# The Fourth Industrial Revolution (4IR) and its Existential Threats in Ghanaian University Libraries

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#### Abstract

The Fourth Industrial Revolution (4IR) is reshaping the roles and obligations of librarians globally. This has spurred a fundamental reassessment and the acquisition of new skills by librarians to provide efficient services. This research aimed to assess the existential challenges Ghanaian university libraries encountered with the advent of the 4IR. The opinions of 218 librarians from nine Ghanaian universities were collected by employing a quantitative research approach. The findings revealed that 4IR presents a potential danger to the job security of library staff in Ghanaian university libraries. Additionally, insufficient technical proficiency of librarians in 4IR technologies may hinder their ability to perform effectively. The results also highlighted inadequate infrastructure, unorganised technology adoption strategies, and financial limitations as primary obstacles affecting the integration of 4IR technologies in Ghanaian university libraries. To mitigate the adverse effects of 4IR, the study recommends regular enhancement of librarians' competencies to manage 4IR technologies effectively.

**Keywords:** Fourth Industrial Revolution, 4IR, Libraries, Academic Libraries, Ghana.

# Introduction

Technological breakthroughs involving the

Internet of Things (IoT), artificial intelligence, robots, nanotechnology, 3D printing, and other technologies with a wide variety of applications are currently unfolding on a global scale involving the Internet of Things (IoT), artificial intelligence, robots, nanotechnology, 3D printing, and other technologies with a wide variety of applications are currently unfolding on a global scale, have ushered in what is commonly referred to as the Fourth Industrial Revolution (4IR). The Fourth Industrial Revolution represents an ongoing technological transformation that is reshaping the way people currently lead their lives and conduct their work. It characterises the progression of information technology toward greater automation and interconnectedness (Lund, 2021). The principles underpinning the 4IR are built upon those of the preceding industrial revolutions. The first three industrial revolutions were driven by steam engines, electricity, and the invention of computers, electronics, and digital technology, each contributing to the mechanisation, mass production, and automation of their respective eras.

While it continues the legacy of the digital revolution, the Fourth Industrial Revolution (4IR) stands out as a distinct phenomenon (Schwab, 2016). It distinguishes itself from its forerunners through its swift technological advancement, extensive scope, heightened interaction between humans and machines, and the substantial impact of novel systems, all of which have left a profound mark on this generation. Key technologies of today encompass automation, artificial intelligence, universal online education for various fields, and mobile computing (Hussain, 2020).

4IR influences practically every aspect of existence. It has an impact on virtually every facet

of human activity. Schwab (2016) describes the 4IR as "an impending monsoon, a sweeping pattern of change seen in the distance, arriving rapidly with little time to prepare". According to the organisation, "In terms of velocity, scale, and systemic influence, this development is unparalleled to anything previously observed. Through the convergence of technologies, the differences between the physical, digital, and biological realms are being eliminated." The 4IR is currently altering the roles and responsibilities of librarians worldwide. This condition has prompted a radical rethink and the retraining of librarians with the necessary skills in order to supply their increasingly dynamic clientele with effective and efficient service delivery. In other words, this era has afforded librarians an ideal opportunity to reconsider their identities. According to Tella (2020), librarians are required to evaluate their services and collections in order to keep them relevant, and in doing so, they have been observed in adopting and implementing new library and information science (LIS) technologies.

In the era of the Fourth Industrial Revolution (4IR), numerous information institutions, such as libraries, have been compelled to re-evaluate their strategies. The industry 4.0 era demands that librarians possess profound expertise in a particular field, coupled with a comprehensive understanding of other domains, along with the capability to proficiently utilise a wide array of digital technologies across various disciplines. As pointed out by Chisita and Chibanda (2019), digital technologies have triggered transformative shifts within libraries, fundamentally altering the methods and processes through which work is conducted.

Hence, it is imperative to cultivate a library workforce that doesn't feel threatened by these emerging technologies, and this can be achieved through ongoing professional development. As highlighted by Ahmat and Hanipah (2018), there are four strategic steps that libraries of all kinds should implement to manage the disruptive alterations introduced by the Fourth Industrial Revolution. These encompass the reshaping of organisational behaviour, the redesign of business models, the restructuring of workflow in business processes, and the revision of job descriptions and roles. Similarly, De Mauro et al. (2016) emphasised how the Fourth Industrial Revolution (4IR) would amplify the significance of librarians in the realm of big data by generating value in bibliometrics, data sharing, and data curation.

The business of higher education has

grown into a free market where competition and consequently, visibility are crucial. Meanwhile, funding arrangements are changing and becoming more challenging, placing additional stress on those participating in higher education. As a result of shifting supply and expanding demand for higher education, the higher education business has generated applications of competitive intelligence and innovations. Owing to the inextricable connection between the history of education and the history of libraries, academic libraries have always played vital roles in their institutions' instructional missions.

Now, university libraries must successfully adapt to change to remain relevant to university education (Harland et al., 2017; Koz, 2014) (Harland et al., 2017). In a climate of rising market exposure and rivalry, the library must restructure its roles, offerings, and resource accessibility in order to enhance university operations (Harland et al., 2017; Koz, 2014).

Gathering, analysing, preserving, and disseminating critical knowledge and information, the university library continues to function as the institution's epicentre. The training of librarians includes retrieval, analysis, evaluation, preservation, and display of information. These skills are durable since they are not entirely dependent on technology. The 4IR expands access to a vast array of information, which can only enhance the quantity and quality of research. Librarians comprehend the ethical and legal ramifications of information access and usage, as well as the economic, legal, and social values and difficulties connected with information use. According to Saunders (2020), emerging librarians, current librarians, and other information professionals must learn and master specific knowledge, skills, and abilities in order to function covertly.

#### **Statement of the Problem**

A university library has always been recognised as the intellectual centre of the institution, serving as a vital resource for all faculty, researchers, and students (Stamatoplos, 2014). Accreditation requirements for universities in Ghana include the provision of a well-established and resourced library. Thus, every institution must have a library that supports its teaching, learning, and research missions. Universities have had libraries for as long as they have existed. The size of Ghanaian university libraries varies according to the size of the parent institution. Ghana currently has ninety-four recognised private degree-awarding institutions, sixteen accredited public universities, and ten public technical universities (GTEC, 2024).

Ghanaian libraries' adoption and use of 4IRrelated technology (robotics, user experience, aska-librarian, social media, reference management tools, e-Resources, Research Commons, and WiFi access) is commendable and demonstrates the LIS sector's growing commitment and intent to adopt technology to address disruptive change and achieve the Sustainable Development Goals. To be compatible with the 4IR's design principles and objectives, libraries must continue to conceive, explore, and adopt it in a comprehensive and sustainable manner. Thus, university libraries in Ghana that cannot connect to the current wave of 4IR risk being left behind. This is a concern because Ghanaian libraries may lack the necessary infrastructure to execute the composite 4IR idea. This is due to the fact that both students and library personnel are required to possess particular skills and abilities. These capabilities are the enablers that assure 4IR's effective use; without them, its existence will be of little benefit, leading to a decline in university library usage in Ghana. This study sets out to find out the potential existential challenges that university libraries in Ghana face in the era of 4IR.

# Literature Review

## **History of 4IR**

The First Industrial Revolution, which occurred in the late eighteenth to nineteenth centuries in Europe and America, was characterised by the rise of the iron and textile industries and the invention of the steam engine. The Second Industrial Revolution, spanning from 1870 to 1940, took place before World War II (1939–1945) and saw the utilisation of steel, oil, electricity, and electric power for mass production. During this period, significant inventions included the telephone, light bulbs, phonograph, and internal combustion engine.

Ellen Frederick (2016) noted that the term 'industrial revolution' is a term many readers encountered in their school history lessons, often associated with a time period from the late eighteenth century to the mid-nineteenth century when small home-based industries gradually gave way to largerscale production in industrial settings. The Third Industrial Revolution, often referred to as the digital revolution, marked a shift from analogue electronic and mechanical devices to digital technology, commencing around 1980. This era witnessed the emergence of personal computers, the Internet, and information communication technology (ICT). The 4IR was coined by Klaus Schwab, a German Engineer and economist who is best known as the founder and executive chairman of the World Economic Forum (WEF, 2016). He posited that the 4IR will affect the essence of human experience (Schwab, 2016; WEF, 2016).

Libraries have encountered three phases of development within these industrial revolutions and these include the emergence of automation systems leading to the use of Machine-Readable Cataloguing (MARC) and Online Public Access Catalogue (OPAC), audio visual media systems and web-based indexing; the development of CD-ROMs, full-text databases, the Internet, and the Web; and the advancement of new technology that was used to accomplish complex tasks (Ahmat and Hanipah, 2018). This led to the development of makerspaces in libraries with collaborative work spaces for making, learning, exploring and sharing using high-technology tools and applications. Some librarians are now responsible for teaching robotics, coding, and programming skills to library patrons.

## Libraries in the Fourth Industrial Revolution

The literature specifically mentions libraries' responsiveness to the 4IR (Ahmat and Hanipah, 2018; Marwala, 2019; Ocholla and Ocholla, 2020). According to Hussain (2020), the 4IR has had a significant impact on libraries, and their ability to adhere to its design principles will determine whether they can continue to exist. Marwala (2019) concurs and cautions against interpreting and responding to the 4IR from a conventional and well-known "library" perspective. According to Marwala (2019), it is challenging for a traditional librarian to grasp the reality of a cyber library, but he stresses that libraries have always been adaptable and flexible. Although libraries are reactive in their response to 4IR and, as a result suffer disruptive changes, Marwala (2019) and Ocholla and Ocholla (2020) counsel that libraries must "adapt or die." According to Ocholla and Ocholla (2020), the 4IR idea does not appear frequently in academic library literature; yet, there is mounting evidence that studies on the 4IR in relation to libraries is crucial. According to Ocholla and Ocholla (2020), scholarly research on 4IR and the LIS business is increasing at a 2.8% yearly pace.

Ocholla and Ocholla (2020) support academic libraries' ability to adopt new technology rapidly, and numerous examples of 4IR-related technology adoption, such as the Internet of Things, embedded systems, cyber-physical systems, big data, cloud computing, information management, data acquisition and handling, and network security, are already accessed and utilized in academic libraries. So, these instances are theoretically reproducible globally.

The 4IR and the significant disruptive changes it has brought about have profoundly influenced the requirements and anticipations of library users. Consequently, libraries need to embrace a digital environment wherein the entire library and information science (LIS) sector is interconnected, with various participants and stakeholders acting as vital components within this network. Establishing links between these numerous nodes within the LIS ecosystem will facilitate the integration of diverse technologies and the generation of extensive data regarding content publishing, library users, and collections as a whole. Only after exploring and addressing the 4IR design principles of inclusivity, interlinkage, and connectivity will the objective of providing an inclusive, usercentric, one-touch experience in the LIS industry be realized (Ocholla and Ocholla, 2020; Prisecaru, 2016). In addition to an ICT strategy that directs the adoption and implementation of 4IR technology within a larger ecosystem, Prisecaru (2016) cautions against adopting and implementing technologies to facilitate the introduction of a user-centric one-touch experience without considering the overall context of the organisation.

Some specialists insist that, libraries must take into account all potential factors that could impact the successful adoption and implementation of 4IR policies and technology (Ahmat and Hanipah, 2018; Hussain, 2020). These effects include changed business models, reorganized procedures for library labour operations, and organisational behaviour. Critically, a long-term and comprehensive ICT strategy related to the 4IR cannot be executed without careful consideration of a training and development strategy and plan that facilitates the library's incorporation of new and diverse tasks and positions.

#### **Implications of 4IR for Education**

Education in the 4IR has the ability to transform society. This change is nuanced, dialectical, and intriguing. The 4IR has repercussions in numerous other spheres of life. Hence, it provides both educational opportunities and difficulties. By employing several 4IR technologies, such as IoT, 3D printing, quantum computing, and AI, the education industry could experience a radical transformation in order to find answers to new problems.

In contrast to robotic tutors, Butler-Adam (2018) claims that curricula, teaching, and learning are among the 4IR's effects on education. In other words, teaching and learning must span sector boundaries. It is crucial for students and educators from a range of backgrounds to gain knowledge of the numerous elements necessary for the successful implementation of the 4IR. According to Butler-Adam (2018), students studying basic and applied sciences must comprehend the political and social aspects of the society in which they live. In turn, students in the humanities and social sciences must comprehend the theoretical underpinnings and operation of artificial intelligence (AI). In light of the above rationale, the 4IR proposes a multidisciplinary area in which humanities and social sciences collaborate with technologies to solve problems. The 4IR, the advent of biotechnology, and AI call into question fundamentally held beliefs about humans and their relationships with nature. It is crucial to design 4IR liberal arts programs that account for the resulting social shifts. In general, the 4IR curriculum should address the political and social concerns posed by the rapid development of technology (Penprase, 2018).

Online education and the growing usage of artificial intelligence in education need the creation of new concepts to give a theoretical basis for digital pedagogy (Penprase, 2018). Digital literacy is an essential prerequisite for students to develop the adaptive skills necessary to participate in the global digital society, profit from the digital economy, and take advantage of new jobs, innovations, creative expression, and social inclusion opportunities (Brown-Martin, 2017). Any digital education strategy must take into account the influence of change on the educational system. This is a significant issue in that changes may affect the quality of graduates if students are not sufficiently educated and sufficient resources are not invested (Marshall, 2016). Regarding quality measurements, education is particularly susceptible to complex problems (Marshall, 2016). The conceptualisation and implementation of quality assessments, performance indicators, and educational outcomes become increasingly challenging in the context of the educational strategy debate (Marshall, 2016).

#### THE FOURTH INDUSTRIAL REVOLUTION (4IR) AND ITS EXISTENTIAL THREATS

Research and Development (RandD) is generally cited as the sector most affected by technological advances (Xing and Marwala, 2017). There are a variety of benefits to studies that are facilitated by technology. According to Xing and Marwala, technology-driven RandD can take many diverse shapes. Using mobile capabilities to improve the accuracy of data gathering, advanced big data analytics to find hidden statistical trends, and artificial intelligence to retool information search, collection, organisation, and knowledge discovery are some examples of the benefits of technology-driven RandD. In addition, the requisite abilities will be necessary for the successful implementation of the 4IR in education. Some skills are necessary for installing, managing, and collaborating with others when utilizing new technology (Butler-Adam, 2018). To reach the objective of attaining the maximum possible benefits from new technology, the requisite set of skills is crucial. According to Gray (2016), 35% of the current workforce's essential abilities will change in the next years. Hence, new skill sets will be necessary for the new revolution and the use of new technology. Although new technology creates new professions, such as social media specialists, others, such as toll booth operators, may become obsolete (Nordin and Norman, 2018).

With the creation and application of new technology, the 4IR faces new risks. To mitigate these hazards, careful planning is necessary. Novel methods and mechanisms for risk management will also be necessary. This indicates that new technologies have the ability to improve living conditions. Yet, the hazards and negative effects of these technological advancements must not be ignored.

Inequality is the primary threat posed by the 4IR to education. Inequality and wealth disparity are social concerns in South Africa. Social issues such as a high crime rate, gender violence, and unemployment are more prevalent in unequal societies. In South Africa's education system, inequality is a difficult problem that could be exacerbated by technological advancements. There is a possibility that new educational technology will be accessible mainly to the wealthier portions of society, leaving the poor behind (Ocholla and Ocholla, 2020). This is obvious from the implementation of the last three industrial revolutions. Many people lack access to the Internet, transportation, and safe drinking water in the present day. Increased inequality between the "haves" and "have nots" will hence deepen social instability, mistrust, and alienation.

The importance of social justice and the human condition cannot be overstated. Consideration should be given to the effects of shifting economic power and technological innovation on various socioeconomic strata of society. It is essential to recognise the threats that lurk in an increasingly interconnected globe and to promote intercultural harmony, steadfast devotion to freedom, and respect for human rights. Thus, the development of intercultural and social skills is required (Penprase, 2018).

# Theoretical Review (Theory of Technological Determinism)

The concept of technological determinism posits that the foremost catalyst for social and cultural transformation is technology, exerting a profound influence on the fabric and principles of society. This viewpoint contends that technology moulds the manner in which individuals engage with one another and their environment, asserting a potent and selfgoverning impact on social and cultural frameworks.

The concept of technological determinism originated in the 1920s and 1930s through the work of sociologists and philosophers such Lewis Mumford, Jacques Ellul, and Martin Heidegger. Yet, the term was originally coined by the American economist and sociologist Thorstein Veblen in the 19th century and gained prominence in the mid-20th century, thanks to the Canadian scholar Harold Innis. Since its inception, the theory has been a topic of continuous debate and discourse, with scholars across various disciplines delving into the intricate connection between technology and society. This theory has been applied to a range of different contexts, from the development of the printing press to the rise of the Internet, and is particularly relevant when considering the impact of the fourth industrial revolution on libraries.

The Fourth Industrial Revolution, which is characterised by the development of advanced robotics, artificial intelligence, and other disruptive technologies, has the potential to transform the way that libraries operate and the services they provide. While there are many potential benefits associated with the adoption of these technologies, there are also a number of existential threats that libraries must address in order to remain relevant and effective in this new landscape (Hussain, 2020).

One of the key threats associated with the Fourth Industrial Revolution is the possibility of job loss and workforce displacement. As libraries begin to adopt more

automation and artificial intelligence technologies, there is a risk that many of the tasks traditionally performed by librarians may become automated. This could lead to job loss and a shift in the skill sets required to work in the library field, which in turn could impact the quality of service that libraries are able to provide (Ahmat and Hanipah, 2018; Lund, 2021).

Another threat associated with the adoption of Fourth Industrial Revolution technologies by libraries is the potential for increased data privacy concerns. As libraries increasingly rely on data-driven technologies to improve their services, there is a risk that patron data could be compromised or misused. This could erode the trust that patrons have in the library as an institution, potentially leading to a decline in usage and support (Prisecaru, 2016).

A further threat is the possibility of a widening digital divide, as libraries struggle to keep up with the pace of technological change. Libraries in less affluent areas may struggle to adopt the latest technologies, leading to disparities in access to library resources and services. This could have negative impacts on educational outcomes and social mobility, exacerbating existing inequalities (Ocholla and Ocholla, 2020).

Technological determinism provides a useful framework for understanding these and other threats associated with the adoption of Fourth Industrial Revolution technologies by libraries. This theory suggests that technological developments are not neutral, but rather have a significant impact on the social, economic, and cultural structures of society. By examining the ways in which technology is driving change in the library landscape, researchers can better understand the potential risks and opportunities associated with the fourth industrial revolution, as well as the strategies that libraries can adopt to adapt and thrive in this new environment (Schäfer, 2018).

# Methodology

# **Research Design**

The chosen research design for this study is a survey design, which involves gathering data through standardized questionnaires or interviews to understand people's thoughts, preferences, and behaviours (Creswell, 2014). This design was selected because it provides a detailed description of the phenomenon being studied and accurately describes the existing situation. Survey designs are considered ethical as they do not harm the environment and provide information on naturally occurring issues. Since the study population was spread out across Ghana, a survey design was deemed appropriate for collecting data from this dispersed population. Surveys are effective in assessing group attitudes, opinions, and behaviour to identify trends or prevalence, which is why this design was chosen for the study.

#### **Research Approach**

Kothari (2004) defines a research approach as encompassing approaches, techniques, methods and instruments to solve a particular research problem. The chosen research approach for this study is the quantitative research approach. The researcher chose the quantitative research approach because it produces objective data that can be clearly communicated through statistics and numbers. In addition, the researcher adopted the quantitative approach, as it is regarded more scientific, objective, fast, focused, and acceptable approach as compared to other approaches which makes it easy for extrapolation. A questionnaire was used for data collection for this study which aligns with the quantitative approach adopted to investigate the Fourth Industrial Revolution (4IR) and its existential threats in Ghanaian university libraries.

#### **Study Area and Setting**

The focus of this study is on various tertiary institutions across Ghana, which consists of 36 accredited universities, each with a library. The study obtained data from the library staff of these university libraries to identify the existential threats posed by the Fourth Industrial Revolution (4IR). To ensure an adequate representation of the population, the researcher utilised a sampling technique that subdivided the universities based on three main characteristics: chartered private universities, public universities, and technical universities. The stratification method helped to ensure that all universities were represented in the sample. The researchers also considered location and university status when selecting the sample. All library staff of the selected universities were eligible to participate in the study.

## **Research Participants and Eligibility Criteria**

To ensure a representative sample of university libraries in Ghana for the study, a stratified sampling technique was used in the first sampling level. The universities were categorised into three primary groups – public (14), private (12), and technical (8)- to include all types of universities proportionately and at all appropriate levels of library staff. The libraries within these universities made up the population for the study. To proportionately sample the universities, a formula provided by Kish (1965) was used, with a sample fraction of 1/4 suggested for representation. Out of a total of 36 university libraries in Ghana, the proportionate stratified sampling technique was used to select the institutions for the study. Each stratum should have the same sampling fraction as depicted in Table I.

**Table 1:** Sample Size of University Libraries in Ghana.

Library	Public Universities	Private Universities	<b>Technical Universities</b>	Total
Population size	14	12	8	36
Sampling fraction	1/4	1/4	1/4	1⁄4
Final sample size	4	3	2	9

The sample size for public universities was calculated as:  $(\frac{1}{4} \times 14) = 4$ , which is approximately four universities (Kish, 1965). The same fraction was used in arriving at three and two private and technical universities respectively to complete the sample. In the view of Kish (1965), the sampling fraction in each stratum should always be made equal to the sampling fraction for the entire population. The actual university libraries that participated in the study were purposively selected to balance the different geographical, socio-economic, size, age, and other factors relating to the varieties of university libraries in Ghana. The libraries were purposively selected for representation based on the above criteria (geographical, socio-economic, size, and age).

The researchers used the census method to select all 291 library staff from the nine Ghanaian public, private, and technical universities for the study. This method ensures a true population measure and minimises sampling errors, though it can be time-consuming. Since the study population was manageable, all staff, including head librarians, sectional heads, and other staff, were included. This approach aimed to enhance the study's generalizability

#### **Data Collection Tools**

To collect data for the study, a questionnaire was adopted. The questionnaire was used to obtain comprehensive data that aligns with the study objective. According to Creswell (2014), utilising quantitative methods for data collection leads to credible and accurate results.

## **Ethical Considerations**

Ethical considerations were considered during the study to respect the rights of the participants. Informed consent was obtained from all participants, who were informed about the study's purpose and scope. The researcher assured participants of anonymity throughout the study, and pseudonyms were used to protect their identities when reporting the research results. These measures were implemented to ensure confidentiality and protect the participants' privacy. Participants were given the opportunity to ask questions and were made aware of their right to decline participation or withdraw from the study at any time without consequences.

#### **Data Management and Analysis**

To analyse the quantitative data collected in this study on the 4th Industrial Revolution and its threats to Ghanaian University Libraries, Statistical Product and Service Solutions (SPSS) software version 22.0 was used. The data was tabulated based on the study's objective and subthemes were presented using various methods indicated below.

### Study Results

A total of 291 copies of the designed questionnaire were distributed to library staff, with 218 returned, yielding a 74.1% response rate as delineated in Table 2. The study's response rate exceeds Bryman's (2012) acceptable threshold of 60-69%. Data was collected from nine universities in Ghana, including University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), University of Education Winneba (UEW), University of Mines and Technology (UMAT), Ashesi University (AU), Webster University (WU), Central University (CU), Cape Coast Technical University (CCTU), and Takoradi Technical University (TU).

Table 3 provides the background of respondents for the study and shows their gender, ages, educational level, professional categorisation, and working

experience. These demographic characteristics offer more perspectives on the results of the study by projecting the capacity of respondents whose opinions form the study outcome. Table 3 shows respondents have a fair percentage of maturity, a high level of education, and a considerable length of working experience.

Table 2: R	esponse	Rate of	Ouest	ionnaire	in U	Universit	y Librari	es.
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University Libraries	Questionnaire Distribution (N=291)	Response Rates (N=218)	Individual University Response Rate (%)
KNUST	89 (31%)	64 (29%)	72.0
UG	68 (23%)	52 (24%)	76.5
UEW	48 (16%)	28 (13%)	58.3
CCTU	34 (16%)	28 (13%)	82.4
TTU	20 (7%)	16 (7%)	80.0
CU	16 (5%)	14 (6%)	87.5
UMAT	12 (4%)	12 (6%)	100
AU	2 (1%)	2 (1%)	100
WU	2 (1%)	2 (1%)	100

Table 3: Demograp	hic Characteristics
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Demographic Features	Frequencies	Percentages					
Gender							
Male	126	57.7					
Female	92	42.2					
	Age	· ·					
25-29	16	7.3					
30-34	38	17.4					
35-39	58	26.6					
40-44	47	21.6					
45-49	24	11.1					
50+	35	16.0					
	Educational Level	÷					
Bachelor's degree	99	45.4					
Masters	80	36.7					
Diploma	36	16.5					
PhD	3	1.4					
	Rank						
Senior staff	142	65.1					
Senior member	48	22.0					
Junior Staff	24	11.0					
Others	4	1.9					
	Years of Working Experience						
Under 10 years	58	26.6					
10-20	112	51.4					
21-30	39	17.9					
31-40	9	4.1					
Total	218	100.0					

# The Existential Threats on the Adoption of 4IR in Ghana

There are several factors that militate against the adoption of 4IR in Ghanaian institutions. The study ranked these threats from the most threatening to the least threatening factors. This was done with the use of the Relative Importance Index (RII) and weighted totals. The RII and Weighted totals are statistical tools used to rank different factors by their level of importance or impact and are very common for interpreting Likert Scale responses. The usage of these statistical indices elevates the analysis to provide a more holistic picture of the threatening effect of the identified factors. Thus, they hedge against the common practice of focusing on the extreme measures of the Likert scale responses. In this study, the RII and weighted totals were used to rank the factors in terms of their militating influence.

The RII is calculated by applying the following formula:

$$\mathbf{RII} = \sum \mathbf{W}_i \mathbf{X} \mathbf{X}_i / \mathbf{k} \mathbf{X} \mathbf{n}$$

Where:

RII is the Relative Importance Index for an item

 $W_i$  is the weight assigned to the  $i^{ih}$  level of the Likert Scale

 $X_i$  is the frequency of respondents who chose the  $i^{ih}$  level of the Likert scale

k is the highest weight on the Likert scale (5 in this case)

n is the total number of respondents.

In the formula,  $\sum (\mathbf{W}_i \mathbf{x} \mathbf{X}_i)$  represents the Weighted Total and is the sum of the product of the weights and frequencies for each level of the Likert scale.

The result is presented in Table 4.

Factors	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Weighted Total	RII	Rank
Inadequate skilled and tech-savvy personnel to manage 4IR technologies	2(0.93%)	4 (1.83%)	21 (9.63%)	86 (39.45%)	105 (48.16%)	942	0.86	4th
Lack of adequate infrastructure to meet the needs of 4IR technologies	1 (0.46%)	3 (1.37%)	10 (4.59%)	36 (16.52%)	168 (77.06%)	1021	0.94	1st
Lack of legal backing for universities to adopt 4IR technologies	1 (0.46%)	1 (0.46%)	28 (12.84%)	80 (36.70%)	108 (49.54%)	947	0.87	3rd
Inadequate programs/courses in Ghanaian universities to increase 4IR literacy among Ghanaian librarians or students	3(1.37%)	7 (3.22%)	24 (11.01%)	86 (39.45%)	98 (44.95%)	923	0.85	6th
Poor adaptability of library staff to new technologies	52 (23.85%)	52 (23.85%)	10 (4.59%)	48 (22.02%)	56 (25.69%)	658	0.60	7th
Privacy issues accompanying the use of 4IR technologies	2 (0.93%)	4 (1.83%)	21 (9.63%)	87 (39.90%)	104 (47.71%)	941	0.86	5th
Poor and unsystematic technology transformation strategies	5 (2.29%)	3 (1.37%)	12 (5.51%)	42 (19.27%)	156 (71.56%)	995	0.91	2nd
Inadequate financial resources to fund 4IR technologies at the universities	0(0.0%)	3(1.37%)	11 (5.05%)	38 (17.43%)	166 (76.15%)	1021	0.94	1st

The survey results identified eight threats to the adoption of 4IR in Ghana. Based on the index ranking method, "Lack of adequate infrastructure to meet the needs of 4IR technologies" and "Inadequate financial resources to fund 4IR technologies at the universities" attained the topmost threats to the adoption of 4IR in Ghana. This resulted in RII score of 0.94 respectively with a corresponding level of agreement predominantly "agree" and "strongly agree". Whereas those who agreed that "Lack of adequate infrastructure to meet the needs of 4IR technologies" is a threat to 4IR came up to 36(16.52%), those who "strongly agreed" came up to 168 (77.06%). Similarly, those who agreed that "Inadequate financial resources to fund 4IR technologies at the universities" was a great threat to 4IR adoption in Ghana were 38 (17.43%), while the "strongly agreed" was also 166 (76.15%). Based on the RII ranking, "Poor and unsystematic technology transformation strategies" emerged as the second most threatening factor for the adoption of 4IR in Ghanaian libraries. This was based on the agreement levels of the respondents. As such, those who agreed to "Poor and unsystematic technology transformation strategies" as a threat were 42(19.27%), while those who strongly agreed were 156 (71.56%).

The survey results also showed that the "Lack of legal backing for universities to adopt 4IR technologies" was one of the threats to the full adoption of 4IR in Ghanaian universities. The responses indicated that 80 (36.70%) agreed while 108 (49.54%) of the respondents strongly agreed. However, only 1 (0.46%) of the respondents strongly disagreed. This resulted in placing the "Lack of legal backing for universities to adopt 4IR technologies" as the 3rd most threatening factor relative to the other identified setbacks.

The "Inadequate skilled and tech-savvy personnel to manage 4IR technologies" was also identified as a barrier to the successful adoption of 4IR in Ghanaian libraries. About 86 (39.45%) of the librarians agreed, while, 105 (48.16%) strongly agreed. To gauge the level of threat this particular challenge poses to 4IR adoption relative to the other eight challenges identified, the RII index placed this factor as the fourth most threatening factor inhibiting the adoption of 4IR in Ghanaian libraries.

The use of 4IR also exposes users to threats of "Privacy issues accompanying the use of 4IR technologies". This is mostly the case when users have little knowledge about the 4IR technologies. As such 87(39.90%) and 104(47.71%) of the respondents agreed and strongly agreed respectively to this particular issue as being a threat to the existence of 4IR technology in Ghana. The relative rank of the severity of this threat was placed at 5th, indicating that it is less of a threat to the adoption of 4IR in Ghana than the aforementioned threats. The least ranked factor among the identified threats was "poor adaptability of library staff to new technologies" This particular factor witnessed an even distribution of agreement and disagreement among respondents, perhaps indicating the arguable nature of the threat and occupying the 7th spot on the RII rank.

Having diagnosed the various threats to the adoption of 4IR in Ghanaian universities, the researchers sought solutions to the threats. As a result, seven different solutions were suggested as depicted in Table 5.

		r	r		r		1	1
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Weighted Total	RII	Rank
Provision of adequate infrastructure to meet the needs of 4IR technologies	0(0.0%)	1(0.46%)	3(1.37%)	58 (26.61%)	156 (71.56%)	1022	0.94	6th
Enactment of cyber security laws to support universities to adopt 4IR technologies	0(0.0%)	0(0.0%)	4(1.83%)	54 (24.77%)	160 (73.40%)	1028	0.94	5th
Introduction of 4IR programs in Ghanaian universities	0(0.0%)	0(0.0%)	2 (0.93%)	24 (11.00%)	192 (88.07%)	1062	0.97	2nd
Provision of a blue print to guide the systematic technology transformation strategies by universities	1(0.46%)	2(0.93%)	4(1.83%)	40 (18.34%)	171 (78.44%)	1032	0.95	4th
Provision of adequate financial resources to fund 4IR technologies by universities	0(0.0%)	0(0.0%)	0(0.0%)	28 (12.84%)	190 (87.16%)	1062	0.97	2nd
Possession of soft skills such as data literacy, adaptability and digital skills by librarians	0(0.0%)	0(0.0%)	1 (0.46%)	21 (9.63%)	196 (89.91%)	1067	0.98	1st
Implementation of nationwide policies to encourage the adoption and training on 4IR technologies by government	0(0.0%)	0(0.0%)	1 (0.46%)	45 (20.64%)	172 (78.90%)	1043	0.96	3rd

Table 5: Solution or Strategies to Encourage the Adoption and Utilisation of 4IR in Ghana.

The study assessed the sense of agreement or disagreement with these identified solutions using the five-point Likert-scale response. The responses then enabled the researcher to rank these solutions from the highly impactful up to the least impactful solution using the relative impact index (RII). The responses are predominantly made up of "agreed" and "strongly agreed", only a handful of respondents disagreed or remained neutral. The responses showed that based on the relative impact of these solutions, "Library staff should possess soft skills such as data literacy, adaptability, and digital skill" with (RII=0.98), emerged as the topmost solution that can enhance mass adoption of the 4IR technologies. This corresponded with agreed responses of 21 (9.63%) and strongly agreed response of 196 (89.91%) indicating that the majority of the respondents agreed to this solution as the surest way to improve the adoption of 4IR at Ghanaian university libraries.

Similarly, the study relied on the responses produced by RII rank and produced "Universities should provide adequate financial resources to fund 4IR technologies at the universities" and "Introduction of 4IR programs in Ghanaian universities" as joint second most impactful solutions based on RII of 0.97. Thus, those who agreed with these solutions were found to be [28(12.84%) and 24 (11.00%)] while the strongly agreed respondents were [190(87.16%) and 192 (88.07%)] respectively. National policy direction could also improve the rate of adoption of 4IR technologies. To this end, 45(20.64%) respondents agreed, while 172(78.90%) also strongly agreed that the "Implementation of nationwide policies to encourage the adoption and training on 4IR technologies" is a solution expected to improve the adoption of 4IR technologies. Based on the relative impact of this solution vis-à-vis the other solutions, it occupied the 3rd position with an RII value of 0.96.

Likewise, when universities put up a tentative plan on how they are going to implement 4IR technologies, it will go a long way to expedite the successful utilization of 4IR technologies. For this reason, 40 (18.34%) of the respondents agreed, while 171 (78.44%) strongly agreed that "Universities should provide a blueprint to guide the systematic technology transformation strategies" thereby placing this solution at the 4th rank. Also, at the national level, government support is needed to facilitate the mass adoption of 4IR in the public tertiary education system. This includes the laws that will authorise and protect the use of certain technologies in the country as well as the privacy of users. As such, 54 (24.77%) and 160 (73.40%) of the respondents agreed and strongly agreed respectively that the "Enactment of cyber security laws to support universities to adopt 4IR technologies" will aid the neutralisation of the existential threats to 4IR adoption in Ghanaian university libraries. However, 4(1.83%) of the respondents sought to remain neutral on using the enactment of laws as a solution. Thus, based on the relative impact index, this particular solution was ranked as the 5<sup>th</sup> after it obtained 0.94 RII value. "Provision of adequate infrastructure to meet the needs of 4IR technologies" was also identified as one of the strategies to ensure the adoption of 4IR technologies. The results showed that 58 (26.61%) agreed while 156 (71.56%) strongly agreed. The RII value of 0.94 placed it as the 6th solution that can help improve 4IR adoption.

# **Discussion of Findings**

Both the bivariate (correlation) and multivariate (multiple regression) outputs in Tables 2 and 3 point to the fact that the adoption of 4IR poses a threat on the performance of library staff. Also, due to the lack of technical know-how among Ghanaian librarians regarding the use of 4IR technologies, the adoption of 4IR will occasion a limitation on the effective work performance of staff. That is why Butler-Adam (2018) noted that there will be some need for retraining to improve the skills of the staff before the adoption of 4IR. With the adoption of 4IR in university libraries, Marshall (2016) noted that the quality of education is highly prone to weaken due to insufficient technological infrastructure and personnel who can adequately manage 4IR systems. Therefore, without the requisite skillset and infrastructure that can support the implementation of 4IR, its adoption in the current state of Ghanaian libraries will be a threat not only to the performance of library staff but also to higher education in general.

One possible strategy for libraries to address these threats is to embrace a culture of innovation and experimentation. Libraries should work to stay ahead of the curve by experimenting with emerging technologies and developing new services and programs that take advantage of these tools. This strategy enables libraries to stay pertinent and adaptable to evolving patrons' needs, simultaneously addressing potential challenges related to workforce displacement and concern about data privacy. Another strategy is to develop partnerships and collaborations with other institutions and organisations. By working together, libraries can leverage their collective resources and expertise to better address the challenges and opportunities presented by the fourth industrial revolution.

The study further surveyed librarians to examine their sense of agreement with the factors that lead to the low adoption of 4IR technologies. The results showed that out of the eight identified factors, the lack of adequate infrastructure to meet the needs of 4IR technologies and the inadequate financial resources to fund 4IR technologies at the universities were ranked as the topmost challenge as far as the adoption of 4IR is concerned. Therefore, to solve this problem, the respondents indicated that library staff should possess soft skills such as data literacy, adaptability, and digital skills, and universities should provide adequate financial resources to fund 4IR technologies are the surest ways through which the full adoption of 4IR in the university libraries as well as the whole Ghana will become a reality.

# Conclusion

The utilisation of technology is dual-natured; it can serve as a force for good or as a potential disruptor of human capital. Consequently, some users approach the adoption of advanced technologies like AI, IoT, and robotics, which collectively constitute the technologies of the fourth industrial revolution (4IR), in institutions like libraries with caution. Given the ambivalent impact of 4IR on human capital, particularly in libraries, this study examined the existential challenges posed by 4IR in Ghanaian university libraries. The findings indicate a significant risk of librarians becoming obsolete with the adoption of 4IR if regular staff training is not adopted.

This study identified eight distinct threats that 4IR poses to libraries, with the most prominent ones being the insufficient infrastructure to support 4IR technologies and the inadequate financial resources to implement 4IR technologies at universities libraries in Ghana. Consequently, the surveyed librarians proposed seven potential solutions to address these challenges and threats.

#### Recommendations

Based on what the paper has found, the following policy-based recommendations are pertinent for libraries in their usage of 4IR technologies.

- 1. To overturn the threatening impact of 4IR on university libraries, the skillset of librarians needs to be upgraded to handle 4IR technologies.
- 2. Also, the lack of funds to acquire 4IR technologies threatens its adoption in Ghana, thus, a common national trust fund could be established by Ghanaian universities to seek support from their alumni, philanthropic organisations, and tech enthusiasts as far as funding 4IR is concerned.
- 3. To further cement the adoption of 4IR which will be beneficial to human capital and libraries, basic digital centres as undertaken by the government should be encouraged. This will serve as a stepping stone to boosting the literacy level of the citizens of technology and for that matter 4IR.

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