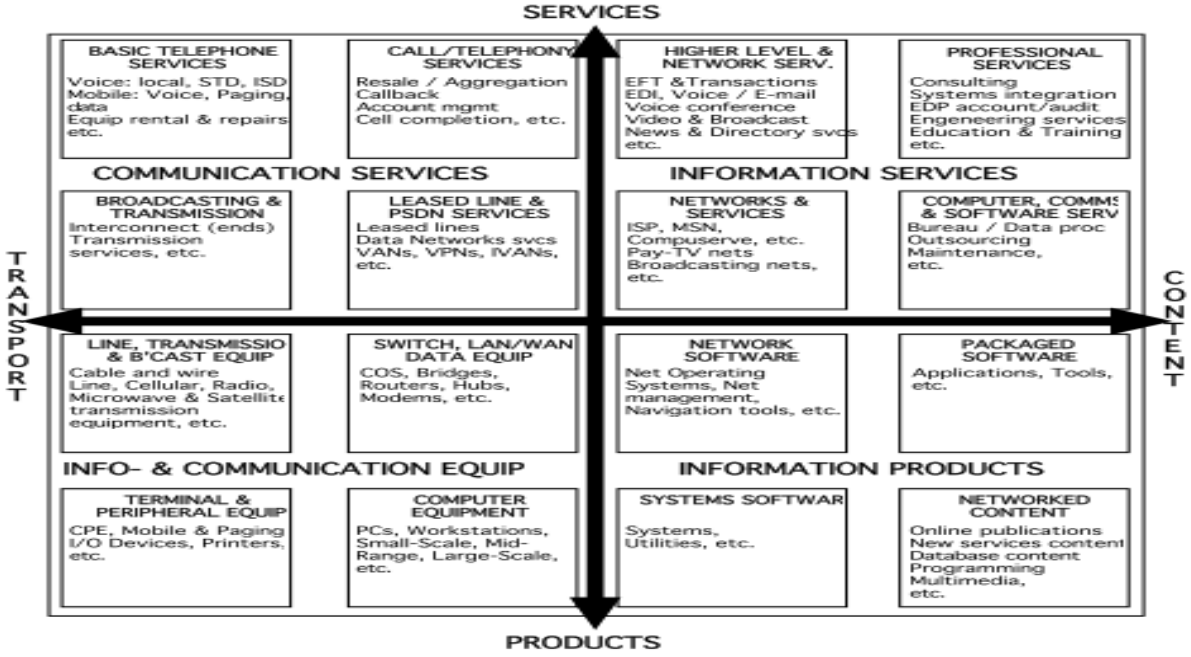
Figure 1: Illustration of the Industrial Revolution



Source: *Information Africa Organization (2020)*

The 4IR is distinct from the 3IR in terms of velocity, scope, and systems impact. The speed of current breakthroughs has no historical precedent as we experience exponential transformation of entire systems of production, management, and governance. Prior revolutions occurred within 100 years of each other (1784–1870 and 1870–1969). However, the fourth revolution is on an expedited trajectory, occurring about 50 years after the third revolution in 1969 (Audenhove & Brussel, 2018). The remarkable adoption of the Internet has greatly contributed to the use of Information Communications Technologies (ICTs) within the information society. The Internet demonstrates the enormous potential of the convergence between informatics, telecommunications, and content, raising high hopes for growth in related industries (Audenhove & Brussel, 2018). The ICT-related information industry transformations can be understood from the point of view of production and markets as illustrated by Houghton in 2009 (Gonel & Akinci, 2018).

Figure 2: ICT–Related Information Industry

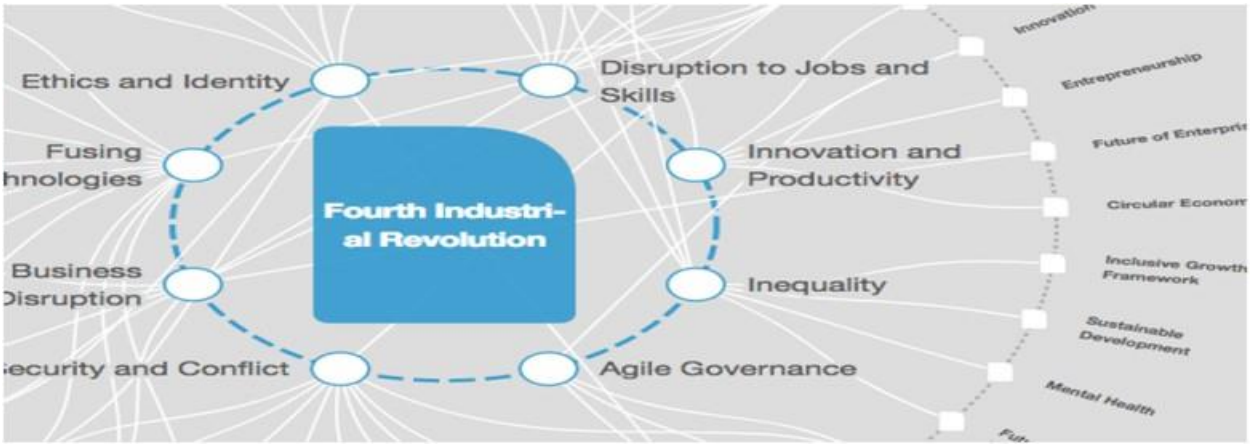


Source: *Houghton (1999), p. 692*

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

In a replica of the blockchain technology, Houghton places services and products at the end of consumption. Services and products move from left to right as content grows. The service industry is seen as the most important part of the information industry over time. The traditional publishing sector is defending its position against the computer software sector, which is rapidly developing new products, especially on the Internet. ICTs are often seen as the driving force behind economic globalisation and, more fundamentally, the restructuring of national and global economic processes (Gonel & Akinci, 2018). These impacts on how libraries function, manage processes, and continue to deliver products and services in the information age.

Figure 3: Impact of the 4th Industrial Revolution



Source: *The World Economic Forum (2016)*

For the impactful implementation of the 4IR in libraries and information centres, we may adopt Ntlotlang's (2019) recommendation that stakeholder engagement is very crucial for project sustainability, especially when you bring everybody on board at the inception stage, it bears fruit as they own it, and the level of their engagement is very high.

Reflecting on the past transformations, libraries were able to gradually adopt industrial revolution technologies. However, the information professionals have discovered that big data, artificial intelligence, and machine learning technologies hold important potential for transforming library and information services. They have actively been involved with addressing the problem of the digital divide as ICTs become central in the development, management, processing, and delivery of information services. However, the digital divide persists in the less affluent regions where the outcome of numerous obstacles, ranging from inadequate availability and access to technology and information resources, to limitations in awareness and utilisation of numerous digital tools and resources, for some users (Freder, 2017).

The main objective of the review was to systematically explore the impact of the 4IR on library and information services.

Justification for the Study

The study is important because it provides a foundation for libraries to adapt and leverage emerging technologies to enhance their service delivery and operational efficiency.

LITERATURE REVIEW

The reviewed papers collectively offer valuable insights into how libraries can adapt to and benefit from the Fourth Industrial Revolution. They highlight the need for updated skills, innovative practices, and strategic responses to technological

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

changes. For Ugandan libraries, these insights underscore the importance of embracing 4IR technologies, addressing challenges, and leveraging opportunities to enhance library services and relevance in a rapidly evolving landscape.

Implications of 4IR for Libraries and Librarians

In reflection of Hoosain *et al's* (2020) revelation on how the 4IR digital technologies and circular thinking impact the United Nations Sustainable Development Goals (SDGs). The study suggests that technologies associated with 4IR can be leveraged to achieve sustainability goals, including improving resource efficiency and fostering economic growth. It suggests that libraries can play a significant role in supporting these goals by integrating 4IR technologies to enhance their service delivery and contribute to broader societal objectives.

According to Audenhove & Brussel (2018), theoretical insights concerning the information society and their relevance for the developing world. The study explores the theoretical contributions of the information society to development strategies, especially in less affluent regions. It fosters understanding of theories that are crucial for adapting library and information services to the needs of developing countries. Incorporating technological adoption and adaptation theories in library services design thinking helps in tailoring library services to support societal development and technological advancement.

Evolving Skills

Reflecting on the work of Ayinde & Kirkwood (2020), who highlight the evolving roles and skills required of information professionals in the context of the Fourth Industrial Revolution (4IR). The study reveals that the rapid technological advancements necessitate a reevaluation of the skills and roles of information professionals to ensure they remain relevant and effective. The study concluded that information professionals must develop new competencies related to emerging technologies, such as data analytics, prompt engineering, and digital management, to meet the demands of modern libraries and information services. According to Carter (2017) highlights of the potential for creativity and innovation within the field of information professions in response to the Fourth Industrial Revolution. Research reveals that the integration of innovative technologies, such as artificial intelligence and data analytics, as part of the curriculum and continuous professional development (CPD), presents opportunities for libraries to enhance their services and operations (Nakaziba & Ngulube, 2024). This forecasts the professional adaptation to mushrooming AI tools and innovative technologies to enhance our productivity. Similarly, Hussain (2019) examines the implications of 4IR for libraries and librarians, focusing on how technological advancements are reshaping the information field. The study recommends that libraries must adapt to these changes by adopting new technologies and redefining their roles. This adaptation is critical for maintaining the relevance of libraries in the face of rapid technological change and ensuring that librarians possess the necessary skills to manage these advancements.

Smart Libraries and 5G Technology

The Internet is no doubt the most transformative innovation of the 3IR and 4IR. According to Segan (2021), the wireless industry introduced the first official 5G standard at the end of 2017. The wireless network generations 1G, 2G, 3G, 4G, and 5G have technically been defined by their data transmission speeds; each has also been marked by a break in encoding methods that makes it incompatible with the previous generation.

According to Segan (2021), 5G technology has implications for various sectors, including libraries. The study observed that 5G can improve connectivity and enhance digital services, offering insights into how libraries can leverage this

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

technology to better serve their users. Insights from Jiahui *et al*. (2020) suggest that the design and implementation of smart libraries using 5G technology is on the rise. The study highlights how 5G can enhance library services by providing faster connectivity and supporting advanced digital services. This integration of 5G technology promises to transform library operations, enabling more efficient access to digital resources and improving overall user experiences. Furthermore, Khan *et al.* (2023) establish the impact of technological modernisation and management capabilities on user satisfaction and trust in library services. The study reveals that advanced technologies, including faster internet, significantly improve user satisfaction by enhancing library services and management practices. The study underscores the significance of integrating modern technologies to meet user expectations and build trust in library services.

Existential Threat or Opportunity for Libraries?

There are concerns from information science scholars as well as practitioners as to the implications of the 4IR technologies, such as AI and robotics, on the information management and distribution landscape. According to Lund (2021), the question of whether the Fourth Industrial Revolution poses an existential threat or an opportunity for libraries lies in the likely threat to human jobs, much as they also offer significant opportunities for libraries to innovate and evolve. These technologies have the potential to transform their services and maintain their relevance in the digital age, so most information professionals must adapt to the unstoppable trends. Libraries have been responding to these advances, as highlighted by Marwala (2022), libraries responded to crises, such as the COVID-19 pandemic, through the lens of the Fourth Industrial Revolution. The study suggests that libraries have the potential to adapt and thrive by leveraging 4IR technologies to address the challenges posed by crises and enhance their service delivery. Muhammad & Hanipah (2018) provide strategies for preparing libraries for the Fourth Industrial Revolution. They emphasise the need for libraries to develop strategic plans and invest in new technologies to stay competitive. Their recommendations include enhancing digital infrastructure and training staff to handle advanced technologies.

Enhancing Digital Transformation through the Fourth Industrial Revolution

Libraries have been called upon to enhance the digital transformation through 4IR as an opportunity. Emphatically, Nakaziba & Ngulube (2024) propose a model for enhancing digital transformation in academic libraries through technology-related continuous professional development (CPD). The study identifies challenges such as a lack of support and funding and suggests that a structured CPD model can address these issues and facilitate successful digital transformation in libraries. Similarly, Partridge (2007) had earlier emphasised the need to consider the human perspective in the information society. The paper suggests that libraries should focus on the human aspects of technology to provide more effective and relevant services. According to Ntlotlang (2019), technology-mediated tools can facilitate collaboration between libraries and researchers. The study highlights the benefits of digital tools in improving research outcomes and suggests that libraries should embrace these technologies to enhance their collaborative efforts and service delivery.

The World Economic Forum (2016) outlines the key characteristics of the Fourth Industrial Revolution and offers recommendations for responding to its challenges. The report provides a framework for understanding how organisations, including libraries, can adapt to and benefit from 4IR technologies. According to Freder (2017), the impact of digital technologies on cataloguing practices and bibliographies is tremendous. The paper highlights the need for libraries to innovate

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

their cataloguing methods to stay relevant in the digital age.

Artificial Intelligence (AI) and Machine Learning in Libraries

The integration of Artificial Intelligence and Machine Learning in libraries is gaining momentum. According to Yao *et al.* (2019), AI technologies, such as smart talking robots, are increasingly being used to enhance participatory library services in the affluent regions. The paper provides practical examples of how AI can be used to improve user engagement and service delivery in libraries. In a related context, Ingraham & Clair (2020) highlight the role of blockchain technology in healthcare information systems, which they say has been far-reaching, emphasising its potential to enhance data security and interoperability. While the study's focus is on healthcare, the implications for libraries are significant, particularly in terms of managing and securing digital resources. Libraries can learn from these advancements to improve their data management practices and integrate secure technologies into their operations. These technologies also support data-driven decision-making, predictive analytics, and digital preservation, while raising ethical concerns around bias and privacy. As AI continues to advance, its integration into library services is likely to enhance both efficiency and user experience significantly.

METHODOLOGY

This study adopted a qualitative approach, utilising a desk review method to collect and analyse information from secondary sources, including documents, reports, and academic publications. The research team employed My LOFT, Google Scholar, and Research4Life to access relevant resources. Data collection involved accessing online information and synthesising the output. Initially, a broad search was executed, generating a pool of approximately 100 papers comprising articles and reports related to the adoption of the Fourth Industrial Revolution (4IR) with a preference for papers related to the library and information services sector. The search focused on materials published between 2007 and 2024 to ensure contemporary relevance. After careful screening, 23 papers met the criteria and were selected for inclusion in the study. Data Analysis involved the systematic interpretation of key aspects constituting themes that were extracted from the selected papers. The findings were synthesised and categorised into thematic areas, which were then carefully reviewed and analysed to provide a comprehensive understanding of the current state and prospects of 4IR adoption in libraries and information services.

FINDINGS

Innovative libraries are using digital tools of the Fourth Industrial Revolution to: Make working more flexible, make services easier to use and access; Inspire and inform; Help customers learn new skills, and promote self-life-long learning. The key findings are presented as follows:

Virtual Reality/Artificial Intelligence

This automation drive allows people to immerse themselves in a 3D new universe. Many libraries have started offering their users the chance to play, learn, and explore other places just by sitting in the comfort of their local library. At the same time, virtual reality can be used to bring the library closer to the users by creating virtual tours of the library or even virtual workshops and training. According to Kemp *et al.* (2017), libraries should take a continuous training style for Artificial Intelligence, both from the perspective of its staff and its users. This means that libraries should be actively integrating AI into the virtual reality reference process through automated chatbots and a participatory culture that allows users to engage in the learning experience with the technology (Yao *et al.,* 2019).

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

Mobile Apps/Big Data Analytics

Big data is a dataset with the ability of a typical database, whose size can capture, store, manage, and analyse (Manyika *et al.*, 2011). It can be performed at each stage of the information life cycle, such as Plan, Obtain, Maintain, and Apply. Big data analysts are responsible for creating value-added outcomes through designing, collecting, storing, managing, analysing, and visualising them, as the current Mobile apps trend is real, as people have access to their mobile devices constantly. Also, people are spending more time on mobile apps and less time on mobile browsers.

Figure 4: Big Data Process Performed by Big Data Analyst

Source: *4th I-LISS International Conference (2021)*

A mobile app can extend the library's services outside its physical borders and facilitate interaction with patrons. An app that offers functionalities such as a library catalogue, interactive library guides, a library virtual tour, an interactive calendar with all the library's events, the possibility to loan and read electronic books and articles, the possibility to reserve the library's resources or to pay for some services represent a real benefit for the patrons, facilitating their activities at the library.

The library can use the mobile apps as part of a library service. Nicole Henning, a library mobile technology professional, made a list of 50 ideas for creative uses of mobile apps in library services and including ideas like app workshops, app clubs, augmented reality books, and more. Information skills have tremendous value in the information society. They not only enable the information professional to provide the right information at the right time, but are transferable skills that have the potential to be monetised. (Carter, 2017).

Internet of Things/Smart Devices

The Internet of Things is a network of interconnected smart devices that allow each separate device to interact (i.e., send or receive data) with other devices on the network. As the Internet of Things becomes more mainstream, smart devices will have more access to data, which could allow them to become more independent. With a decline in DVD loans and the popularity of streaming TV and film, streaming for library customers is already a reality and one that may well become common in the years to come.

Cloud Services (Single Sign-on to Resources)

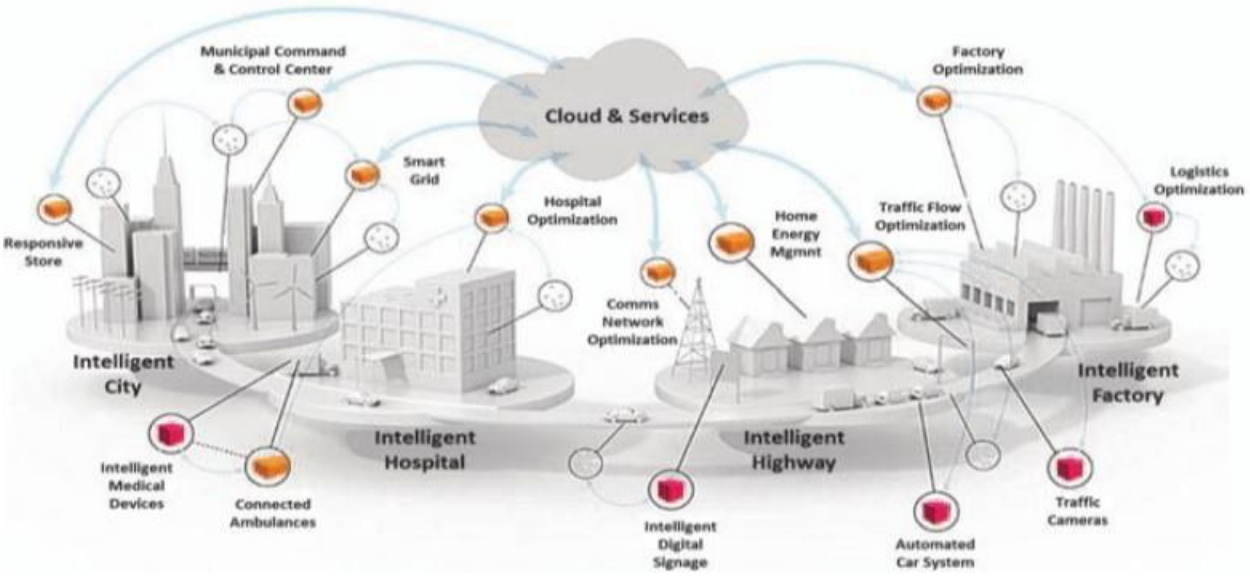
Tremendous data storage solutions and single sign-on allow customers to sign into all the valuable electronic resources with just one sign-in. An

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

example is the services developed in partnership between UK Connected Libraries and all the major UK Library software companies. Single Sign On gives fast and secure access to all the amazing content libraries purchased for their customers that are not accessible on the normal internet.

A decentralised business model built on a blockchain framework can provide the decentralisation and security needed for this industry shift (Ingraham & Clair, 2020). To envision bibliographic and authority data having any other purpose until now was a very far thought. Many cataloguing and metadata librarians are wondering how their local MARC Data has been tweaked or modified for other purposes (Hussain, 2019). Research and Education Network for Uganda (RENU), in Partnership with the Consortium of Uganda University Libraries (CUUL), is in the process of implementing these recommendations.

Figure 5: Internet of Systems



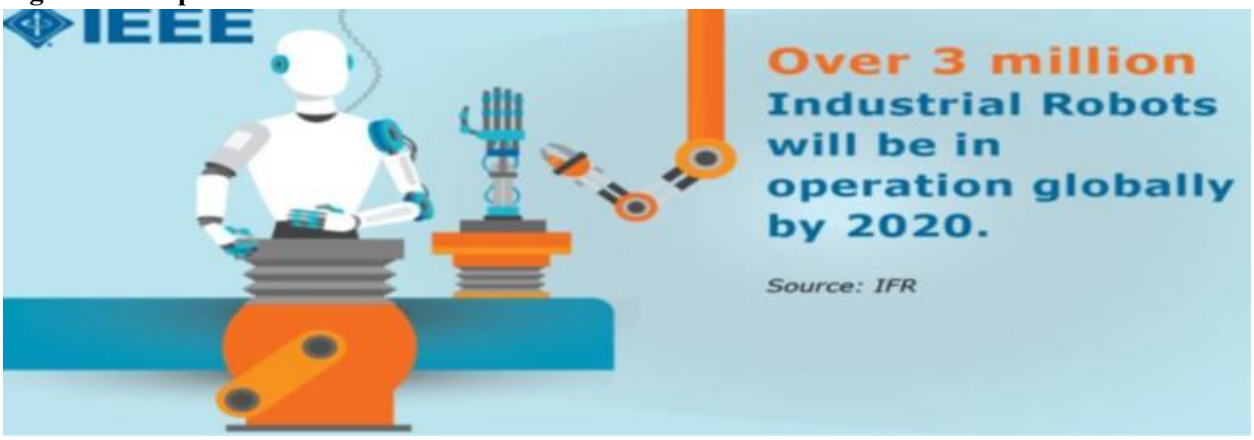
Source: *Information Africa Organization (2020)*

Robotics

Most people believe that robots would eradicate the rather dull aspects of our work and allow humans to focus on more challenging, fulfilling tasks, leading to an overall happier and more productive society. Regardless, once the Fourth Industrial Revolution reaches full maturity, it'll impact nearly every industry in every country. There are a number of libraries that have already successfully implemented some kind of automated technology. For example, the Joe and Rika Mansueto Library in Chicago has an automated storage and retrieval system housed in a large underground space. Another great example is Connecticut's Westport Library, which recently acquired two robots, Vincent and Nancy, that will be used to help teach coding and computer-programming skills. Information professionals should adopt the missing middle model/ techniques in organisations that assert that robots, by and large, will not be taking our jobs; instead, human-machine collaboration will reconfigure some of our work and make human skills more unique and significant than ever (Ayinde & Kirkwood, 2020).

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

Figure 6: Adoption of Innovative Robots



Source: *IEEE Explore 2019*

High Speed Internet

The 5G is a tremendous network portfolio with the ability to carry simultaneous amounts of data across different devices with super connectivity. According to Li *et al.* (2020), the development opportunities of 5G and its group technology make full use of the functions of 5G mobile Internet, and promote the application of 5G communication technology in the library. The 5G, if adopted by Uganda, will enhance the effectiveness of information systems and cloud storage response time, leading to efficient access to information resources.

DISCUSSIONS

Currently, the 4IR requires that information professionals update their skills to remain relevant in the creation, manipulation, validation, and distribution of information. Whatever business sector the information professionals work in, it is clear that the pressures of budgets, staff time, demand for more services, and the challenges of demonstrating value effectively are shared by all information professionals. However, it is imperative that information professionals strategically focus on delivering creative and impactful resources and services that resonate strongly within their respective organisations (Carter, 2017). However, Lund (2021) observed that the 4IR does not pose a significant threat to Libraries if the available technologies are properly embraced. The changes brought cannot affect libraries more than the previous technological innovation did. The 3IR innovations, such as information systems, personal computers, the Internet, e-readers, Google, web 2.0, among others, demonstrated the resilience of the information professionals.

The technologies that emerge from the 4IR era will expeditiously lead to profound changes in how libraries operate. Those libraries that fail to understand or embrace these technologies could lose their relevance and face extinction. Staying abreast of trends in emerging technologies should be our core business as information professionals. According to Lund (2021), libraries have already been adopting many of the 4IR technologies for quite some time, whether we were cognizant of it or not. A lot of what could be called “artificial intelligence” (AI) already exists in our library systems, and more is on the way as current projects are getting accomplished. We must therefore continue to adapt to the latest trends in a bid to amaze our information consumers and stay relevant in the increasingly interconnected world.

According to the World Economic Forum (2016), the Fourth Industrial Revolution will change not only what we do but also who we are. It will affect our identity and all the issues associated with it: our

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

sense of privacy, our notions of ownership, our consumption patterns, the time we devote to work and leisure, and how we develop our careers, cultivate our skills, meet people, and nurture relationships.

The implementation of the Fourth Industrial Revolution requires agile adaptability to new technology and a considerable amount of financial, skilled human, and technological resources. In the information age, information systems have always been shaped by available technologies that have transformed the creation, capture, preservation, and discovery of content. Although the 4th Industrial Revolution requires libraries to adapt quickly, economists predict that 50% of jobs from various sectors are likely to be lost as a result of robotics and extreme automation (Lund, 2021).

However, according to Carter (2017), the ability to get as much information on one page that does not require additional translation is just one of the ways information professionals are adding expert, stable value to their respective organisations. In addition to the new roles and responsibilities, the 4IR could also lead to more libraries employing specialist contractors or remote workers. This can be very beneficial for libraries since it can allow them to recruit a global workforce, increase employee loyalty and commitment, scale at a quicker pace, and reach new levels of productivity. Employees will not have to commute to work, which renders more free time, a better work-life balance, and greater flexibility, leading to overall employee satisfaction and commitment.

The digital divide is a core issue of the information society. It refers to the division between those who have access to, or are comfortable using, information and communication technology (ICT) (the “haves”) and those who do not have access to, cannot afford technological adoption or are not comfortable using ICT (the “have-nots”). The digital divide is a complex phenomenon involving more than just the availability of resources and funds to access those resources. But it incorporates the internal forces of an individual that motivate them to use or integrate ICT into their lives (Partridge, 2007).

While exploiting the range of wonders, information professionals should be aware of digital inequality in the community. The effects of the evolution towards a global information society, the rising importance of information and knowledge, and the deepening of the capitalist logic, make that the liberalization and commodification of information, knowledge, and education in itself might have perverse effects on this sector in many countries, not the least the developing ones (Audenhove & Brussel, 2018).

The disruption has been there in the past three industrial revolutions, but more challenging now is the adaptation to the Fourth Industrial Revolution era, which requires managers, librarians, and library support staff to participate collectively and understand the comprehensive action strategies to stabilise the foreseen disruptions. Moreover, over tactical planning and budgeting is required to ensure priorities are given due consideration amidst scarce financial resources.

The 4IR has transformed the ideation, research, and innovation ecosystem through the adoption of smart technologies. According to Monyela (2020), the introduction of robots in libraries has helped accomplish cataloguing tasks, providing ample time for cataloguers to ensure timely information processing and quality assurance. The cataloguers are also able to contribute to the Robotic Programme Automation process to ensure that systems and software programs are compliant with the cataloguing standards.

According to The World Economic Forum (2016), neither technology nor the disruption that comes with it is an exogenous force over which humans have no control. All of us are responsible for guiding its evolution, in the decisions we make daily as citizens, consumers, and investors. We should

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

thus grasp the opportunity and power we have to shape the 4IR, directing it toward a future that reflects our common objectives and values.

To this end, we must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments. This is the basis for our call for funding and inclusion in global partnership grants.

Librarians should continuously be prepared to empower people in terms of knowledge and skill capabilities, especially by making them understand how the future world of technology works and become technology literate so that them to be able to use the knowledge properly and will not be left behind (Muhammad & Hanipah, 2018). Continuous Professional Training of staff is critical to enhancing the adaptation of the 4IR in the libraries.

The rapid changes in present smart environments by the 4IR are unavoidable for all. According to Hussain (2019), the technologies that we have present and the technologies yet to come will make the librarians' duty easier and more durable. Better still, according to Ayinde & Kirkwood (2020), the 4th Industrial Revolution is the era of smart technologies such as AI, drones, 3D printing, IoT, and various internet-connected devices, which are used in a smart environment to achieve the organisation’s goals.

CONCLUSION

As we stand at the edge of the 4IR innovations, digital technologies such as data analytics, artificial intelligence, prompt engineering, machine learning, Internet of Things, Big Data, Blockchain, Robotics, 3D technologies, and many more have become the means and solutions to many of the world’s problems. Most recently, these technologies have assisted in the global fight against the COVID-19 pandemic and other societal problems (Hoosain *et al.,* 2020). There has never been a time of greater promise, or one of greater potential threat, than that of the 4IR. In decision making, we should not be trapped in traditional linear thinking or too absorbed by the multiple predicaments demanding our attention. We must think strategically about the forces of disruptions and innovations that are definitely shaping our future.

Recommendations

According to the insights of this study and the experience of the researchers, during the Fourth Industrial Revolution (4IR), libraries and researchers must acquire new skills and leverage advanced tools to stay relevant and efficient, specifically:

- Librarians must acquire new skills and leverage advanced tools to stay relevant and efficient.
- The Information Science niche should be outreach/community engagement to amaze, inform, and inspire.
- Libraries must adopt tools that are not only top-rated but also reflective of the global shift toward high dependency on technology.
- Since the adaptation to the 4IR by libraries is reliant on the availability of technological infrastructures, training, funding, and a quality assurance regulatory framework.
- Stakeholders should take a keen interest in addressing the needs of those who remain on the margins of transformation while improving the quality of those who are adapting.

In summary, the study recommends the adoption of tools that are not only top-rated but also reflective of the global shift toward high dependency on technology for managing and advancing research, ensuring that libraries and researchers can effectively navigate the complexities and opportunities of the 4IR. Since the adaptation to the Fourth Industrial Revolution by libraries in Uganda is reliant on the availability of technological infrastructures, training, funding, and a quality assurance regulatory framework. Stakeholders take

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

a keen interest in addressing the needs of those who remain on the margins of transformation while improving the quality of those who are adapting.

REFERENCES

Audenhove, L. Van., & Brussel, V. U. (2018). Theories on the information society and development: Recent theoretical contributions and their relevance for the developing world, (January 2003). https://doi.org/10.1080/02500160308538020

Ayinde, L., & Kirkwood, H. (2020). Rethinking the roles and skills of information professionals in the 4th Industrial Revolution. https://doi.org/10.1177/0266382120968057

Carter, D. (2017). Creativity in action – the information professional is poised to exploit the fourth industrial revolution : The business information survey 2017, *34*(3), 122–137. https://doi.org/10.1177/0266382117722440

Freder, D. E. (2017). Disruption or revolution? The reinvention of cataloguing (Data Deluge Column). *Library Hi Tech News*, *34*(7), 6–11. https://doi.org/10.1108/LHTN-07-2017-0051

Gonel, F., & Akinci, A. (2018). How does ICT-use improve the environment? The case of Turkey. *World Journal of Science, Technology and Sustainable Development*, *15*(1), 2–12. https://doi.org/10.1108/wjstsd-03-2017-0007

Hoosain, M. S., Paul, B. S., & Ramakrishna, S. (2020). The Impact of 4IR Digital Technologies and Circular Thinking on the United Nations Sustainable Development Goals.

Hussain, A. (2019). Industrial revolution 4.0: Implication to libraries and librarians, (September). https://doi.org/10.1108/LHTN-05-2019-0033

Ingraham, A., & Clair, J. S. (2020). The Fourth Industrial Revolution of Healthcare Information Technology : Key Business Components to Unlock the Value of a Blockchain-Enabled Solution, 1–4.

Jiahui, L., Ningxing, W., & Chao, D. (2020). The Design of Smart Library Based on 5G. In *Journal of Physics: Conference Series* (Vol. 1606). https://doi.org/10.1088/1742-6596/1606/1/012011

Kemp, S. E., Hort, J., & Hollowood, T. (2017). Descriptive Analysis in Sensory Evaluation. *Descriptive Analysis in Sensory Evaluation*, 1–724. https://doi.org/10.1002/9781118991657

Khan, A. U., Rafi, M., Zhang, Z., & Khan, A. (2023). Determining the impact of technological modernization and management capabilities on user satisfaction and trust in library services. *Global Knowledge, Memory and Communication*, *72*(6–7), 593–611. https://doi.org/10.1108/GKMC-06-2021-0095

Lund, B. (2021). The Fourth Industrial Revolution: Does It Pose an Existential Threat to Libraries? (March), 2–5.

Manyika, J., Chui Brown, M., B. J., B., Dobbs, R., Roxburgh, C., & Hung Byers, A. (2011). Big data: The next frontier for innovation, competition and productivity. *McKinsey Global Institute*, (June), 156. Retrieved from https://bigdatawg.nist.gov/pdf/MGI_big_data_full_report.pdf

Marwala, T. (2022). *The Fourth Industrial Revolution and Academic Library Practices*. *Academic Libraries: Reflecting on Crisis, the Fourth Industrial Revolution and the Way Forward*. https://doi.org/10.36615/9781776402304-01

Monyela, M. (2020). DigitalCommons @ University of Nebraska - Lincoln, 11–24.

Muhammad, A. A. R., & Hanipah, A. A. (2018). Preparing the Libraries for the Fourth Industrial Revolution (4th IR). *Jurnal PPM: Journal of Malaysian Librarians*, *Volume 12,*(June).

Article DOI: https://doi.org/10.37284/eajit.8.1.3436

Retrieved from https://www.researchgate.net/publication/332319225%0APreparing

Nakaziba, S., & Ngulube, P. (2024). A model for enhancing digital transformation through technology - related continuing professional development activities in academic libraries in context. *Discover Education*. https://doi.org/10.1007/s44217-024-00178-8

Ntlotlang, T. (2019). Technology mediated tools as drivers of library - researcher collaboration : the case of Botswana International University of Science and Technology (BIUST) Institutional Repository (IR), 1–10.

Partridge, H. (2007). Establishing the human perspective of the information society.

Schwab, K. (2017). The Fourth Industrial Revolution. Crown Publishing Group, New York.

Segan, B. S. (2021). What Is 5G ? *American Association Libraries News Magazine*.

The World Economic Forum. (2016). The Fourth Industrial Revolution : what it means, how to respond. *Foreign Affairs*.

Yao, X., Zhang, J., Yu, Z., Zhao, F., & Sun, Y. (2019). Random Noise Suppression of Magnetic Resonance Sounding Data with Intensive Sampling Sparse Reconstruction and Kernel Regression Estimation.

