

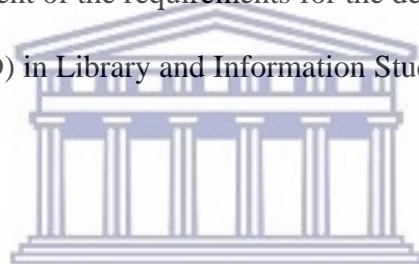
THE READINESS IN SELECTED ACADEMIC LIBRARIES TOWARDS THE FOURTH INDUSTRIAL
REVOLUTION: A COMPARATIVE STUDY BETWEEN GHANA AND SOUTH AFRICA

BY

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A thesis submitted to the Department of Library and Information Science, University of Western
Cape, South Africa in fulfillment of the requirements for the degree of Doctor of Philosophy

(PhD) in Library and Information Studies



Supervisor: Dr. Lizette King

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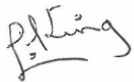
DECLARATION

I declare that this work titled, ‘The Readiness in Selected Academic Libraries Towards the Fourth Industrial Revolution: A Comparative Study Between Ghana and South Africa is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used, have been indicated and acknowledged as complete references.



.....
Noah Darko -Adjei

March 2023



.....
Dr. Lizette King



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March 2023

DEDICATION

This scholarly work is dedicated to the Almighty God for seeing me through this journey, to the Darko and Boateng Families, and to all my loved ones.



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I am eternally grateful to my supervisor Dr. Lizette King, for giving me all the necessary support to make my scholastic dream a reality. My heartfelt appreciation goes to my mentors, Professor Harry Akussah, Prof. Anaba A. Alemna, Prof. E. E. Badu, Prof. Perpetua Dadzie, Prof. Emmanuel Adjei, Dr. Musah Adams, Dr. Philip Kwaku Kankam, Dr. Eric Opoku Osei, Dr. Patience Dzandza Ocloo, Dr. De-Graft Johnson Amenuveve Dei, Dr. (Mrs.) Florence O. Entsua-Mensah, and to all others who in diverse ways contributed to the completion of this thesis.

I am also thankful to the heads of all the various libraries for permitting me to carry out this research in their institutions and to all participants for their input.



ABSTRACT

Disruptive changes precipitated by the 4IR have steadily revolutionized the dynamics of library services delivery compelling libraries to embrace disruptive technologies to stay relevant. The study assessed two advanced academic libraries each from Ghana and South Africa by comparing their readiness in the 4IR.

The study was guided by an adjusted model emanating from the Socio-Technical Theory (STT) and Global Competitiveness Index (GCI) framework. It employed the convergent parallel mixed methods from the post-positivists' perspective using questionnaires and interviews to solicit data from technologically influenced librarians and library directors as well as IT staff whose tasks influence the decision-making of the library. In addition to four library directors, the study obtained 167 respondents from the University of Ghana Balme library and Sam Jonah Library from Ghana as well as the University of Johannesburg library and the University of Cape Town Library from South Africa.



Significant awareness of the 4IR was revealed and it emerged that academic libraries are fairly equipped with 4IR technologies and applications where South Africa appeared better than Ghana. The libraries were poised to incorporate 4IR but with no clear explicit strategies. Among the myriads of challenges, they faced were the fact that they were greatly saddled with a 4.0 skills gap, limited budget allocation, inadequate ICT infrastructure and network facilities, lack of IT priority and support from authorities, lack of Lib 4.0 policies, long bureaucratic processes, lack of data infrastructure, and issues of incompatibility.

In terms of originality, to undertake a comprehensive assessment of academic libraries' preparedness towards 4IR, none of the following factors should be excluded: *Technoware* (4IR technologies and applications and innovation), *Financeware* (source of funds and allocation of funds for 4IR), *Humanware* (retraining, new library staff's skills-set, knowledge and attitude, and innovative leaders), *Patronware* (digital literacy programme 4.0 and 4IR school curriculum), *Orgaware* (structure, tasks, Lib 4.0 policies, procedure, steps, and environment, collaboration and network and change management), and *Infoware* (information access, usage, and interconnectivity).

The study emphasized that academic libraries should perceive the disruptive changes as an opportunity to provide smart library services to maintain the interest of existing technologically savvy library customers, attract new ones, and win back lost ones but not to replace their jobs. It is recommended that embracing 4IR technologies should be context-specific, and without creating digital disparity. Digital transformation is lifelong learning. Hence, librarians should continue to have a growth mindset, learn, relearn, reskill, and upskill and start thinking about the next revolution disruption.

The ongoing digital transformative changes will significantly impact the functions and obligations of academic libraries, necessitating a reinvention of their approaches to remain pertinent and responsive to the ever-changing demands of patrons.

The findings of this study offer original and pragmatic insights, serving as a valuable reference point for future research in the context of the 4IR, particularly within the domain of academic

libraries, which remains relatively nascent and evolving, especially in the context of developing countries.

However, it is essential to acknowledge that the preliminary investigation encountered limitations in acquiring comprehensive information for the selection of advanced academic libraries in two countries. To address this constraint, the researcher resorted to utilizing website information as a means of determining the research settings.



KEYWORDS:

Fourth Industrial Revolution

Transformation

Academic Libraries

Library 4.0

Industry 4.0

Disruptive Technologies

Robotic

Artificial Intelligence

Big Data

Cloud Computing

Virtual Reality

Augmented Reality

Library 4.0 policies

Innovative leaders

Smart Library



LIST OF ACRONYMS:

IR- Industrial Revolution

1IR- First Industrial Revolution

4IR-Fourth Industrial Revolution

GCI - Global Competitiveness Index

STT- Socio-Technical Theory

IFLA - International Federation of Library Associations and Institutions

Lib 4.0-Library 4.0

3D- Three dimensional

IT- Information Technology

OPAC- Online Public Access Catalogue

OCLC- Online Computer Library Center



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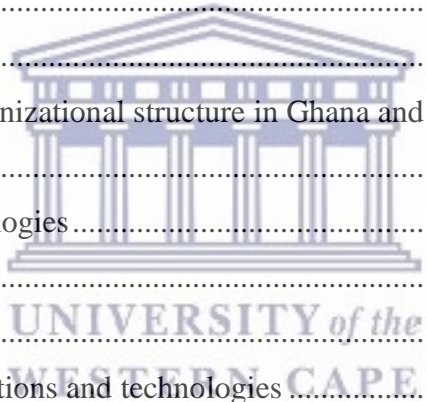
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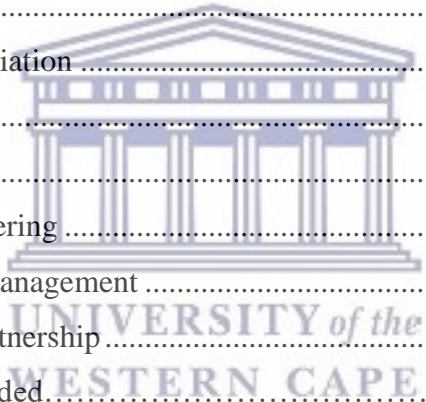


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CHAPTER ONE: INTRODUCTION

1.1 Introduction

As described by Ranganathan (1931) many years ago, the library is a growing organism for the reason that it keeps changing as new technologies keep evolving. This prediction is still relevant today, as witnessed especially in the massive transformation in modern academic libraries due to technological development. This can be traced from the era of Web 1.0 where a gap between libraries and users is bridged through the use of the internet and technological advancements. This study assesses the readiness of academic libraries in the Fourth Industrial Revolution (4IR) by comparing two advanced academic libraries in Ghana and South Africa.

1.2 Background to the study

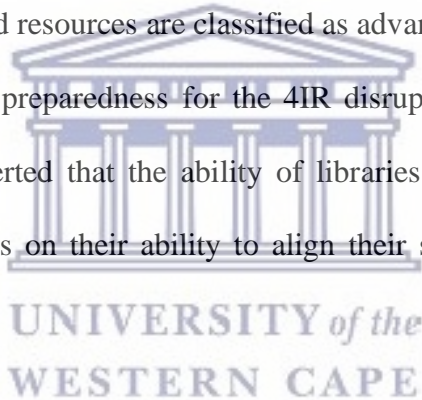
The progressive changes in technology can be traced from the first industrial revolution to the current 4IR. The library is one of the many institutions drastically affected by the 4IR (Ahmat & Hanipah, 2018). Already a couple of years ago, Noh (2015) used the term Lib 4.0 to refer to the changing nature of the internet and the new attributes based on the uniqueness of libraries. Several authors such as Noh (2015), Aghaei, Nematbakhsh, and Farsanim (2012) as well as Biziwe and Mkhathali (2019) have arrived at a consensus that Lib 4.0 is characterized by technological environments to provide virtual spaces for library services resulting in intelligent libraries where machines are able to analyze the information needs of users and decide which information will be relevant to meet those information needs.

Library services offered and the provision of brand-new kinds of information (Gleason, 2018) to meet the varying information needs and demands of library users have some disruptive influences.

In an attempt to address the challenges of the 4IR, the International Federation of Library Associations and Institutions (IFLA) concluded that libraries need to adopt emerging technologies to provide universal access to information and scholarly works, preserve information in all formats, and provide trusted and effective support for political and social engagement (Church et al., 2017). Cronje (2018) posits that libraries should embrace new services like Book to Desk, mobile worklist alerts, and pushing information for academics. As Ahmat and Hanipah (2018) hinted, for libraries to survive in the 4IR era and to support patrons' demands, it is crucial for librarians to equip themselves with multiple new skills and knowledge such as critical thinking, creativity, cognitive flexibility as well as good judgment and decision making. Mauro et al. (2017, p.9) sum it up by stating that, fundamentally librarians should focus on the varying needs of patrons and potential patrons by acquiring skills that will enable them to “identify patterns, apply context and intelligence, extract relevant information hidden in the large volumes of data, design and implement data models and statistical methods”. Manda and Dhaou (2019) admonish that librarians should, however, not forget that in the same manner in which they are preparing for change, library users should constantly be educated in accessing all the new library services offered.

Librarians are speculating that their work will be taken over by artificial intelligence and other related emerging technologies (Hussain, 2019; Ahmat & Hanipah, 2018) resulting in them becoming redundant (Mhlongo, 2019) while Manda and Dhaou (2019) posit that the 4IR is a golden opportunity for libraries to grow astronomically. While the 4IR is being vigorously embraced by libraries in developed economies around the world, it is still in its infant stage in developing countries (Moyo, 2019).

Several authors such as Manda and Dhaou (2019), Manda and Backhouse (2017), and Ahmat and Hanipah (2018) have sought to espouse the apparent challenges lumbered by academic libraries, especially in Africa which have hampered them from fully leveraging digital transformation due to 4IR disruption. Authors such as Ocholla and Ocholla (2020); Marwala (2019) and Botha (2021) shed light that a couple of libraries in South Africa which includes the University of Cape Town library and the University of South Africa have initiated to reinvent themselves with new technologies to harness their service delivery to patrons. A close observation from the University's library's website and information from articles brought to bear their preparedness. Given this, it makes it hard to have a practical view of these libraries' actual current state in embracing disruptive technologies. However, in the case of Ghana, the University of Ghana Balme Library and the Sam Jonah Library whose services and resources are classified as advanced did not reveal any cutting-edge research to ascertain their preparedness for the 4IR disruption. Meanwhile, the study by Hussain (2019) empirically asserted that the ability of libraries to remain active and provide relevant services largely depends on their ability to align their services and products with the design principles of the 4IR.

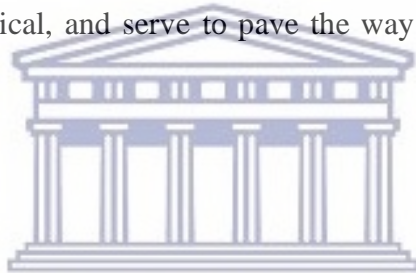


It was therefore critical to determine the preparedness of the academic libraries in Ghana and South Africa towards the 4IR with its inevitable disruptions and to propose responsive strategies to help them reposition themselves to benefit from the technological advancement and stay relevant in the digital transformation era.

Aside from having a bigger picture of the preparedness of academic libraries towards the 4IR which influenced the selection of two countries, it will be more practical to generalize the findings

from a wider view instead of focusing on a country or a single academic library. For the four academic libraries selected from both countries, the nature of the services they provide and the resources available at their disposal were observed and compared with other related academic libraries. Also, a preliminary investigation of the various libraries influenced the selection of the research settings. To avoid bias, it was imperative to do a comparison of these selected libraries from different countries based on institutional policies, organizational styles, organizational cultures, organizational structure, governance, and level of IT infrastructure.

Even though the study was limited by the fact that the criteria for selecting the research settings were based on website description and limited information from the preliminary investigation, the findings are timely, novel, practical, and serve to pave the way for further studies on 4IR and beyond.



Development stages of LIB 4.0

The development of Lib 4.0 can be linked to that of the industrial revolutions which started from the 1IR through to the 4IR (Noh, 2015). Bongomin et al. (2020) observed that a new industrial revolution comes with an upgrade from the previous generation and the introduction of novel technologies and their associated forms of applications. The findings of scholars in the information field have made critical developmental guidelines for future libraries, as the concept of 4IR technologies appears to cause an unprecedented influence on society (Hussain, 2019; Frederick, 2016). It is also known from the literature that the philosophy of the development stages of Web 1.0 to Web 4.0 is comparable to that of Lib1.0 through to Lib 4.0 (Shukla & Tripathi, 2018). There have been progressive major developments in libraries from Lib 1.0 through to Lib 4.0. Every

stage brought to being technological innovations that enhanced information provision and services in the various facet of the library (Noh, 2015). The major chronological developments and their impact on libraries are depicted in Figure 1.1:

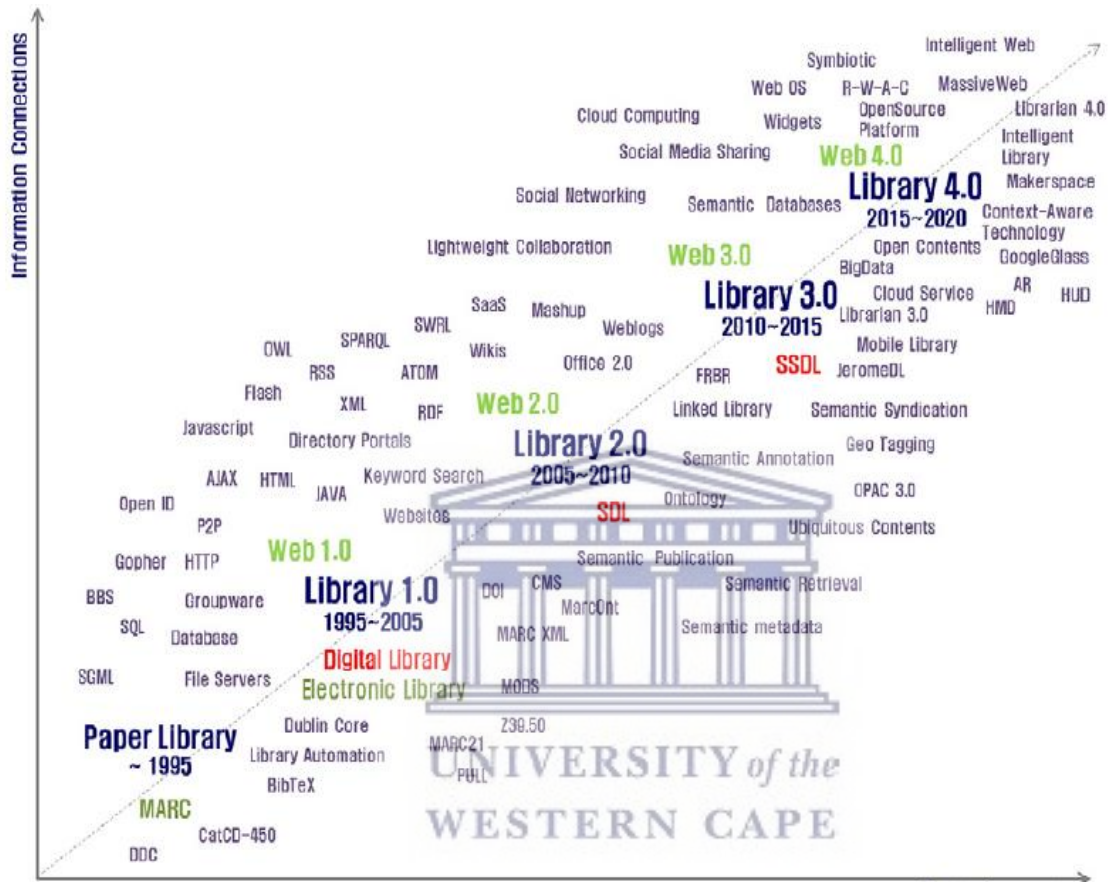


Figure 1.1 Development process of Library 4.0. (Noh, 2015)

Library 1.0

The term “Library 1.0” began to be used for comparison when the term “Library 2.0” was introduced by Michel Casey (Noh, 2015). Library 1.0, also known as Lib 1.0 was defined based on the way library resources are physically kept on shelves thus, it “only allows for unidirectional flow of information” (Shukla and Tripathi, 2018, p.1). According to Curran, Murray and Christian

(2017), Lib 1.0 was mainly characterized by where library resources were kept on shelves, how they were kept, and how they were checked in and checked out. Thus, Lib 1.0 was seen to be a one-directional service. From 1995 to 2005, paper-based libraries were largely complimented with electronic resources such as machine-readable catalogues (MARC), databases, and file servers ushering in an era of hybrid libraries which mostly combined the traditional library services (mostly books in hardcopy format) with the electronic or digital library.

Library 2.0

Between 2005 and 2010 the Internet as a gateway to information caused a major development in libraries resulting in the era of Library 2.0 or Lib 2.0 (Noh, 2015) and the provision of information to library users via the Internet. “Library 1.0 only allowed for a unidirectional flow of information while Library 2.0 provided a multidirectional flow of information as well as it is a read/writes type library that gives users the power to decide the service they get” (Shukla & Tripathi, 2018, p.1). Maness (2006) and Cho (2012) observed that Lib 2.0 was characterized by multimedia web-based technologies and social networks implemented in library services and collections making library service delivery more interactive and collaborative. Kwanya, Stilwell, and Underwood (2013) concluded that Lib2.0 made the library human, ubiquitous, user-centered, and flexible. Access to information, resources sharing, and reaching out to large audiences or customers became easy. Channels such as wikis, blogs, podcasts RSS, social bookmarking systems, tags, public and private profiles as well as the Online Public Access Catalogue were used to bridge the gap between librarians and their patrons. These tools were also used to reduce barriers to access to information and create an avenue for the involvement of patrons in deciding the kind of services or information resources they required. (Cho, 2012). Besides, search engines and search capabilities of online

databases made information retrieval quicker, more efficient and more effective (Kwanya, Stilwell & Underwood, 2013).

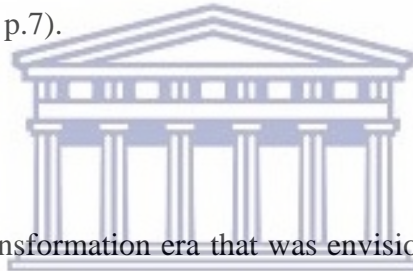
Library 3.0

Library 3.0 / Lib3.0 became widely accepted from 2010 to 2015 when modern libraries were generally regarded as “intelligent libraries” due to the implementation of artificial intelligence to offer information services to users “based on what the users mean; not what they say” (Kwanya, 2014, p.1). Lib 3.0 is an era characterized by the use of emerging technologies including the semantic web, mobile devices, cloud computing, and tools like federated search systems to facilitate the development, organization, and sharing of user-generated content through seamless collaboration between users, experts, and librarians (Belling et al., 2011; Noh, 2016). Kwanya, Stilwell and Underwood (2013, p.87) described Lib 3.0 as a “personalizable, intelligent, sensitive and living institution created and sustained by a seamless engagement of library users, librarians, and subject experts on a federated network of information pathways”. Technologies were able to help patrons to locate, evaluate, synthesize, and utilize relevant information from myriads of sources. According to Breeding (2008), Lib 3.0 introduced a full-text, fully integrated, and comprehensive search environment which is comparable to searching inside a book as opposed to searching for the book. Lib 3.0 also emphasized marketing, promoting, and offering library services virtually and ultimately making its collections accessible, searchable, and usable (Kwanya, 2014).

Library 4.0

According to Noh (2015, p.10) library 4.0 or Lib 4.0 emerged between 2015 and 2020 and has widely been described as “intelligence-based, massive data, augmented reality, context-aware,

cutting-edge displays, and infinite creative space”. Lib 4.0 technologies and applications such as Augmented Reality, State-of-the-art Display Cloud Service Open Source, Big Data, robotic services, simulation prototypes, 3D printing, AI, and Blockchain direct the focus of library services. As an imminent intelligent library, not only inference and research are available, but the system will analyze information by itself and discuss findings with users like a colleague (Aghaei, Nematbakhsh, & Farsanim, 2012). Consequently, Librarians 4.0 must constantly update themselves to meet the information needs and demands of users (Kamble, Gawankar & Gunasekaran, 2018). Lib 4.0 has been ascribed as a place where librarians, users, and machines coexist (symbiotic web), and “librarians, users, and machine can read-write, execute, and concur at the same time a library that thinks, makes decisions and provides library services using reasoning (intelligent library)” (Noh, 2015, p.7).



Library 5.0

Lib 5.0 is a visualized digital transformation era that was envisioned based on the impact of Lib 4.0 and it is expected to be more community-centric, highly digitized, and intelligent intelligent-based human-customized services (Noh, 2022). In the epoch of Lib 5.0, disruptive technologies will be used to personalize user experience and enhance community engagement for academic libraries to succeed. It will be more synonymous with a symbiotic web where librarians, users, and machines will coexist in a digital space and it will be incumbent on the part of the academic library to reinvent into learning and innovation centers that support creativity, entrepreneurship, and lifelong learning in the era of Lib 5.0 (Noh, 2022; Lee, 2021) and continue to critically analyze new workable strategies and effective line of directions, paying close attention to trends and challenges and applying pragmatic solutions based on local context.

Even though the concept of Lib 5.0 was coined in 2021, it is still at the infant stage and few studies so far are accentuated on visualized disruptions that are expected to occur and much concentration is on Lib 4.0 with disruptive changes being felt drastically. Among the few studies, Noh (2022) asserted that the recent explosion of the novel concept known as “Metaverse” will be part of the element of Lib 5.0. The word “Metaverse” is a compound word consisting of “meta,” meaning transcendence and virtuality, and “universe,” meaning the world and the universe. The author empirically envisioned that the onus lies in the library to utilize virtual technologies to shape library services to meet the modern demand of patrons.

This section of the thesis chronicles the various digital transformations from the era of Lib 1.0 to Library 4.0 and shared light on the anticipation of Lib 5.0 which is still in the developmental stage. Every stage has unique characteristics; while Lib 1.0 is characterized by unilateral interactions, Lib 2.0 is a user-centered service that provides a multidirectional flow of information with the internet, the gateway to information. Lib 3.0 centered on “intelligent libraries” where smart emerging technologies began to dominate. Lib 4.0 fully dwells on an intelligent library where machines, patrons, and librarians co-exist. While both Lib 4.0 and Lib 5.0 centered on intelligence with disruptive technologies such as the Internet of Things, Augmented and Virtual reality, robotics, artificial intelligence, blockchain technologies, cloud computing, and big data, Lib 5.0 provides data and intelligent-based human-customized services, removes redundancy by converging and applying these disruptive technologies to provide smart library services.

1.3 Rationale for the study

Manda and Dhaou (2019) as well as Petrillo et al. (2018) reflected in their respective studies on the future, challenges, and opportunities of Lib 4.0, mostly in first world countries. The same cannot be said of academic libraries in Africa as there is a paucity of literature on their readiness for 4IR. As this transition is critical for Ghanaian and South African academic libraries, it would be imperative to determine their level of preparedness. The readiness (or lack thereof) towards the digital transformation in the 4IR is crucial in seeing a holistic picture of the current situation. This will create the necessary avenue in proffering necessary recommendations and actions to be taken in bridging the gap. Also, it will enable academic libraries to prepare adequately in diverse ways to face the disruptive changes of the 4IR. This is essential since academic libraries that do not embrace technology and prepare steps towards addressing disruptive changes of the 4IR face an eminent risk of becoming redundant.



1.4 Theoretical perspective

The Socio-Technical theory was adopted to guide and underpin this study. The theory is based on the fact that behavioral and social elements in the implementation of any new systems should not be overlooked otherwise the new technology will not achieve its ultimate purpose (Bostrom & Heinen, 1977). The theory states that to successfully adopt any technology, it is imperative to consider and understand the social and technical environment in which they operate in the smart society. Thus, they should not be considered as a separate strand, but as an integrated whole. Therefore, the variables within the social system such as the structure and the people who are going to be involved as well as the technical system, technology, and the task were considered. All these variables interconnect to ensure a successful digital transformation.

Conceptual framework

To direct the focus of the study, the researcher also adopted the Global Competitiveness Index (GCI) developed during the World Economic Forum in 2016 for measuring the readiness for the 4IR. The GCI 4.0 is a standardized criterion that was developed using 140 economies. It is succinctly defined as the set of institutions, policies, and factors that determine the level of productivity (Schwab, 2016). The GCI has twelve pillars (constructs) but based on the research objectives and questions and the present focus of this research on academic libraries, the researcher chose to consider the following four constructs of Innovation which include Infrastructure, Technological Readiness, and Higher Education and Training as critical to this study. These constructs and sub-elements were selected to serve as a basis for measuring the extent to which academic libraries are able to stay relevant amid rapid technological change. Chapter three (3) of the thesis elaborates on the details of the theory and conceptual framework applied in the study.

1.5 Literature overview

An overview of the literature indicates that although 4IR has been researched extensively and much has been written on the 4IR, little research has been done on its effect on libraries and in particular, academic libraries. A few studies have focused on the preparedness of libraries in general (Ahma & Hanipah, 2018; Frederick, 2016). Some South African studies have focused on the readiness of South African academic libraries to research, teach and support the 4IR (Ocholla & Ocholla, 2020) the 4IR and library practices in South Africa (Cronje, 2018; Frahm-Arp, 2019), strategies for South African public libraries to bridge the digital divide (Mphidi, 2016; Ocholla & Ocholla, 2019) and the launch of an application providing one-click access to library resources (University of Pretoria, 2020). Surprisingly no research focusing on Ghana has been captured to

date. The literature review chapter of the thesis provides an extensive and critical review of studies conducted on academic libraries and the 4IR.

1.6 Problem statement

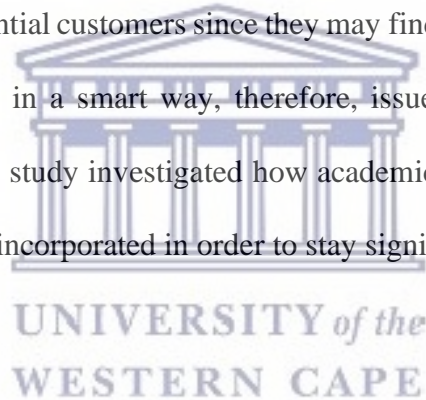
The extant literature (Tella et al., 2022; Ocholla & Ocholla, 2020; Mohideen, 2020; Frahm-Arp, 2019; Hussain, 2019) has indicated that disruptive changes caused by the 4IR has affected almost every facet of human life and that the library is not immune to this phenomenon. Several authors such as Du Toit (2019), Attaran and Stidham (2017), as well as Ocholla (2016), have further revealed that the impact on the library is colossal as librarians need new skill-sets, intelligent technologies, innovative ideas, new organizational flow as well as a growth mindset to stay relevant by offering smart library services. Therefore, the library should act with urgency to prepare adequately for the disruption.

At the World Economic Forum in Davos, Switzerland, Klaus Schwab explicitly divulged that the impact of 4IR, his brainchild, will include research and libraries (Ocholla & Ocholla, 2020). In spite of this assertion, limited research has been done to reflect the true picture of how academic libraries are coping and preparing for the disruption.

In addition, the majority of the aforementioned studies were desktop research which dwelled on the data gathered from the websites of the chosen institutions and desktop literature reviews. This study focused on cutting-edge research where data was obtained directly from participants — professionals library staff members of academic libraries — to obtain real-life practical findings. As far as the researcher could determine, no study employing a mixed-method approach to obtain

detailed but concrete empirical evidence focusing on academic libraries in Africa has been done. A comparative study between South Africa and Ghana regarding the 4IR and academic libraries has also not been done. Studies that combined different research sites were within the same country. Cao, Wu and Stvilia (2020) compared research sites in China, Ocholla and Ocholla (2020) compared sites in South Africa and Akparobore, Omosekejimi and Nweke (2020) in Southern Nigeria.

Africa is already hampered by technological challenges to accessing information. It is believed that this situation may exacerbate if guidelines on preparing for the disruptive changes due to the 4IR are not provided. Not only will the services of academic libraries end up becoming irrelevant but also lose its existing and potential customers since they may find better alternatives like Google to meet their information needs in a smart way, therefore, issues relating to 4IR in academic libraries cannot be ignored. This study investigated how academic libraries are preparing for the 4IR and the best strategies to be incorporated in order to stay significant amidst digital disruption.



1.7 Research objectives

The objectives of this study are to compare the readiness in selected academic libraries in Ghana and South Africa for the 4IR and to develop responsive strategies toward disruptive changes.

1.8 Research questions

From the research objectives, the study sought to answer the following research questions:

1. What are academic librarians' awareness and knowledge about the 4IR?
2. Which Lib4.0 technologies and applications are used in Ghana and South Africa?
3. What is the level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies?
4. What challenges do academic libraries face in incorporating 4IR technologies?
5. Which responsive structures and policies are in place for disruptive changes?
6. What are the available actions toward the disruptive changes?
7. Hypothesis Testing:
 - a. What is the relationship between technological readiness and innovation readiness?
 - b. What is the relationship between training on new technologies and interest in newly adopted technologies?



1.9 Research design and methodology

The post-positivist paradigm was chosen to guide this study. The choice of this paradigm was fueled by the fact that it highlights a proper understanding of the directions and perspectives of any research study from multi-dimensions and multi-methods (Panhwar, Ansari & Shah, 2017; Guba, 1990). This study employed a mixed approach using both qualitative and quantitative methods. According to Creswell (2018), mixed methods give the latitude for researchers to gather diverse data and to holistically establish a better understanding of the research problem which was

investigated. The study adopted the cross-sectional survey where data collection was done at a particular point in time reflecting Lib4.0 developments (Creswell, 2018).

1.9.1 Population

As this is a comparative study, the research sites were the two most technologically advanced libraries in Ghana and South Africa. Ghanaian academic libraries selected were the University of Ghana and the University of Cape Coast. For South Africa, the academic libraries of the University of Johannesburg and the University of Cape Town were selected. Not all staff members in academic libraries are equally influenced by technological changes, thus, only certain positions were targeted resulting in a total population of 207. The entire population was used for the study, therefore, there was no sampling technique as well as sample size.

1.9.2 Data gathering instruments

Since the research sites are geographically far apart, an online questionnaire created using Google Forms containing both closed and open-ended questions was used to gather data (Appendix A - Questionnaire). Questionnaire questions were aligned with the objectives and research questions of the study. The set of questionnaires were distributed via emails to the identified library staff. After the data collected was analyzed, directors of libraries were interviewed through Zoom and Microsoft teams to obtain richer, more detailed data where needed (Appendix B – Interview schedule). Appointments were made prior to the interviews. The reliability and validity of the quantitative data collection instrument were tested using Cronbach’s alpha coefficient.

1.9.3 Analysis of data

For the quantitative analysis, data from completed questionnaires were captured and analyzed using the Statistical Package for Social Science (SPSS) version 25.0 supported by Descriptive and inferential statistics were obtained, and data were presented in graphic, tabular, and textual formats. For qualitative analysis, the principles of thematic analysis (Braun & Clarke, 2012) was used. The research design and methodology have been carefully detailed in chapter four of this thesis.

1.10 Ethics statement

The researcher strictly adhered to the rules and regulations governing research as stipulated by the University of Western Cape (UWC). After official ethics clearance was obtained from the UWC Research Office (Appendix C Ethics clearance letter), permission to research the various academic libraries identified as research sites were sought (see Appendix D – University of Johannesburg, Appendix E –University of Cape Town, Appendix F – University of Ghana and Appendix G- University of Cape Coast). Informed consent to complete the questionnaire or partake in the interviews was obtained from all respondents (Appendix H – consent letter) after they were informed in detail about the study (Appendix I – Information letter). Respondents were assured of confidentiality and anonymity, and their right to decide to withdraw from taking part in the research was duly considered. The participants were also assured that the responses will be used for academic purposes only. The research was devoid of modification and falsification of data.

1.11 Significance of the study

The study was forestalled to be significant in several ways. The findings of this study have helped to know the readiness of academic libraries towards the 4IR and how they can incorporate new technology and development in library services. The proposed guidelines in this research have provided valuable insights for policymakers, stakeholders, and library management to make well-informed decisions concerning the adoption of 4IR technologies in academic libraries. The study has shed light on the required skillsets and attitudes necessary to effectively implement these technologies and enable their successful integration. Within the academic domain, the study's findings have addressed a critical knowledge gap in a cutting-edge research area, thus paving the way for future investigations. The objectives of the study not only offer a framework to assess libraries' readiness for the 4IR but also establish a robust foundation for exploring the implications of the Fifth Industrial Revolution (5IR).

Overall, the significance of this thesis lies in its potential to inform policymakers, educators, and stakeholders about the state of academic libraries in Ghana and South Africa concerning the Fourth Industrial Revolution. It can offer valuable insights to guide strategies for libraries' adaptation to the changing technological landscape and support the advancement of higher education in the context of the 4IR.

1.12 Delimitations and limitations

The study was undertaken using two academic libraries from both Ghana and South Africa. Despite the myriads of academic libraries, the study was saddled with insufficient funds and a limited time frame to complete the research, focusing on the advanced libraries where staff were

in the best position to provide data for the study. The author relied on website information in selecting advanced libraries for the study since little information was known during the preliminary investigation. Non-responses due to the busy work schedules of some subjects especially in South Africa and the adverse impact of the COVID-19 influenced the full participation of some respondents.

1.13 Chapter outline

Chapter One (1) provides background and motivation for the study

Chapter Two (2) critically reviews relevant and related literature

Chapter Three (3) discusses the theoretical perspective and conceptual framework employed to underpin the study

Chapter Four (4) elucidates the research design and methodology

Chapter Five (5) presents quantitative data in a graphic, tabular, and textual format.

Chapter Six (6) captures qualitative data

Chapter Seven (7) discusses the findings

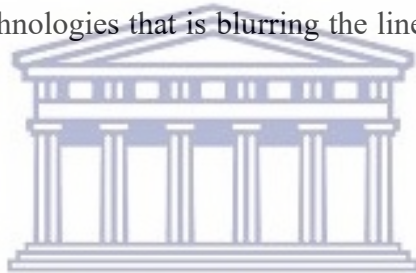
Chapter Eight (8) provides the summary of findings, draws a conclusion, and makes recommendations

1.14 Definition of terms and concepts

This section throws light on the main terms and concepts used in the study. Many of these concepts will be discussed in detail as part of the literature review as well.

Fourth Industrial Revolution (4IR)

The 4IR, a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum, has no universally accepted definition but describes a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives (Xu, David & Kim, 2018; Schwab, 2016), resulting in extreme changes in economic systems and social structures (Ahmat & Hanipah, 2018, p.56). According to Manda and Dhaou (2019), it is a collective term for technologies and concepts of value chain organization including cognitive computing and artificial intelligence, advanced (autonomous) robotics, cyber-physical systems, the Internet of Things, virtual reality, big data, advanced analytics, cloud computing, and Blockchain technology. Schwab (2016, p. 1) also described the 4IR as an era characterized by a “fusion of technologies that is blurring the lines between the physical, digital, and biological spheres”.



Internet of Things

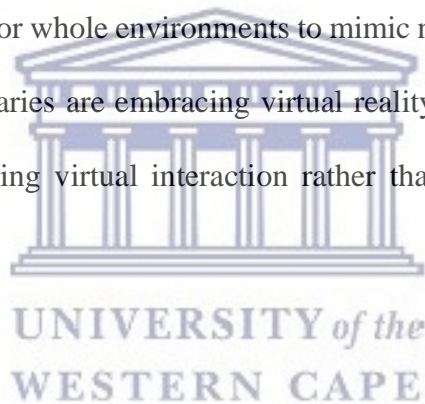
The Internet of Things, in simple terms, is the interconnection of physical devices with unique identifiers or Internet protocol addresses to collect and share data with little or no human intervention (Ranger, 2020). The ‘things’ can be electronic sensors, actuators, other digital devices, or any other objects (Bongomin *et al.*, 2020, p.3). An example is in libraries where books are not available for circulation and are assigned special codes resulting in the alarm being tripped by the automated system when the book is returned (Pujar & Satyanarayana, 2015).

Cognitive computing and artificial Intelligence

Artificial intelligence is a paradigm where physical and social phenomena are programmed to solve complex problems and to work as human beings with or without human effort (Tehseen et al., 2020). It can also be explicated as technology capacitating machines to be intelligent, for example, to reason like a human. For qualitative service delivery, libraries have embraced cognitive computing in general and artificial intelligence in particular (Vijayakumar & Sheshadri, 2019, p.1; Liu, 2011).

Virtual reality

According to the American Library Association (2020) and Liu, 2011, virtual reality is computer-generated simulations of images or whole environments to mimic natural realities and experiences through digital technology. Libraries are embracing virtual reality technologies to enhance their services by, for example, allowing virtual interaction rather than visiting the physical library (Oyelude, 2018).



Big data

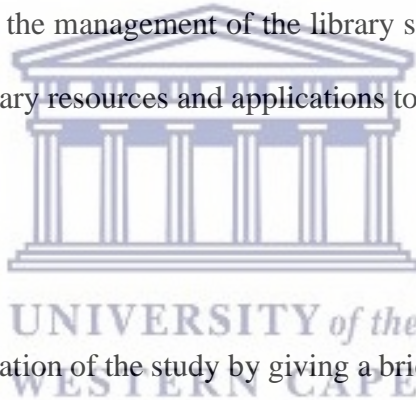
Big data refers to the effective storage, management, retrieval, and evaluation of a large number of data sets in various formats requiring very fast internet connections (Rafael, 2019) and software to organize and process due to its unpredictability and unstructured nature (Olendorf & Wang, 2019). As data becomes the new currency of the 4IR, expertise concerning big data will be needed (Frahm-Arp, 2019). Sengupta (2019) listed big data tools to be used in academic libraries and concluded that they can be used to determine the impact of research and to assist in library administration, for example, collection development by tracing the use of library material.

Advanced (autonomous) robotics

A robot is used in diverse ways which makes it difficult to come up with a general definition. In generic form, it has been widely defined as “a device that works on behalf of a human, which automatically and continuously performs some steps or procedures” (Harada, 2019, p.1). In the library field, a Semi Humanoid Robot “Pepper” is used as a library guide to, for example, direct patrons to the various sections of the library.

Cloud computing

Cloud computing is a service provided to users to remotely access resources and applications over a network environment either on-demand or pay-per-use fashion (Bongomin *et al.*, 2020). In a library environment, it is used in the management of the library system where access is provided to patrons to remotely access library resources and applications to meet their information needs.



1.15 Concluding summary

This chapter highlights the foundation of the study by giving a brief introduction and background. It provides a short description of the theoretical perspective and conceptual framework which underpin the findings of the study. It also discusses the problem statement which serves as the motivation of the research and brings to light the backdrop that fuels this study to be undertaken. The chapter succinctly captures the objectives as well as the research questions of the study and a short description of the significance of the study. It is then followed by a concise elucidation of the research design and methodology, the limitations, delimitations of the study, and as well as the ethics statement which governs the study right from the proposal stage to the various chapters of this thesis. This chapter finally provides the outline of the various chapters which gives a holistic

structure of the entire thesis as well as short definitions and discussions of the terms and concepts used in the study.

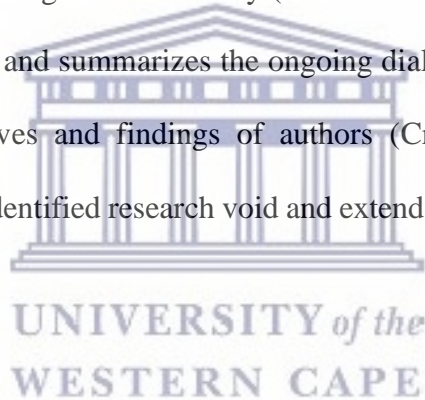
The next chapter focuses on the literature review which gives an account of related studies pertinent to the various research questions of the study.



CHAPTER TWO: LITERATURE REVIEW

2.1: Introduction

Research is usually highly impossible to be undertaken without a reference to the previous relevant related subject matter (Creswell, 2018). The literature review attempts to broaden the horizon of the focus of the study through a chronicled discussion of themes using pertinent studies from different authors (Creswell & Creswell, 2018). According to Neuman (2011a), a literature review is based on the assumption that knowledge accumulates and that people learn from and build on what others have done. It serves to provide an overview of the particular topic, identify areas already researched, identify gaps in research about the topic under study, and demonstrate how the study will fit in with the existing larger field of study (Clark & Creswell, 2014). It also critically evaluates, analyzes, synthesizes, and summarizes the ongoing dialogue about a particular subject matter from different perspectives and findings of authors (Creswell, 2018; Cooper, 2010). Besides, it attempts to fill in an identified research void and extend prior studies (Creswell & Poth, 2017).



The literature review of this study captures the worldview, African view, and then views of Ghanaian and South African authors. The following subtopics were addressed under the literature review:

- i. Overview of the 4IR
- ii. Academic librarians' awareness and knowledge about the 4IR
- iii. Lib 4.0 technologies and applications used in academic libraries
- iv. Level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies

- v. Challenges academic libraries face in incorporating the 4IR technologies
- vi. Available structures and policies in place towards 4IR disruptive changes in academic libraries
- vii. Actions towards 4IR disruptive changes in academic libraries

2.2 Overview of the Fourth Industrial Revolution (4IR)

The world has witnessed precipitous changes in the 21st century spanning from the way of life to the technologies that emerged (Bongomin et al., 2020). Retrospectively, the 4IR has evidently affected almost every facet of human life, especially in the area of medicine, communication, government, transport, sports, food, and agriculture education (Marwala, 2019; Xu, David & Kim, 2018). The library and information services are not unaffected by this disruption. The conventional understanding of the library is steadily changing (Ranjan & Singh, 2018) as “libraries are becoming less about the brick and mortar and more about access to knowledge in digital space” (Marwala, 2019, p.1). These changes, according to the lens of some scholars in the library field argued that they are regarded as a double edge sword. For instance, Schwab (2016) postulated that the 4IR brings promise and peril for humanity, therefore, it is expedient to anticipate what is unknown and strategically make provisions before the changes eventually happen. Global Business Coalition for Education (2020) described the 4IR as “an incoming thunderstorm” hence, all sectors of an economy need to prepare strategically because its impact will be immense. Consequently, Warren (2020, p.2) says that as the 4IR disruptive change is inescapable, his practical advice in tackling this issue is to “plan for the worst, hope for the best, and be opportunistic”. Planning for the worst according to the author means academic libraries should take critical risks analysis, delve deeper into the future possibilities and their inherent challenges,

and have the full understanding to make prudent decisions to curtail the change. Hoping for the best means employing the strategic positive approach in dealing with the uncertainty of the 4IR and all in all, academic libraries should endeavor to leverage all challenges imposed by destructive technologies.

Currently, “the 4IR is building on digital technology as data and knowledge become the premium commodities for innovative solutions; as people, machines and locations become hyper-connected and lines between digital, physical and biological realities blur” (AFLIA, 2020) even though the library is at the dawn of the 4IR (Kim, 2020). On the contrary, Tella (2020a) argues that the impact of the 4IR has already been felt, therefore, there is no need to dream or imagine how the disruptive changes will affect libraries. In the same token, Hattingh (2018, p.1) maintained that the future is already here therefore “It is not correct to talk about the future world of work”. In light of this, libraries should wake up quickly to strategically respond to the demand of the 4IR. Ocholla and Ocholla (2020) maintained that the COVID-19 pandemic where lockdown was mandatory and discouraged physical meetings to avoid the spread of the novel virus epitomizes the reality of how the 4IR will be where patrons should be able to access library resources digitally anywhere without worrying about been physically present. These findings were echoed by Mhlanga and Molo (2020) who found that, during the outbreak of COVID-19 when the lockdown was necessitated, various forms of 4IR were swiftly implemented by various institutions across the world. South Africa, for instance, has been hailed by several authors for leading 4IR in Africa. Emphasizing these findings Ayinde and Kirkwood (2020) explored rethinking the roles and skills of information professionals, in the 4IR. The study highlighted a great opportunity for librarians to embrace the various 4IR tools to provide innovative support to patrons to meet their information needs. Besides, the

disruptive changes on the job, during the world economic forums in Davos, Switzerland, Klaus Schwab, Founder who doubles as the Executive Chairman of the World Economic Forum, in 2016, empirically found that with the disruptive changes of the 4IR in mind, 65% of students in the basic level will end up in jobs which are not in existence. That is yet to be created (Hussain, 2019; Ocholla & Ocholla, 2020). Several authors (Manda & Backhouse, 2017; Ocholla & Ocholla, 2019; Hussain, 2019; Warren, 2020) have concluded that the impact of the 4IR is unprecedented and in whirlwind pace and when strategic actions are not quickly put in place to embrace its inherent destructive changes, not only will services of affected information professionals become redundant but will eventually hamper the drive for economic growth in the long run. This proposition is directly in line with Noh (2015) who claimed that libraries and librarians will vehemently be affected by the changes initiated by the 4IR in terms of services and marketing. The author posits that libraries are changing agents of the 4IR and later cautioned that if they do not quickly upgrade themselves and their services, will result in many challenges such as an alarming rate of unemployment will become evident. It is also synonymous with findings by Gaspar, Juliao and Cruz (2019) indicating job losses as a great caution to employees in the 4IR. In the same token, Frey and Osborne (2013) investigated the future of employment and how susceptible jobs are to computerization and found there is a high risk of jobs lost due to the quick rise in technological changes. These possible employment risks were evident in a later study by Frey et al. (2016) where it was revealed that there will be about 57% of jobs lost globally as a result of technological innovation.

In light of this, Frahm-Arp (2018, p.1) alerted all librarians to the fact that they need to embrace what the world of work looks like in this 4th Industrial Age. New opportunities for libraries include

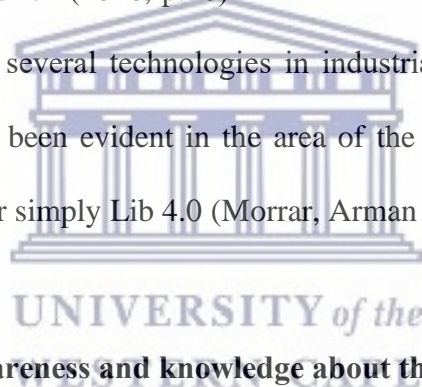
Uber; Book to desks (B2D) for academics; Mobile worklist alerts; and push information for academics. Frahm-Arp (2019) also added that even in this uncertainty, academic libraries will continue to play a pivotal role in the success of any university or research unit, therefore, academic institutions must focus on how their libraries can be technologically equipped to enable active provision of relevant library services to information seekers. Liu (2011) agrees by indicating that the implication of the 4IR with Lib 4.0 applications such as artificial intelligence and robotics should rather be seen as supplementary to the library service instead of threats.

Origin of the 4IR

Historically, Darwinists, to a great extent educated by Charles Darwin's fundamental work, "The Inception of Species", written in 1859, broadly hold the view that human society has changed from tracker/finders to the agrarian-a/rural society, to the modern and post-mechanical or data and information social orders (Ocholla & Ocholla, 2019; Mohideen et al, 2022). Chronologically, due to the societal and economic transformations, the 4IR popularly known as Industry 4.0 or 'Industrie 4.0' was coined (Schwab, 2016). The term 'Industrie 4.0' or Industry 4.0 was generated from Germany's ten 'target items of a high-tech strategy action plan of a 2012 project (Kamble et al, 2018; Ranjan & Singh, 2018). In early 2011 in Germany, it appears that the most common term used at that time was 'Industrie 4.0' (Schafer, 2018). Later, a thorough search using Boolean operators revealed that the "fourth industrial revolution" was found on the website of several industries, media, government, and universities website outside Germany and interestingly a search on YouTube alone discloses over 20,000 search hits about the Fourth Industrial Revolution. As a result of this development, it alerted the world with a belief that the world has transitioned to

another phase of industrial development “fourth industrial revolution” or Industry 4.0 (Frederick, 2016; Gaspar, Juliao & Cruz, 2019).

The 4IR focuses on the manufacturing of products using sophisticated information technology. This attention eventually brought about the so-called “smart industry” which is characterized by increasing automation, digital transformation, and adaptability to new technological changes, or demand (Kamble et al, 2018). The authors further emphasized that Industry 4.0 by characterized by technologies such as artificial intelligence, Internet of Things (IoT), virtual and augmented reality, robotic systems, big data, cloud computing, simulation prototypes, 3D printing, Context-Aware Technology, embedded systems, cyber-physical systems, data acquisition/handling, Makerspace, Open Source. Frederick (2016, p.10) revealed that “the 4IR is considered to be the outcome of the convergence of several technologies in industrial operations”. The destructive changes by the 4IR have vastly been evident in the area of the information provided which is popularly known as library 4.0 or simply Lib 4.0 (Morrar, Arman & Mousa, 2017).



2.3: Academic librarians’ awareness and knowledge about the 4IR

It is evident that the government, academia, and the industry are jointly working assiduously to prepare current and future work scenarios as the disruptive changes brought by the 4IR are inevitable (Penprase, 2018). The World Economic Forum predicted in 2016 already that by 2021 over one-third of skills that are cardinal in today’s workforce will have changed (Gaspar, Juliao & Cruz, 2019). Whether libraries become aware or not, the disruptive changes of the 4IR will surely be manifested (Tella, 2020a). Howard et al. (2018) emphasized that the fundamental focus of the library should be on future awareness to prepare strategically and fully for the unknown. Libraries

need to steadily change from passive to active involvement in the provision of library services (Chigwada & Nwaohiri, 2020).

Several authors (Gaspar, Juliao & Cruz, 2019; Ntlotlang, 2019; Penprase, 2018) have brought to light that, libraries are now making a conscious effort to create awareness about the 4IR and its inevitable disruptive changes through workshop training and consultative meetings. This effort is not only directed to library staff but also stakeholders, policymakers, donors and philanthropists, and government officials. According to Gaspar, Juliao, and Cruz (2019, p.8), it was postulated that “the ability to correctly interpret and perceive these changes will allow current and future workforce gains a higher level of awareness to prepare and adapt and allow the organizational alignment with such work paradigm change”. The authors further admonished that, social-relational skills (such as emotional intelligence or negotiation abilities) intercultural and communicative, collaborative, and digital skills should be the core focus of libraries to invest in as they welcome the unavoidable disruptive changes of the 4IR.

Hussain (2019) investigated the industrial revolution 4.0 and its implication on libraries and librarians and found that librarians were aware of the impact of the 4IR. The study, however, concluded that all librarians should be proactive to constantly prepare themselves to face the inevitable disruptive changes to keep their jobs and to stay relevant in providing library services to their patrons. Similarly, Tella (2020a, p.1) asserted that “libraries will need to be aggressive and review their resources and services so that they will be relevant, have a place and be functional in the 4IR era”.

Frederick (2016) also affirms that several librarians are aware and have some level of knowledge of the 4IR, however, few are aware of how the application of the 4IR can be fully applied to heighten the provision of library services. Similarly, Fibrich (2017) explored libraries and their place in the 4IR through a literature search and found that most libraries have been informed about the unprecedented changes that await them and the need to adequately prepare for the novel disruptive changes. As such, they are willing to adopt new business models to provide services having in mind the demand of the 4IR to satisfy the varying information needs of users. Ntlotlang (2019) undertook extensive qualitative research at the Botswana International University of Science and Technology and revealed that academic libraries in Botswana have begun to leverage digital technologies to provide innovative services to technology-driven patrons that will meet the unprecedented demand of the 4IR. The findings signal confirmation that libraries are aware and working proactively to quickly respond to the obvious demand of the 4IR.

Sanjeeva (2018) found that libraries are steadily replacing their conventional library services with sophisticated tools that will give patrons the convenience and ease to access library materials digitally. The findings are in line with those of Mashiyane, Bangani, and Deventer (2020) who investigated the awareness and application of multimedia content for information literacy instruction at the North-West University in South Africa and found that most academic librarians were aware of the critical importance of Lib 4.0 but are more interested in Lib 4.0 tools that they are aware of and easy to use - for example, LibGuides. Khan and Bhatti (2017) concluded that academic libraries in Pakistan are championing providing digital platforms to their users to accommodate varying information needs. The Botswana International University of Science and Technology, for instance, is providing digital library guides, social media, and e-learning

management platforms to make digital information readily available (Ntlotlang, 2019). A review of the literature by Ahmat and Hanipah (2018) focused on how libraries are preparing for the 4IR and found that libraries were implementing strategies such as allocating adequate budgets, designing effective business models, and good organizational behavior. The study concluded that until libraries hone their ability to make sure that all these factors are put in place, they will not be in a better position to leverage digital services to their maximum.

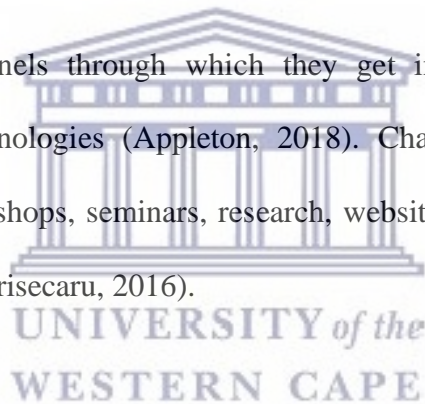
Kennedy (2018) found that findings from literature brought to the fore that research libraries are working sedulously to implement Lib 4.0 applications and technologies and alerted to the role played by the Association of Research Libraries (ARL) in creating awareness through seminars, conferences, and symposiums. Through the agenda of awareness creation, librarians were encouraged to refocus their research on the changes and impact of the 4IR and how to prepare for the unknown. Libraries quickly prioritized adopting Lib 4.0 technologies and applications, reshaped library policies, and constantly informed stakeholders about what the library needs most to prevent the 4IR disruptive changes (Ntlotlang, 2019).

It is worth noting that almost all the authors acknowledged the fact that the majority of academic libraries are aware of the 4IR disruptive technologies. It is therefore not surprising several academic libraries are putting in place strategies such as allocating adequate budgets, designing effective new business models, and good organizational behavior as emphasized by the study by Gaspar, Juliao and Cruz (2019); Ntlotlang (2019) and Penprase (2018). The awareness has also signaled the Association of Research Libraries (ARL) to include in their programmes; the creation of awareness of the 4IR through seminars, conferences, and symposiums. However, it can be

inferred that the extent of awareness, and what kind of disruptive changes and technologies that can affect the services of the library if the library fails to act timely were left unmentioned. Even though the authors' conclusions show positive awareness, there was no clear evidence of the consequences of libraries whose level of awareness is low, or no awareness as well as those who are aware and not acting and those fully aware and adequately responding to the demand of the 4IR. It is worthwhile to know that disruptive changes exist without creating strategies to respond to changes does not create much relevancy.

2.3.1: Channels of awareness about the 4IR

Libraries have numerous channels through which they get informed about pertinent new happenings and emerging technologies (Appleton, 2018). Channels include library training programmes, conferences, workshops, seminars, research, websites, and social media platforms (Chigwada & Nwaohiri, 2020; Priseccaru, 2016).



2.3.1.1: Training programmes

The essence of training programmes cannot be overemphasized especially when the focus has to do with awareness creation and acquiring lacking or new skills needed to provide adequate library services to patrons (Ocholla & Ocholla, 2019). Appleton (2018) emphasized that programme trainers inform attendees about the 4IR, its opportunities, challenges, and consequences if ignored. This finding is consistent with the study by Catalano et al. (2018) who investigated academic libraries' participation in 21st-century library trends, findings from 10 libraries showed that

retraining of staff yielded a positive impact with 92% agreement. Also, the findings from Chiware and Becker (2018) confirmed that training had a positive impact on research data management services in Southern Africa in responding to change. Likewise, the findings of Sewell and Kingsley (2017) concluded that the staff at Cambridge University Library will be able to thrive in the 21st century through continuous training.

2.3.1.2: Conferences, workshops, and seminars

Both international and local conferences, workshops, seminars, and symposiums provide avenues for discovering emerging trends and gaining insight into how they can benefit from new technologies (Appleton, 2018; Church et al., 2017). The World Economic Forum in Davos where the concept of the 4IR was birthed by Klaus Schwab, created the platform for librarians to be informed about the 4IR and to ignited researchers to focus on the 4IR (Ocholla & Ocholla, 2020; Prisecaru, 2016).



Also, a study by Deng (2017) confirmed conferences as an important channel through which library professionals became aware of the disruption triggered by the 4IR. For example, the author added that library staff who participated in the 4th International Conference on Education Management and Computing Technology which was held in Hangzhou, China, and focused on “Research on service innovation of library in big data age: Advances in Social Science Education and Humanities Research” got the opportunity to be abreast with the 4IR in libraries. Ocholla and Ocholla (2020, p.4) cited several examples including “Capstone Carnegie Conference organized by the University of Pretoria in March 2019, the 20th IS Annual conference organized by the University of Zululand in September 2019, University of Johannesburg’s 4th Industrial Revolution

and Library Practices Conference in October 2019. The authors added that these conferences have created massive awareness of the 4IR. Also, China Library Annual Conference which was held in 2016 gave insight into Makerspace dubbed: “Makerspaces: Creativity in the Library” (Colegrove, 2016, p.1). The prime purpose of the conference was to adequately gear the attention of librarians towards the provision of Makerspace services since it is compelling in the 4IR. Again, at the Emerald Librarian Conference 2018, resource personnel of the conferences carefully gave insight into “preparing the libraries for the fourth industrial revolution” (4IR) (Ahmat & Hanipah (2018, p.1). The participants were educated on four strategic actions that the various libraries can take into consideration to welcome the unescapable disruptive changes of the 4IR. Additionally, AFLIA (2020) announced its 4th Conference and 6th African Libraries Summit which focuses on the ‘4IR, sustainable development and African libraries’ and stated that it hoped to help introduce information professionals and strategies they can use to prepare for the 4IR as it is already here. During the programmes, participants had the opportunity to obtain first-hand information about 4IR, ask questions, and interact with experts. Also, a “Blockchain National Forum in August 2018” was held at Mississippi State University where 26 notable experts introduced librarians to Blockchain and how it can be used to enhance information services (Zhang, 2019).

Additionally, Idiegbeyan-Ose, Ohaegbulam, and Osayande (2015) found that conferences /workshops/seminars create golden opportunities for library staff to get posted about the new trends in ICT technologies that are pertinent to information provision. They also serve as avenues to draw attention to new skills needed by librarians to operate effectively and ultimately to provide upgraded services that will meet the needs of information seekers. The authors then stressed the fact that “conference or workshop attendance by librarians is not a matter of choice but a must if

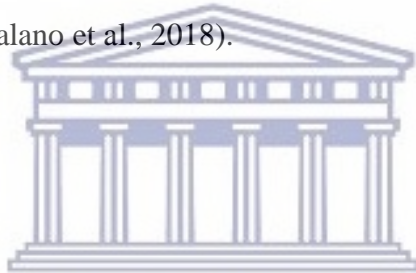
they want to remain relevant and up-to-date in the information age” (p.1). These conferences enable librarians to remain up-to-date, acquire new skills, network with colleagues, develop article writing and presentation skills, and so on. The challenges that library professionals encountered included the high cost of conference registration fees, lack of sponsorship, and unawareness. Church et al (2017) maintained that so far from being a necessary evil, attending and engaging in professional conferences is a fundamental necessity. This is because as asserted by Appleton (2017), conferences provide a golden opportunity for library professionals to get informed about innovation that will help harness their services as developmental changes in technologies keep on unfolding.

2.3.1.3: Scholarly research

Library professionals are required to publish acceptably recognized scholarly journals (Fiawotoafor, Dadzie, Adams, 2019; Hahn & Jaeger, 2013). Consequently, Penprase (2018) emphasized that libraries through scholarly research get informed about the 4IR. Hussain (2019) literature search confirmed that library professionals conduct scholarly research allowing them to learn about innovation in technologies which is pertinent to the provision of library services. Okike (2020) also indicated that scholarly research serves as a gateway to critical information pertinent to librarian duties. Both studies by Ocholla and Ocholla (2020) and Ahmat and Hanipah (2018) concluded that scholarly research serves as an opportunity for library professionals to be updated about the 4IR, to prepare, therefore, and to learn about available resources to face the future.

2.3.1.4: Websites

Appleton (2018) identified websites as channels for information professionals to discover emerging trends and developments. The author further accentuates that library professionals depend heavily on their websites for articles published on the 4IR and other related topics. For instance, Ocholla and Ocholla (2020) studies which investigated the readiness of academic libraries in South Africa to research, teaching, and learning support during the 4IR brought to the fore that, institutional websites have created an avenue for information professionals to be abreast with the changing trends in technology that affects libraries. Also, events such as a workshop, seminars, conferences, symposium, and the like are usually published on institutional websites and constantly reminds intended participants such as information professional about current trends and disruptions (Zervoudi, 2020; Catalano et al., 2018).



2.3.1.5: Social media platforms

Social media has become a compelling tool used by libraries to reach out to their users and serve as a platform through which they get informed about library services (Prisecaru, 2016). Studies by Howard et al. (2018) as well as Harrison et al. (2017) illustrated the value of social media as channels to share information and create awareness., while Tella (2020a) and Hussain (2019) revealed that various social media platforms informed library professionals about the 4IR. The South African study by Ocholla and Ocholla (2020) found that academic librarians identified social media as the most useful platform to get information on the 4IR. Ali and Gatiti (2020) confirmed the critical importance of social media amid COVID-19 where public libraries in Pakistan used social media platforms to provide relevant but reliable information curtailing fake news. Buriro et

al. (2018) concluded that academic libraries in the Sindh Province used social media to promote libraries, resources, and services.

It can be deduced from the above section that libraries are colossally leveraging various channels to champion awareness about the 4IR. For instance, during training programmes participants are able to get the opportunity to obtain firsthand information from experts. Evidently, during the “Blockchain National Forum in August 2018” which took place at the Mississippi State University where participants had the chance to interact with 26 notable experts who introduced librarians to Blockchain and how this innovation can enhance the services of the library in the digital era (Zhang, 2019), conferences /workshops/seminars introduce new trends of technologies that libraries can adopt to harness their services. It was also found that scholarly writing stimulates the minds of researchers, encourages resource sharing, and delves into key challenges and opportunities about the 4IR. Institutional websites as well as social media platforms have also shown clear evidence as an effective channel of awareness of the 4IR.

2.4: Lib 4.0 technologies and applications used in academic libraries

The 4IR shows evidence of a transitional change where the use of sophisticated technologies and applications is ubiquitous (Ahmat & Hanipah, 2018). It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres (Schwab, 2016). Academic libraries especially are working assiduously to fully create a virtual space for patrons as their information needs keep changing and with the intent of protecting its services from fading away (Ocholla & Ocholla, 2020). In the quest for academic libraries to respond to the demand of

the 4IR various technologies such as Artificial intelligence (AI); Big data, Internet of Things (IoT), Virtual reality, Advanced (autonomous) robotics, 3D modeling software, Cloud computing, Blockchain technology, Chatbot, Quick Response (QR) code, Ask-a-librarian, and Library mobile application are being applied (Labangon & Manabat, 2018).

2.4.1: Artificial intelligence (AI)

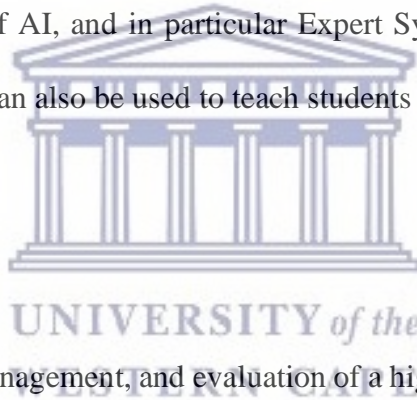
The expression “artificial intelligence” was introduced as a ‘digital’ replacement for analog ‘cybernetics’ (Mogali, 2015). George Boole (1815-1864) first started experimenting with AI while the pioneers Allen Newell and Herbert Simon initiated the first artificial intelligence laboratory (Kumar, 2004). AI is the theory and development of computer systems to perform tasks that normally require human intelligence (McPherson, 2018). Examples of such tasks are visual perception, speech recognition, decision-making, and language translation. AI focuses on non-algorithmic methods for solving problems or in the words of Marwala (2019a, p.1) “a paradigm where physical and social phenomena are programmed to solve complex problems”.

The work of Yu et al. (2019) which accentuated how bots in the library asserted that the world is steadily becoming an intelligent society due to the vast application of IA technologies resulting in AI tremendously changing the nature of library services and developing smart libraries for easier, faster and more convenient information access and retrieval. The study also revealed that some academic libraries have implemented AI applications as part of the library security system. Face recognition instead of library identity cards is for example used to provide access to the physical library.

The study of Vijayakumar and Sheshadri (2019) on the application of AI in academic libraries concluded that it is an innovation enabling interaction among librarians, patrons, and machines to meet information needs. A classic example is the ability of search engines to during information searches, correct spelling and suggest other relevant information.

After investigating the application of AI in Iranian libraries, Asemi and Asemi (2018) identified functions such as predictive analysis, speech-to-text, and text-to-speech, image recognition, information extraction, and translation classification clustering were mostly implemented.

The study by Mogali (2015, p.5) which explores artificial intelligence and its applications in libraries revealed how the use of AI, and in particular Expert System, can be a substitute for a reference librarian. The system can also be used to teach students reference skills.



2.4.2: Big data

Big data captures the storage, management, and evaluation of a high volume of data such as email messages, photographs, postings on internet forums, and phone transcripts (Blummer & Kenton, 2018) in structured and unstructured ways (Ball, 2019).

Utilizing big data in libraries impacts positively the handling of digital information and communication (Ball, 2019), and enables analyzing and synthesizing high volume of data holdings to obtain a clear picture of their users' statistics to upgrade and improve their services and environments. It leads to cost reductions, automation, and faster and better decisions as well as benefits scholarly work (Blummer & Kenton, 2018).

Sengupta (2019, p.2) investigated the use of big data in libraries and found that although it analyzes enormously large sets of data to reveal patterns, trends, and associations, especially relating to human behavior and interactions, only 15% of institutions have managed to apply it in the day to day activities. The low utilization was attributed to insufficient qualified staff, legal uncertainties, and data protection risk issues. The author concluded that librarians don't necessarily have to become programmers but at least have the basic knowledge, necessary skills, and service mentality to use various software tools to transform huge amounts of data.

2.4.3: Internet of Things (IoT)

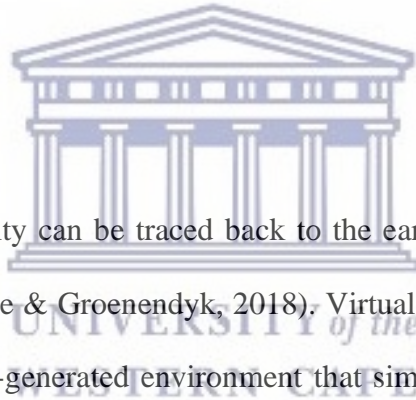
The IoT is not just a mere interconnection of devices or nodes or objects (Mohideen, et al, 2022), but creates an intelligent, invisible network that can be sensed, controlled, and programmed through which the physical world objects or things become intelligent to facilitate communication and to collect and exchange data (Bongomin et al., 2020). These 'things' can be electronic sensors, actuators, electronic devices, or objects such as human beings or buildings that can be connected anytime and anywhere (Liang, 2018), and can exist as entities on the internet (Abo-Seada, 2019).

The application of the IoT is widely evident in libraries, especially in the era of 4IR. Abo-Seada (2019), as well as Bansal, Dipti & Alka (2018, p.1), observed that the IoT is used in libraries to collect data and transfer data over a network without human intervention and making it possible for libraries to render digital services to large audiences.

Wojick (2016) concluded that IoT enables library clientele to utilize available information resources with ease as it provides innovative ways for sharing information, tracking, tracing services, and notification services, while Liang (2018) added that it controls and tracks the

movement of library resources and reduces the workloads of the librarians. Abo-Seada (2019), Liu and Sheng (2017) as well as Pujar and Satyanarayana, (2015), alluded to IoT enabling digitized security systems to prevent theft of library resources and alert the emergence of security personnel.

Research by Buckland (2017) as well as Nolin and Olson (2016), identified the phenomenal role of IoT at library circulation desks. It provides applications enabling notifying or alerting users about the availability of library resources, overdue items, profiles, and circulation rules and regulations. It also allows for user identification, locating books on shelves, online reservation of library material, interlibrary loans, and fire detection. The IoT thus saves time and effort for the library staff and users and improves access to collections and resources.



2.4.4: Virtual reality

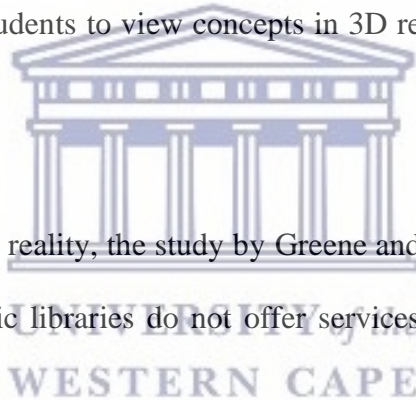
The development of virtual reality can be traced back to the early 1960s but was not explored extensively until recently (Greene & Groenendyk, 2018). Virtual reality according to Johnson et al. (2016, p. 40) is a “computer-generated environment that simulates the physical presence of people and objects to generate realistic sensory experiences”. Virtual reality is commonly defined as an experience in which a user remains physically within the real world while entering a virtual world using a headset with a computer or a mobile device (Hahn, 2017).

Internationally there have been conscious attempts by academic libraries to make virtual reality available to their users as it can productively be used to engage technological-oriented patrons (Massis, 2015). Some examples of academic library innovations are the Ryerson University Library and Archives in Toronto which provides access to students, researchers, and faculty to

Oculus Rift headsets for about two to three days (Wang, Kimberley & Wang, 2017). Both the Claude Moore Health Sciences Library at the University of Virginia and the University of Utah Library offer open-door, drop-in virtual reality workshops once a week. In the health field emphasis is on the application of virtual reality through a combination of large-group demonstrations, one-on-one consultations, and workshops (Lessick & Kraft, 2017). The South African University of Pretoria has created a world-class Virtual Reality Centre with the original intent of enhancing teaching and learning, training, and research. Access to authoritative library content from trusted aggregators and publishers is provided by a one-click user-friendly application popularly known as the Boopsie mobile app (University of Pretoria, 2020).

Frost et al. (2020) surveyed the Brigham Young University Library to determine the interest and needs of virtual reality among patrons. Results indicated enough interest to expand the existing service. The use of customized library applications can be used for in-house activities such as storytelling, virtual travel, virtual gaming, and developing new skills while using the Aurasma mobile application could spark the interest of patrons to explore various library resources. The survey also emphasized the use of virtual reality to provide access to relevant library resources and for the foundation to gain basic information literacy skills enabling assessing, retrieving, and evaluating relevant information to complete academic work. Although the findings reflected that students showed interest in exploring virtual reality technologies, applying it in their various disciplines was challenging for students without engineering, medicine, or another related science background.

The study by Santos and Esposito-Betan (2017) on virtual reality at the College of Engineering Library at the University of the Philippines had similar findings. They concluded that virtual reality is advantageous to academic or research libraries offering library orientation programmes and information literacy initiatives. As such, virtual reality should not be viewed only as an application or technology, but rather as a gateway or a medium to relay relevant information to their clientele. A similar study by Huang et al. (2016) concluded that offering virtual reality library services is cost-effective, especially where large student groups are involved. In their literature review of virtual reality in education, Akcayır and Akcayır (2017) added the benefits of being user-friendly as a user can easily follow instructional guides to download materials from mobile applications as well as being interactive and fun to use. The Utah State University (2017) opined that virtual reality also allows students to view concepts in 3D resulting in them visualizing and grasping the information easier.



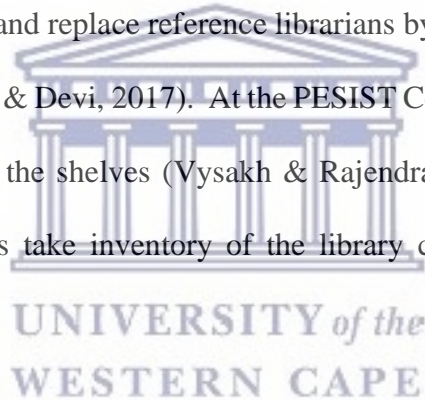
Despite the advantages of virtual reality, the study by Greene and Groenendyk (2019) found that a significant number of academic libraries do not offer services embedded with virtual reality applications.

2.4.5: Advanced (autonomous) robotics

Historically, the word robot was coined from the Czech word “robota” which means “forced work or labor”. Today the word is used to represent any man-made intelligent machine programmed to automatically perform a series of complex tasks traditionally performed by human beings (Xu, David & Kim, 2018). Robotics is a branch of artificial intelligence that is used widely in sectors such as industries, hospitals, sports, military, aviation, and educational institutions (Abram, 2019).

It has three main parts namely a controller, a mechanical part, and a sensor (Vysakh & Rajendra, 2020a). “The controller is the brain that is controlled by a computer program that commands the moving part of the robot. The mechanical parts consist of motors, pistons, grippers, wheels, and gears that enable the robot to lift, grab, turn, and move. The sensor determines the size, shape, space between objects, and direction (Vysakh & Rajendra, 2020a; Asemi & Asemi, 2018).

The application of robotics to augment library services is already evident in many libraries (Tella, 2020a). Internationally, quite a number of academic libraries have begun to replace librarians with robots to perform library tasks that are repetitive and time-consuming (Vysakh & Rajendra, 2020b). Robots, for instance, deliver library material to patrons in a simple, fast, and convenient way (Unnikrishnan et al, 2017), and replace reference librarians by answering questions posed by patrons (Mahalingam, Aravindh, & Devi, 2017). At the PESIST Central Library robots are filling, sorting, and replacing books on the shelves (Vysakh & Rajendra, 2019b). Bomble, Pranit, and Dipika (2015) added that robots take inventory of the library collection using a scanner and barcode technology.



This is in contrast with the argument of Mohideen (2022) that 4IR tools are developed to empower librarians to work more effectively and in an enhanced manner, not replace them.

2.4.6: Cloud computing

The term cloud computing appears to have been generated from drawings of stylized clouds which represent networks in diagrams of computing and communications systems (Nagalakshmi, 2015; Goyal & Jatav, 2012). Group computing simply means a network over a remote area (Fakir,

Bhakar & Waghchoure, 2020) which is a service rather than a product (Shane, 2009). Goyal and Jatav (2012) succinctly elucidated cloud computing as a system that provides a platform for a large pool of systems to interconnect with each other either on a public or private network to provide dynamically scalable infrastructure for application, data, and file storage. Simply put, it is the use of hardware and software to deliver digital services over a network using the Internet (Tella, 2020a). Cloud computing has three main types which comprise Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

2.4.6.1: Software as a Service

Software as a Service (SaaS) is also known as pay-as-you-go or software on demand. It is a service where applications or software are provided to users and can be accessed through the use of licenses or subscriptions via any suitable platform such as a web browser (Ireola, Tijani & Bakare, 2018; Kaushik & Kumar, 2013). SaaS makes it possible for users not to worry about hosting, installing, upgrading, or maintaining the software or applications but has 24/7 access to support services (Dutt, 2015, p.5). Live examples include Google App, LinkedIn, Netsuite, Workday, and Salesforce (Goyal & Jatav, 2012).

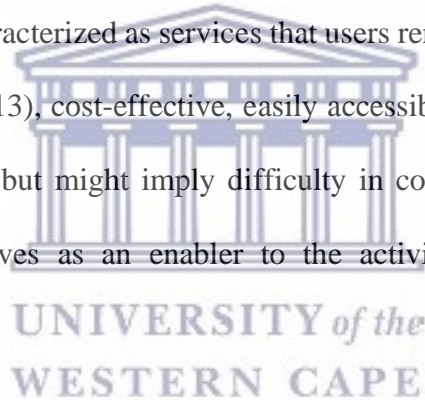
2.4.6.2: Platform as a Service

Platform as a Service (PaaS) permits developers to build the applications or software that is required and users simply can access the services via the internet (Fakir, Bhakar & Waghchoure, 2020) without worrying or paying for the maintenance of hardware and software infrastructure. Examples include Google App Engine and Force.com (Dutt, 2015).

2.4.6.3: Infrastructure as a Service (IaaS)

The Infrastructure as a Service (IaaS) is also known as the “pay-as-you-go service model”. This service deals with the process of hardware virtualization and shows the users only the abstract computing platform instead of the physical function (Ireola, Tijani & Bakare, 2018). This leads to what is known as a virtual machine “monitor” or “hypervisor”. The services are provided by Software as a service provider and users can access the service usually through a browser. Users have control over the software or applications to be used (Dutt, 2015). However, the backdoor activities such as networking, configuration, and others are done by the service providers, who are the engineers of the services (Fakir, Bhakar & Waghchoure, 2020). Examples include Amazon’s web services, and mobile service providers such as MTN, AitelTigo, and Vodafone.

Cloud computing services is characterized as services that users rent instead of buying, are easy to maintain (Kumar & Mandal, 2013), cost-effective, easily accessible irrespective of geographical area, and flexible (Dutt, 2015), but might imply difficulty in controlling privacy (Dutt, 2015). Cloud computing critically serves as an enabler to the activities of other 4IR destructive technologies (Elets, 2020).



Cloud computing performs remarkable roles in the provision of library services. It permeates almost every facet of the library services such as reference services, acquisition, cataloging, and internet services (Fakir, Bhakar & Waghchoure, 2020). Ireola, Tijani and Bakare (2018) maintained that cloud computing is compelling in libraries for their survival in their quest to embrace the destructive of the 4IR. The increasing use of cloud computing in library services is fueled by the fact that it helps to minimize costs and avoids duplication of resources (Dutt, 2015).

As data storage is a core focus of every library, cloud computing enables librarians to digitally store information in a large quantity that can be accessed or retrieved by patrons irrespective of their geographical location, time of the day, and convenience (Narottam, & Vashistha, 2016; Nagalakshmi, 2015). It also allows the library to easily share resources with other libraries and provides better mobility and 24/7 service to users (Tella, 2020b).

Cloud computing is enormously utilized in libraries, for example, the Cloud Library Management Systems, Cloud OPAC, and Cloud Electronic Resource Management Systems. OCLC Web-scale, Ex-Libris Cloud, Duraspace's, DuraCloud for Repository solutions like DSpace, Open source software like Koha, DSpace, Greenstone, Sakai or Moodle for learning management systems, Drupal for content management, etc. for instance, a study by Nagalakshmi (2015) who investigated the application of cloud computing focusing on library and other information centers revealed that libraries are now utilizing the application of cloud computing to store more information at libraries as content creation, storage, e-learning, archives, etc. Similarly, Islam, Anwar and Alam (2020) extensively investigated cloud computing applications in library services in Bangladesh. The findings accentuated the fact that cloud computing supports libraries and librarians to build a collaborative digital environment to stand strong to deliver effective and efficient information services to libraries and to stand tall among information rivals.

Additionally, other scholars such as Tella (2020a); Goyal and Jatav (2012) also found that the use of cloud computing is evident in several services provided in the library including institutional repositories, subscribed online databases, e-books, newsletters, creation of e-alert to library users community based on Selective Dissemination of Information Web OPAC, online renewal,

reservations and among others. The study by Dutt (2015) which explored the application of cloud computing in libraries found that library staff are usually not given the needed training to use and maintain cloud computing in rendering services. And it usually becomes frustrating when IT staff do not respond to their plight at the right time. This finding suggests that for libraries to leverage the application of cloud computing to provide smart services, then there is a need to invest in training.

2.4.7: Blockchain technology

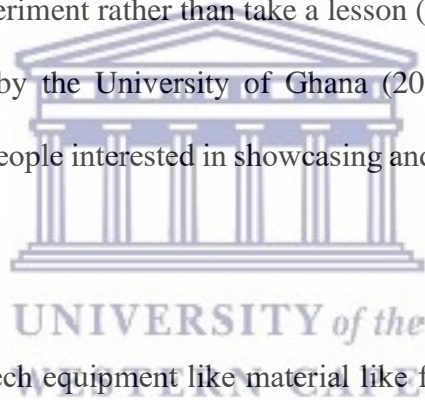
Blockchain technology was developed as part of the so called “cryptocurrency technology” (Vysakh & Rajendra, 2020a; Zheng et al., 2018), and was originally developed to record Bitcoin transactions as it records, validates, and authenticates digital transactions using a cryptographic hash function hence rendering it unsusceptible to fraud (Ameer, 2020; Zhang, 2019; Hoy, 2017). For instance, the work of Hoy (2017) which explored the application of blockchain technologies revealed that the use of blockchain technologies helps librarians to gather, preserve and share authoritative information with information seekers. The author further highlighted that blockchain technology helps create “timestamped, verifiable versions of journal articles” (p5). In the same vein, the findings of Greg and Holden (2016) blockchain helps to perform scientific studies audits to check for the authenticity of the research at a low cost.

The study by Suman and Patel (2021) explored Blockchain technology and its application in libraries, the findings show that blockchain technologies help protect the intellectual property and copyrighted materials of authors and support scholarly publishing and Digital Rights Management. The study further added that, in a creating nation like India, it is expedient to implement blockchain to bring drastic changes in library services. Similar findings were found in the study by Chen et al

(2018) which emphasized that blockchain performs phenomenal roles in library services including digitization, preservation, and tracking of records, library card, library verification of credentials, and intellectual property (Hirsh & Kim, 2019).

2.4.8: Makerspace

Makerspace started around 2006 and can be understood as a physical space for people mostly in science, computer, technology, digital or electronics that provides myriads of carefully selected tools to develop certain skills or innovative and creative art (Hussain & Nisha, 2017; Radniecki & Klenke, 2017). It is usually a space earmarked to provide room for users to demonstrate their creative ideas practically, to experiment rather than take a lesson (Webb, 2018; Hussain & Nisha, 2017). The space is described by the University of Ghana (2020a) as a “digitally-connected community workshop” open to people interested in showcasing and sharing their innovative skills, interest, and ideas.



Makerspace may include ‘low tech equipment like material like fabric, paint, and LEGO blocks and/or ‘Hi-Tech; tools like 3D printers and scanners, virtual-reality headsets, video game consoles, Digital Die-Cutting (Radniecki & Klenke, 2017) laser sculpting, smart terminals (Li, Fan, Luo, 2018).

Okuonghae (2019) explored Makerspace in Nigeria's academic libraries. Findings show that Makerspace provides a platform for users to think critically and find solutions to problems through technological orientation. It also allows users to work collaboratively and “foster the development

of their interpersonal, communication, teamwork, leadership, and mentoring skills” (Okuonghae, 2019, p.49).

In China, the first Makerspace was implemented at the Shanghai Library in 2013 (Li, Fan & Luo, 2018; Qu, 2014). Since then, academic libraries have progressively implemented Makerspace incorporating new technology and experts to interest patrons who are innovatively inclined and need a stimulating environment to transform their mental picture into physical reality.

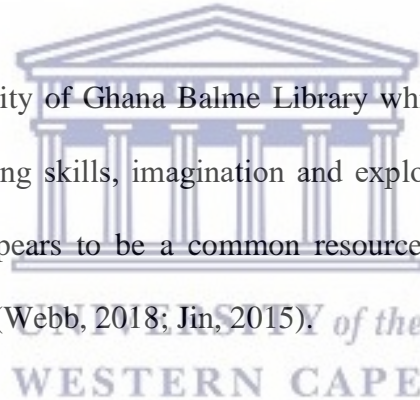
Cao, Wu, and Stvilia (2020) further studied Makerspace in Chinese libraries by comparing public, academic, and school libraries. The study found that several academic libraries have purposely implemented Makerspace as part of their library resources and are better equipped and utilized compared to public libraries. The implementation of Makerspace was hindered with the scarcity and cost of professional instructors. Similar funding challenges, soliciting support from stakeholders, and lack of expert instructors were recorded in earlier studies by Fang (2017), Gao et al. (2017), Curry (2017) as well as Li, Fan and Luo, (2018).

The study by Hussain and Nisha (2017) which explored awareness and use of library Makerspaces among library professionals in India revealed that most academic libraries in India vastly utilize the Makerspace as their curriculum largely focuses on technology innovation. Specifically, the study found that Makerspace helps educate students for both local and global economies to become innovative and critical thinkers. The implementation of Makerspace in academic libraries has several valuable benefits (Horton, 2019; Ahn & Noh, 2018), especially for lifelong learning through developing creative art (Li, Fan & Luo, 2018) and encouraging personal development

through the learn-by-doing approach (Boyle et al., 2016). The DeLaMare Science and Engineering Library appeared to be the first library to implement Makerspace when they provide services to interested parties regardless of discipline or institution (Radniecki & Klenke, 2017).

De Beer et al. (2017) scanned Makerspace in South Africa and concluded that a couple of academic libraries have begun leveraging the implementation of Makerspace to enhance their library. The University of Pretoria library was launched in 2015 Makerspace at their library with the focus dubbed “do-it-yourself” and “do-it-with-others” (University of Pretoria, 2015). Innovative use of Makerspace was demonstrated by the University of Johannesburg Library utilizing 3D printing to develop surgical face masks to halt the spread of COVID-19 (Lewis, 2020).

Another example is the University of Ghana Balme Library which launched its Makerspace to “activate dormant critical thinking skills, imagination and explorative learning” (University of Ghana, 2020a). Makerspace appears to be a common resource provided in most British and American academic institutions (Webb, 2018; Jin, 2015).

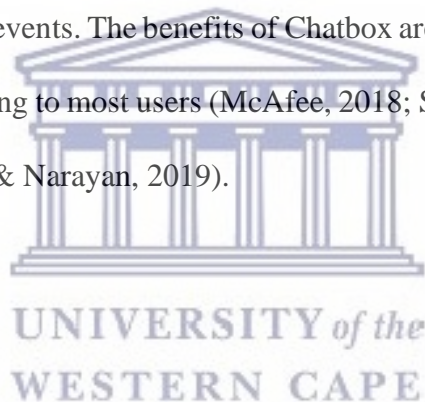


2.4.9: Chatbot

Chatbot is an application of artificial intelligence (Young, 2019) as it is an intelligent interactive chat that applies intelligently to respond to the queries of a person (Indra & Narayan, 2019; Woods, 2018). It is also known as “conversational agents” or “talk bots”. It is regulated by a well-structured algorithm that automatically answers questions of information seekers or redirects queries (Young, 2019; Contzen & Alders, 2015) mostly via chat boxes on websites. The answers are programmed using Natural Language Processing and work in a “logical sequence of

information flow” (Indra & Narayan, 2019, p.3). It is applied in different areas such as medicine, social media, and libraries are no exception.

Jameson, Natal and Napp (2018) delved into patterns surrounding student usage and perceptions of academic library reference services at the University of Toledo, USA. The findings indicate that chat reference services tools like chatbots enhance references transaction and bring patrons closer to the library and librarians. The study further added that it helps market library services to patrons, maintains their interest, and attracts new customers. Again, it provides information to patrons regarding, for example, locations in the library, where they can find specific library materials, borrowable books, duration to return, fine payment information, how to use plagiarism software, new acquisitions, and upcoming events. The benefits of Chatbox are that it is user-friendly, reduces anxiety, is interactive, is interesting to most users (McAfee, 2018; Shelmerdine, 2018), and creates a sense of belongingness (Indra & Narayan, 2019).



2.4.10: 3D Modelling Software

Another innovation of Lib 4.0 technology relevant to the 4IR is the 3D modeling software (Attaran & Stidham, 2017; Walker, 2017). The 3D modelling software together with 3D printers uses an additive process where the plastic material is exposed to high temperature, melt and transform into a 3D object. Three-dimensional modeling and printing will promote creative thinking and open the opportunity for teaching, research, exploration, and experimentation (Walker, 2017).

Walker (2017) conducted a case study to investigate the use of the 3D printer service offered by the National Institutes for Health Library in Bethesda, USA as a new opportunity in biomedicine.

The study concluded that scientists found 3D printing very interesting, but that training will be needed. They were of the opinion that 3D printing will improve research and that supplied new avenues for problem-solving.

The 3D modelling software has been in existence for quite a long time but now becoming more ubiquitous in academic libraries (Attaran & Stidham, 2017; Horton, 2017). Pryor (2014, p. 2) indicated that the use of 3D software allows libraries to “provide resources for not only consuming information but also for generating new information and research”. Nowlan (2015) agreed by stating that Makerspaces coupled with 3D printing in academic libraries provide an environment for patrons to generate new knowledge through creative and critical thinking (Nowlan, 2015).

Examples include the University of Toronto Libraries (University of Toronto Libraries, 2015), the University of Regina Library, Dalhousie University Libraries, Thompson Rivers, University Library in British Columbia (Nowlan, 2015). These libraries have invested immensely in 3D printing applications, shaping and raising innovative, critical thinkers and problem solvers.



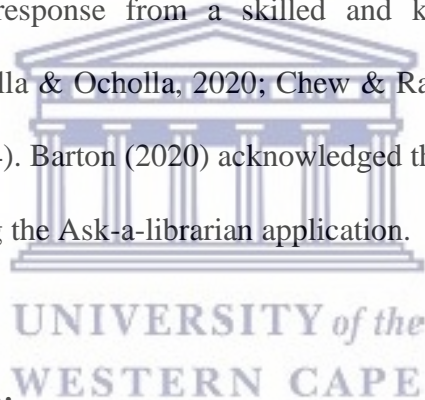
2.4.11: Quick Response (QR) code

QR codes are bi-dimensional (Mishra, Umre & Gupta, 2017) or two-dimensional black-and-white pixel matrix barcodes that are scanned using a bar code reader or a smart or mobile phone (Shettar, 2016; Kharat & Pange, 2013). In libraries, QR codes enable library users to use their smartphones to scan QR codes of library books to obtain quick access, to obtain ranting and review information about them, or to check the availability thereof (Chigwada & Nwaohiri, 2020; Kim, 2020; Mishra, Umre & Gupta, 2017). QR codes, therefore, create awareness and promote the digital marketing

of library resources and services (Mishra et al., 2017) to facilitate optimum use as well as raise the reputation and profile of the library (Shettar, 2016).

2.4.12: Ask-a-librarian application

Ask-a-librarian application or digital reference service is one of the library applications that provides personal assistance to library patrons (Sankar & Kavitha, 2016). Ask-a-librarian is a virtual reference service that connects students, faculty, and researchers with real-time research assistance without being physically in the library. The library users can ‘chat’ with the librarian in real-time by typing a query regarding information needs in a chat window, Instant Messaging, or video conferencing to get a response from a skilled and knowledgeable librarian either immediately or via email (Ocholla & Ocholla, 2020; Chew & Rahim, 2017; Sankar & Kavitha, 2016; Whitlatch & Searing, 2014). Barton (2020) acknowledged the effective rendering of library services during COVID-19 using the Ask-a-librarian application.

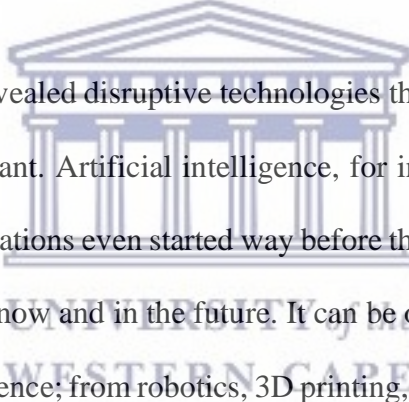


2.4.13: Library mobile applications

In the quest for academic libraries to prepare adequately for 4IR, the incorporation of library mobile apps into library services cannot be underscored and is even more critical in the era of COVID-19 (Okike, 2020). Mobile devices like smartphones, tablets, and laptops have made it possible for academic libraries to implement library mobile applications to make library services easily available in an attractive and hi-tech manner (Acheampong, 2019; Okike, 2020). Library mobile applications have critical benefits as it provides means to reach a large audience, save time

and space, provide limitlessly, 24/7 personalized access, offer user-friendly and cost-effective library services, and encourage reading habits (Manjula, 2016).

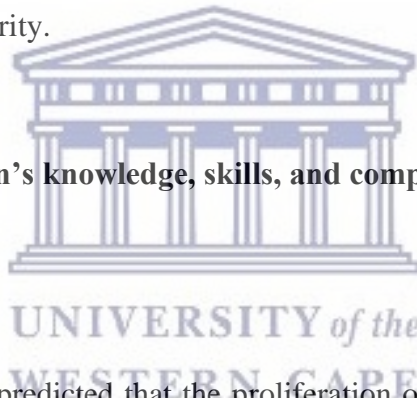
Examples, where mobile applications have been implemented in academic libraries, include the UP Mobile App which was launched by the University of Pretoria to ensure easy access and good interaction among students, faculty, and librarians (Ocholla & Ocholla, 2020; University of Pretoria, 2020), the UJ mobile App was launched by University of Johannesburg (Niemand & Chauke, 2017), the UG mobile App (Acheampong, 2019), Library of Congress BARD Mobile App, AnyBooks app, Wattpad Famous books - Treasures of the Bavarian State Library, the District of Columbia Public Library iPhone App (Manjula, 2016).



This subdivision has evidently revealed disruptive technologies that demand academic libraries to incorporate in order to stay relevant. Artificial intelligence, for instance, runs through almost all disruptive technologies. Its applications even started way before the concepts of the 4IR but appear to be an unavoidable application now and in the future. It can be observed that other technologies have elements of artificial intelligence; from robotics, 3D printing, blockchain technology, chatbot, Ask-a-Librarian, and big data, to virtual and augmented reality, the Internet of Things, and Makerspace, and enhance literature search. The onus lies with library management and individual librarians to decipher how these technologies can enhance library service delivery. For instance, artificial intelligence can be applied to library security systems using face recognition instead of library identity cards to access the physical library. The application of big data enables academic libraries to analyze and synthesize high volume of data to obtain user statistics, Internet of Things (IoT) are also applied in circulation desks to notify or alert users about the availability of library

resources, overdue items, profiles, and circulation rules and regulations and help to easily locate books virtually, make a reservation and even for fire detection in the library. Further, robotics employees for instance performing the role of reference librarian are being used to interact with patrons to locate books in some academic libraries. Whiles blockchain technologies help librarians to check the authenticity of pieces of information, Makerspace, and 3D printing provide a simulation environment for patrons to initiate their creative ideas into reality. It was also revealed that Ask-a-librarian and chatbot provide 24/7 reference services that help patrons to connect with the libraries virtually. There is no doubt that all these technologies provide relevant services to enhance academic libraries services, however, the onus lies in available funds and it is the responsibility of the libraries to decipher based on local needs which of these 4IR technologies to be implemented and in what priority.

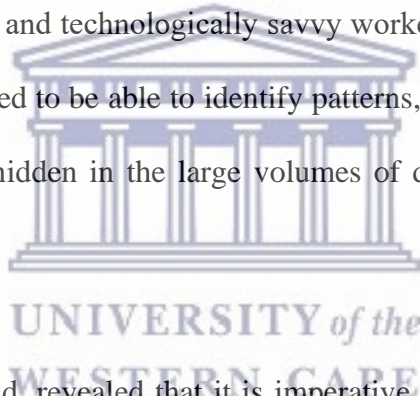
2.5: Level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies



As early as 2018, Corfe (2018) predicted that the proliferation of disruptive technologies in the 4IR will affect every facet of the economy and readiness will be shown in the extent of preparation with regard to knowledge, skills, and competence. Similarly, the confidence of library professionals as well as library users needs to be strengthened through the required knowledge, skills, and competence demanded by the 4IR (Tella, 2020a). The 4IR has signaled a wake-up call to all librarians that they have no option but to obtain new skills and competencies to enable them to continue providing vital library services to meet the information needs and demands of information seekers (Hussain, 2019; Tait, Martzoukou & Reid, 2016). In support of this, the Global

Business Coalition for Education (2020) estimated that due to automation and 4IR technologies and applications, over 1.8 billion youths will by the year 2030 not have the right skillsets resulting in the need for introducing these disruptive technologies into school curriculum (Tella, 2020a). In the same vein, the University of Calgary (2020) and Schwab (2016) call for school and higher education curricula reviews to incorporate needed technologies. Similarly, the study by Lase (2019) found that academic curricula should be redesigned to incorporate Lib 4.0 to produce graduates who are technologically inclined and able to utilize Lib 4.0 applications.

It is against this backdrop that librarians are called to be aggressive and proactive by reviewing their resources and services to have a place in the 4IR (Corfe, 2018). Manda and Backhouse (2017, p.3) call for “skilled, innovative, and technologically savvy workers”, while Ahmat and Hanipah (2018) stressed that librarians need to be able to identify patterns, apply context and intelligence, to extract relevant information hidden in the large volumes of data, and to use digital content developer and user advisors.



Gleason (2018) on the other hand, revealed that it is imperative information professionals must have cognitive flexibility, emotional intelligence, complex problem-solving, critical thinking, creativity, and people management skills to survive in the 4IR. Tasks should be more fluid as services become automated and information professionals need to be agile and able to switch from one task to the other. The findings are in agreement with Ocholla and Ocholla (2020, p.5) who stressed that “complex problem-solving, critical thinking, creativity/innovation, people management, coordinating with others, emotional intelligence, judgment, and decision-making” are compelling for information professionals.

Similarly, Howard et al. (2018) concluded that complex problem-solving and critical thinking should be one of the basic skills of all librarians to assist in the varying information needs of technology-oriented library users. The study also concluded that one-third of skills considered invaluable for information provision and dissemination will change in the near future. Ayinde and Kirkwood (2020) opined that for librarians to become indispensable workers with diverse and complementary skill-sets, they should aim to constantly meet the varying needs of technologically savvy patrons and even anticipate them to be more sophisticated going forward.

Further, the study by Oke and Fernandes (2020) which explored the views of 33 key stakeholders in education and assess the readiness of and acceptability of the 4IR in the educational sector concluded that, for every employee to stand in a strategic position to leverage from the outcome of the 4IR, they should not undermine the core of becoming technological literate coupled with digital innovated skills and competence. The author then cautioned by unequivocally stating that “if we don’t embrace the idea and take baby steps in the right direction we will be actively, and by choice, placing ourselves further behind the developed world” (Oke & Fernandes, 2020, p.19). The earlier study by Raju (2017) which investigated the library and information science competency index for the higher education sector in Cape Town South Africa concluded that new competencies will be required from information professionals for the 4IR. This phenomenon sends a signal to all academic libraries that there will not be a period of cessation where they can boldly say they have arrived but rather it can be inferred that, for academic libraries not to be left behind, librarians should empower themselves to continually become technology literate and to foresee disruptive changes affecting the library environment and adequately prepare for them (Oke & Fernandes, 2020). Although academic libraries have been forewarned about the need to prepare

for the 4IR, Saunders (2020) explores knowledge, skills, and abilities currently in high demand for academic libraries to thrive amidst digital transformation in five (5) iSchools in the United States. The study revealed that disruptive technological changes will still have a tremendous impact on knowledge, skills, and abilities and therefore the iSchools need to strive to prepare emerging library professionals to meet these needs.

The following sections throw light on specific compelling knowledge abilities, skills abilities, and competencies that librarians need to keep pace with the 4IR era.

2.5.1: Knowledge Abilities

Although Bolisani and Bratianu (2018) claimed that the term knowledge abilities has no clear definition. So far Stroll (2020) defined it as the theoretical understanding of a subject or what one has learned through education, training, or work experience. Nashihuddin and Suryono (2018) completed an extensive literature review on librarians' readiness in facing professional disruption in the era of the 4IR and found that librarians should improve their competence by focusing more on library e-resources management, digital literacy, managerial leadership, and research literacy. The findings also demonstrated that the competence of academic librarians can be measured by considering their level of knowledge critical to the 4IR disruptive technologies. Emphasis was placed on research literacy including research collaboration activities, access to data and research publications, management of research results, and dissemination of research results. Tella (2020a), Corfe (2018), and Massis (2015) had the same thoughts indicating that research literacy coupled with digital literacy will enable library professionals to conduct good research to contribute to professional development as well as the growth of the library as large. Nashihuddin and Suryono

(2018, p.86) also postulated that librarians should consider the disruption change caused by the 4IR as a golden opportunity for career development comprising “knowledge strengthening, connectivity building, and oriented to the community needs”.

2.5.2: Skills and competence

According to Marriam-Webster (2020), skills is the ability to use one's knowledge effectively and readily in execution or performance and competence while Kolle and Parmeshwar (2014, p.3) defined competence as “the descriptions of skills, know-how, abilities, and personal qualities acquired through deliberate, systematic and sustained efforts to smoothly and adaptively perform a particular role and carry out complex activities”.

Tella (2020a) as well as Ocholla and Ocholla (2020) identified a range of skills needed. They include technological, programming, digital, thinking, and personal skills as well as data scientist’s talent capabilities, digital content development abilities, and digital user advisor’s talent capabilities. Additionally, information curation, technology design, analytical thinking and innovation, creativity, originality and initiative, complex problem solving, in-depth research, system analysis, and evaluation, and emotional intelligence are required to ensure that librarians will manage the challenges of the 4IR.

Tella (2020a) focused on repackaging professionals towards the fourth industrial revolution. The study brought to bear that it is imperative for library professionals as well as patrons to be continuously exposed to training to master 4IR skills as a mismatch of skills will negatively impact the growth of libraries. Based on Chang (2019) prediction, 77% of jobs in the future will demand

new technology. These findings send a message to all training institutions to take a cognizance review of the kind of training and skills they are enrolling students for. Considering this, academic libraries need to review their resources and services for the 4IR era and ensure that resources and services are aligned with innovative and technological skills taught by the institution. In line with this projection, the study by Ocholla & Ocholla (2020) where the readiness of academic libraries in South Africa for the Fourth Industrial Revolution to undertake teaching, research, and support learning explored. The study found that library professionals need to acquire 4IR skills in order to train their patrons, similar findings were highlighted in the works of Hussain (2019) and Butler-Adam (2018). To prevent an incongruity between graduate skills and workforce requirements, Tella (2020b) concluded that library professionals should endeavor to have a broader knowledge of disruptive technologies and the ability to use them to render services to patrons. It will also prevent information professionals from becoming unemployed.

This sub-section captures the critical aspect of demand of the 4IR. The findings show that academic librarians need to acquire new skill sets and knowledge to be able to apply and utilize relevant disruptive technologies. Several of the authors maintained that to provide technological mindset librarians, not only should they continue to upskill, reskill, train, and retrain in 4IR technologies but the information science discipline needs to upgrade their curriculum to reflect the changing needs of the library in terms of relevant skills such as complex problem-solving, analytical thinking and innovation critical thinking, creativity/innovation, people management, coordinating with others, emotional intelligence, judgment, and decision-making, in-depth cutting edge research, system analysis, and evaluation, and emotional intelligence to be able to cope with the demand of the 4IR. It can also be inferred from the findings that while academic libraries are pushed to

reinvent themselves to overcome the challenges of the 4IR, the need to change, and upgrades with ongoing trend should be the hallmark of the library to survive because the 5IR is even evolving with its inherent demand. It was realized that the findings emphasized so many generic new skills sets relevant for the 4IR without explicitly highlighting specific critical skills needed in for instance circulations, reference services, IT/Library management system, acquisition, knowledge, and research commons/student support. Even though almost all appear relevant specialized skills give staff the to develop well with available resources.

2.6: Challenges academic libraries face in incorporating the 4IR technologies

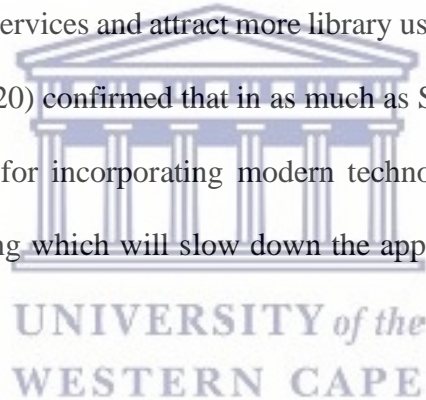
The digital-driven revolution is not only about adopting and applying new technologies but also considering the financial implications, reshaping organizational behaviors, designing new business models, restructuring the flow of processes as well as introducing new job descriptions and roles (Manda & Backhouse, 2017). If all this is not realized, libraries will be unable to optimize their services (Ahmat & Hanipah, 2018). Although the 4IR is bringing tremendous opportunities, several challenges might be experienced and, to minimize the disruptive changes, need to be addressed.

2.6.1: Inadequate funds

It has become an ordinary phenomenon for information centers to constantly fight for the limited institutional funds to render quality library services (Warren, 2020). Scholars Opele (2018), Anyim (2018), and Acheampong (2016) reported inadequate funding in academic libraries in Nigeria and Ghana respectively as the fundamental obstacle to the advancement of modern technology. An older study by Ahenkora-Marfo and Osei-Bonsu (2013) as well as Abban (2018)

demonstrated financial handicaps over years in academic libraries in Ghana depriving them of utilizing modern technologies. The studies by Husain and Nazim (2015) and Antwi, Ankrah and Frimpong (2020) reported similarly on inadequate funds negatively affected the incorporation of modern ICT infrastructure in academic libraries in India and Ghana respectively. Hussain (2019) elucidates that most libraries in the past were not prioritized as a critical sector to spend funds on.

A study on selected libraries in KwaZulu-Natal in South Africa showed that limited funding emerged as a critical obstacle for academic libraries to embrace emerging technologies needed for the 4IR (Mugwisi, Jiyane & Fombad, 2018). Investigating the effect of the 4IR on library practices in South Africa, Cronje (2018) concluded that the 4IR gives golden opportunities for information professionals to upgrade library services and attract more library users but is lumbered with limited funding. Oke and Fernandes (2020) confirmed that in as much as South Africa is known as one of the leading countries in Africa for incorporating modern technology and innovation, they are weighed down by limited funding which will slow down the application of 4IR in teaching and learning.



Mohideen (2020) who investigated Malaysian librarians' perceptions of the 4IR, found that the COVID-19 pandemic will contribute to financial predicament and limit libraries implementing 4IR tools. Schonfeld and Wolff-Eisenberg (2020) also speculated that the COVID-19 pandemic will have a tremendous negative impact on higher education as revenue reduction will occur and academic libraries' visions of incorporating Lib 4.0 technologies will not materialize.

2.6.2: Insufficient ICT infrastructure

Zhou, Lui and Zhou (2015) maintained that 4IR requires adequate ICT infrastructure and constant embracing of emerging technologies. Similarly, Noh and Chang (2020) and Hussain (2019) claimed that, as library user needs to keep increasing, the onus lies on the librarians to incorporate new emerging technologies in the provision of library services.

South African studies have shown that priority has not been given to libraries. For instance, the works of Mphidi (2016) which highlighted the strategy for South African public libraries to bridge the digital divide revealed that libraries have not been accorded the needed attention, therefore, needed infrastructure such as ICT tools for libraries to thrive are in limited supply. It was inferred from the studies that Bridging the digital divide by the library will move at a slow pace if stakeholders and managements of libraries and broader institutions fail to invest heavily in the library technologically wise. Similarly, the study by Mashiyane et al. (2020) at the North-West University in South Africa found that insufficient ICT infrastructures have been a hindrance to academic libraries in South Africa where disruptive technologies are swiftly becoming indisputable. The study further revealed that a lack of priority was evidenced when the library had no plan for technology to deal with an emergency. The recent COVID-19 was cited as a practical example where the lack of technologies for the library to go fully online to avoid a break in the provision of library service was reported. Further, the study by Ocholla (2019) explored the responsiveness of academic libraries in South Africa to research support in the 4IR as well as Manda and Blackhouse (2017) focused on responding to the challenges and opportunities in the 4IR in developing countries explored. These studies found that lack of ICTs, low broadband for internet connectivity, lack of hi-tech devices, and slow digital connectivity are preventing the

smooth transition to smart societies, especially in the area of the library. The authors further predicted that poor ICT infrastructure will be an enormous impediment for many academic libraries to implement Lib 4.0. The finding of the study by Khan and Bhatti (2017) in Pakistan reflected the same trend. Ghanaian studies by Antwi, Ankrah, and Frimpong (2020) and Darko-Adjei (2018) confirmed that inadequate ICT infrastructure in academic libraries resulted in unsuccessful attempts to implement digital library services.

2.6.3: Inadequate Training

The work of Zervoudi (2020) discussed the Opportunities, challenges, and proposed policies in the 4IR. The author maintained that the required advanced IT skills and knowledge to embrace 4IR needed by especially African academic library professionals are woefully inadequate. Therefore, the need for adequate training cannot be underscored. This finding was echoed by the study of Gleason (2018) who explored Higher Education in the Era of the 4IR in the Gateway East of Singapore. It further that education and training in the 4IR will shape employers for a brighter future and recommended that management of organizing should focus on training employees to attain high value-added skills. The study also mentioned that it is through training that employees will be able to upskill and reskill to embrace disruptive technologies.

As Butler-Adam (2018) succinctly posited, the focus should be on human factor development since a new technological skillset will be needed to effectively utilize the 4IR disruptive technologies. Ankrah and Atuase (2018) also observed from their studies that focused on the use of electronic resources among postgraduate students at the University of Cape Coast that the onus lies on the academic library to keep pace with technological advancement, however, most academic libraries

in Africa are unable to train and retrain library staff to attain the necessary skillset demanded by the 4IR due to limited funds. Findings from both the studies by Ocholla and Ocholla (2019) as well as Manda and Dhaou (2019) emphasize that South African academic librarians cannot survive without going through continuous training and retraining locally or internationally paying attention to disruptive technologies and how they can be applied in the provision of library services. The authors further added that it is the responsibility of trained academic librarians to train library users via information literacy and workshops. Their ideas were reflected by Ghosh (2017) who indicated that qualified librarians can't be replaced with technology experts thus existing library staff should be trained and retrained.

2.6.4: Lack of policies on Lib 4.0 technologies and application

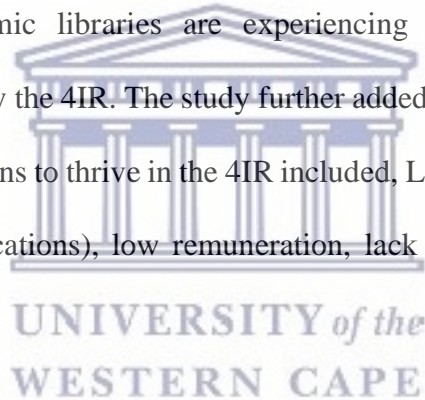
Manda and Dhaou (2019) emphasize that this smart industrialization era requires carefully developed policies to guide every facet of an institution to successfully adapt to the new technological conditions. Zervoudi (2020) agrees that policies on innovation should be the core focus of information professionals and for academic libraries to survive in the technological revolution. Jantz (2017, p. 324) is also of the view that library management innovations have not been given the needed attention to enable transformation and to keep pace in a fast-moving environment. Library policies must be revised and altered regularly and must include budgets for Lib 4.0 technologies and applications. These policies can be used effectively to inform university leaders, decision-makers, and library users to gain understanding and support.

2.6.5: ICT skills gap

Oyewumi, Akanbi and Laaro (2018) explored the ICT competencies of library staff in selected universities in Kwara state in Nigeria. The study emphasized that the ICT skills gap in Africa is a

disturbing issue and academic libraries are not immune to this challenge. The study further found that “tight working schedule, lack of motivation, lack of experience, inadequate training, and inappropriate library and information science curriculum, lack of adequate information infrastructure, absent of provision for staff training and development, limited and tighter budget for the library” (p1) are variables that contribute to the ICT skill gap.

Department of Higher Education and Training of the Republic of South Africa (2020) extensively delves into the library and archive skill plan for South Africa and realized skills gaps among library professionals such as advanced IT skills like programming and web design, data management skills, and social media management. The study predicted that this ICT skills gap is increasing at an exponential rate as academic libraries are experiencing the reality of the disruptive technological changes brought by the 4IR. The study further added that key reasons for the lack of ICT skills gap needed for librarians to thrive in the 4IR included, Lack of qualified applicants (few applicants with relevant qualifications), low remuneration, lack of work experience, and poor conditions of employment.



According to the Global Business Coalition for Education (2020, p.16), “the speed of technological updates often surpasses the speed at which current and future talent can be upskilled and trained, leaving a gap between skills needed and skills available”. As already established, several authors (Ocholla and Ocholla; 2020; Hussain, 2019; Manda & Dhaou, 2019; Ocholla, 2019; Ahmat & Hanipah, 2018) have recommended that for academic libraries to stay relevant and compete with their competitors then there is need to swiftly acquire new competent skills and implement Lib 4.0 technologies to enhance library services.

A holistic analysis of ICT skills, acquisition, and competencies of librarians in Nigerian university libraries by Ayoku and Okafor (2015) identified certain fundamental problems that needed to be reduced before academic libraries can leverage from advance technologies. These problems include a lack of interest in acquiring modern technologies relevant to the libraries, fear of new technologies, insufficient ICT training opportunities, inadequate knowledge in the application of ICT tools, lack of proper managerial planning, and lack of interest. The study then concluded that academic libraries cannot thrive without more breadth and depth of IT knowledge and skills that the electronic age demands. Without this new skill-set, it will be increasingly difficult for academic libraries to stay active and relevant. Similar findings were recorded in a study by Mashiyane et al. (2020) which discussed awareness and application of multimedia tools for information literacy instruction at an African University in South Africa. The study revealed that even though librarians were duly informed about the enormous benefits of the various multimedia tools and technologies that can help them to survive in the epoch of the 4IR, they lack adequate skills to leverage those tools and technologies. The study then recommended the various libraries should channel part of the limited resources into information literacy training to fully take advantage of the ICTs necessary for the 4IR.

Anyim (2018) highlighted Multimedia instructional resources for effective library user education programmes in universities in North-Central Nigeria. The study brought to bear that lack of relevant Lib 4.0 skills is deterring academic libraries from embracing innovative technologies. The study added that “the inability of instructors to make effective use of emerging instructional tools due to incompetency poses great concern for the university library trying to adopt multimedia technologies in library user education” (p.17). In a similar scenario, Khan and Raad (2020)

emphasized the role of e-learning in the COVID-19 crisis in India. The study found incredible benefits of technology helping e-learning to thrive. However, a lack of technological skill-sets will be a big hindrance if there is a lack of them. It is for this reason that Ali and Gatiti (2020) admonished that academic libraries should be triggered by the outbreak of coronavirus (COVID-19) and swiftly upgrade themselves with innovative technologies to continue to stay in service. Ghosh (2017, p.7) summarized the skills gap by averring that “as libraries are struggling for an identity in the era of disruptive change, new skillsets are required to mediate the digitally oriented academic library environment”.

2.6.6: Lack of institutional support

The library is considered the heart of every academic institution because of its pivotal role in ensuring its mission and vision are materialized. However, many academic libraries experienced a lack of institutional support (Sassen & Wahl, 2014). Consequently, it becomes difficult to implement technological innovations. Saxena and Dubey (2014) conducted a study on fostering research and publication in academic libraries. It was revealed that most academic libraries in India most of the time are not given the needed financial or infrastructure support. The study highlighted that librarians need financial support to conduct research and invest in new emerging technologies for the libraries to stay active and relevant in the test of time. The study further argues that, if libraries are not supported to conduct scholarly research which is key for their professional growth, they will not be in a better position to invest in emerging technologies needed for a new revolution. This finding is supported by the study of Mashiyane et al. (2020) in which they found that lack of institutional support has been a big hurdle for academic libraries to progress in the incorporation of modern technologies to enhance the provision of information services. Likewise, Acheampong

and Dei (2020) also found that a lack of institutional support has made it trying for the goals of academic libraries to be materialized. Because of this Ntlotlang (2019) examined Technology mediated tools as drivers of the library at the Botswana International University of Science and Technology. The study found that institutional support is a compelling factor for academic libraries to champion emerging technologies but lack of it slows down progress to embrace technological change pertinent to the library. It was further postulated as information contributes immensely to academic institutions, librarians should be proactive and continue to lobby and solicit support from the top management and other potential sources of funds. Oakleaf (2010) also brought to bear that academic libraries should continue to show evidence of their value and not assume it will be obvious.

2.6.7: Lack of staff motivation

Staff motivation performs a pivotal role in any organization with academic libraries being no exception (Ntlotlang, 2019). A study by Bamgbose and Ladipo (2017) in a Nigerian academic library found that various forms of motivation like job security, wages and salary, relationship with colleagues, staff appraisal, financial incentives, and rewards were available to the library employees as well as that most of the motivational parameters influence the performance of the library employees to a very great extent. However, the inadequate supply of these factors decreases the behavioral intention of librarians to embrace new technologies. Results of the study by Machara and Jain (2018) also found that library staff of some selected public libraries in Botswana were de-motivated and discontented with their jobs. Consequently, the staff was not showing the enthusiasm to support and embrace any initiative that will keep the library with the pace of ongoing trends. The de-motivation was attributed to factors such as job security, bad interpersonal

relationships coupled with a lack of policies and procedures, incentives, and fringe benefits. The findings are not different from the work of Lawson (2018) who investigated the motivation and job satisfaction of staff members in Ghanaian academic libraries and revealed that motivation is a critical factor that fueled library staff to work with enthusiasm and propel them to embrace technological change. The study recommended that library management should endeavor to involve library staff in the planning and implementation of any new Lib 4.0 technology and application. In line with these findings, the study by Ntlotlang (2019) at the Botswana International University of Science and Technology concluded that it is critical to involve library staff right from the inception stage of the implementation of any new technology.

2.6.8: Fear of losing employment

Both Schwab (2016) and Anyim (2018) of Nigeria emphasized that the resistance to adopting some of the 4IR technologies was attributed to the fear of losing jobs. Hussain (2019) explored how developing countries are responding to the challenges and opportunities that libraries have inherited from the 4IR. The findings revealed that workers have a perception that disruptive technology will lead to unprecedented job losses. This finding supports what transpired during the World Economic Forum (2016) where it was emphasized that the 4IR will lead to job displacement and that gaps in skills will heighten the fear of employees losing their jobs. These predictions were reinforced by Zervoudi (2020) who found the fear of losing jobs due to disruptive technologies occurred in the nineteenth and twentieth centuries during unprecedented waves of technological progress. In contrast, Tella (2020a) concluded that the 4IR will not lead to unemployment if library professionals focus on learning to use the latest technologies to provide optimal services.

2.6.9: Technophobia

The World Population Ageing Reports by the United Nations (2013; 2017) described the older workforces as “born before computers” while Thompson and Mayhorn (2012) added that they tend to suffer from technostress, fear technology, or even have technophobia. Grounded on past studies, Thompson and Mayhorn (2012) argued that technical challenges and attitudinal barriers make it difficult for older library staff workers to embrace new technologies that are compelling for service provision. Schwab (2016) postulated that due to the constant upgrading of the digital system, older workers usually find it difficult to upgrade themselves in the technological advancement in the workplace. Penprase (2018) contended that technophobia can be attributed to the lack of workers’ adaptability, self-directed learning, and competence. The study by Yang (2019) on the 4IR and older workers reflects that the swift proliferation of the disruptive technologies of the 4IR has caused fear of technology and even technophobia, especially in the older working forces resulting in resistance to new smart technologies. In a more recent study, Mashiyane et al. (2020) after investigating the awareness and applications of multiple tools for information literacy education at the North-West University Library in South Africa, found that technophobia contributed to 64% of librarians resisting incorporating Lib 4.0 applications and technologies.

Yang (2019, p.5) suggested training to overcome technophobia and address the “intergenerational gap in technology”.

2.6.10: Lack of interest in 4IR technologies.

Interest is key in any implementation of technologies. regardless of how robust or interesting any technology may be without staff interest; its usage will not yield the intended purpose. The study

by Ocholla and Ocholla (2017) which investigated the changing library and information research landscape in South Africa brought to the fore that, staff has a key interest in new technologies to support library services. Support for these findings was supplied by the study by Stilwell (2018) who explored the effectiveness of leadership styles among academic research librarians in Eastern and Southern Africa and found that librarians are supporting new adoption of technology to make the library look smart. Similarly, findings were also recorded in the work by Onyancha (2018) as well as Raju (2017) where librarians were showing eagerness to support innovation in terms of using smart technologies to revolutionize the trend of library services delivery.

2.6.11: Non-availability of IT consultation services

The 4IR technologies and applications come with new challenges that academic libraries need to prepare for. That is maintaining the implemented 4IR technologies to continue serving patrons and to ensure its longevity. IT-related services usually face the issue of a lack of technical experts to handle machines in case they become faulty. Due to a lack of experts, the aftermath is to dispose of machines due to a lack of IT consultants to provide technical services. The works of Hussain and Parveen (2021) investigated the availability of ICT Facilities in libraries and revealed that IT support for libraries is an incredible constraint causing libraries to lose technologies they have invested in. The study further added that the lack of IT expertise among librarians who can handle technical issues and getting support from elsewhere/outsourcing becomes a daunting task. Similar findings were found in the works of as well as Rafi, Ali and Ahmad (2016) as well as Taufiq, Rehman and Ashiq (2020).

This aspect of the literature review details a myriad of challenges mitigating rapid digital transformation in academic libraries towards the 4IR. Among the various pitfalls, limited funds critically slow down academic libraries' efforts to act swiftly to respond to the demand of the 4IR. Without funding it becomes difficult for libraries to implement Lib 4.0 technologies and the cost of consultation services as well as motivating library staff. It is not surprising the findings of Oke and Fernandes (2020) show that North-West University in South Africa's plan to embrace disruptive technologies was obstructed by the limited fund. Again, training in Lib 4.0 technologies and skills requires the same funds, therefore creating skill gaps germane for the library to survive and hence causing low interest in new technologies and limited technical experts to handle Lib 4.0 technologies. A further analysis inferred that lack of institutional support which ultimately could be a result of limited funding. Management is often constrained to channel its limited funds to other pressing needs in the library at the expense of technological changes. On a personal level, library staff's perception of losing jobs due to digital transformation can be attributed to a lack of training and orientation meanwhile this should serve as an opportunity for library staff to upgrade themselves with new skills to fill in opportunities that 4IR may create. Even though technophobia is mostly found among the aged staff, it can be reduced to the barest least if library management is able to channel more funds into training and retraining. However, this is often unattainable due to limited funds. It is also not surprising that there is a lack of interest in the Lib 4.0 academic library among academic library staff let alone creating policies to capture Lib 4.0 while there is limited fund to implement them.

2.7: Responsive structures needed and policies for the 4IR in academic libraries

To prepare academic libraries for the 4IR, the International Federal Library Association (IFLA, 2017) held a special Global Vision discussion in July 2017. Four hundred and fifty-panel members focused on a “united library field” produced a consensus statement and outlined strategies. Church et al. (2017, p. 3) reported it as:

“Libraries enable literate, informed, and participative societies. When we look at the future, according to the debates in our teleconference, libraries will be trustworthy information brokers; will do more with new technology; provide universal access to information and scholarly works, whether it be media or information we already know or new media; preserving and providing access to information in all formats and providing trusted and effective support for political and social engagement. Libraries will be advocates for and facilitators of the Fourth Industrial Revolution, where people create their own devices and objects.”

Schwab (2016, p.1) predicted even before IFLA’s statement that although exact disruptive changes are unknown, “response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society”. Fibrich (2017) opined that disruptive changes brought by the 4IR are paralyzing libraries that failed to envision its demand and prepare accordingly and that new business models are needed to accommodate the needs and demands of library users. Ahmant and Hanipah (2017) agreed by indicating that academic libraries need to be proactive to employ the necessary strategies and policies to deal with these challenges. Mohideen (2020) added the clear mission of librarians.

Leveraging 4IR tools to remain relevant and enhance their services was seen in the innovative provision of library services amidst the COVID-19 pandemic.

From the literature, it is clear that key factors to deal with the disruptive changes of the 4IR are:

- People
- Organization Structure
- Lib 4.0 Technologies
- Tasks
- Library Policies

2.7.1: People

People are among the key players in academic libraries that work to overcome the daunting challenges of the 4IR. In light of this, Leurent and Shook (2019) claimed that the mindset of library professionals needs to be re-oriented towards accepting change to navigate the complexities of today and tomorrow. In reinforcement of what Leurent and Shook (2019) postulated, Hussain (2019, p.4) contends that 4IR will “enhance the safety and security of increased human capacity”.

To prepare library professionals for 4IR changes, Ahmat and Hanipah (2017) concluded that they must continuously be reminded that the only way to experience growth is by way of accepting positive change. The study further recommended that library professionals should consider 4IR change as inexorable and eagerly embrace change.

To successfully change the mindset of information professionals to embrace 4IR changes, library leadership has a pivotal role to play (Tella, 2020a). The best leadership style, especially one focusing on the motivation of library staff, should be adopted (Ocholla & Ocholla, 2020). Ahmat and Hanipah (2017) warned that behavioral change does not occur overnight but rather goes through systematic stages or a so-called cyclical process. Prochaska, DiClemente, and Norcross (1992, p.102) researched how people change and indicated that several theoretical approaches can be adopted to expedite the change process. One such theory is the Transtheoretical Model which states that the change in the mindset of an individual goes through the six structured stages of pre-contemplation, contemplation, preparation, action, maintenance, and termination.

Butler-Adam (2018), Raju (2017), and Prisecaru (2016) agreed that as the 4IR requires information professionals to use new technology requiring new management skills, multi-tasking skills are needed. Dempsey and Malpas (2018), as well as Ocholla (2016), emphasized that there should be a management policy to ensure the behavioral aspect of the employees is constantly evaluated and recommended changes that will embrace the needs of the technological disruptive challenges.

2.7.2: Organization Structure

Morgan (2014, p.1) stated that an organizational traditional hierarchy is rigid and “riddled with bureaucracy and extremely sluggish”. As the 4IR requires change, academic libraries cannot continue to operate with traditional structures (Ahmat & Hanipah, 2017). Although there are several structures that academic libraries may adopt to strategically deal with disruptive change, the authors found the Holarctic structure, which includes employees in decision-making to be effective. In the same token, an earlier study by Ahmat et al. (2016) discussed the establishment of a strategic program in research support service at the University Sains Malaysia (USM) in

Malaysia. The study concluded that a flatarchy structure that focuses on innovation can be adopted as it allows employees to produce innovative ideas, especially in the quest of introducing a new system or ad hoc programmes.

2.7.3: Lib 4.0 technologies

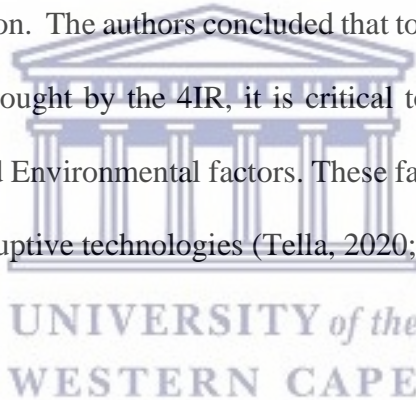
The 4IR is all about the introduction of new but innovative technologies to enhance service provision, making it more cost-effective, attractive, and functional to continuously attract more customers (Ahmat & Hanipah, 2017; Ocholla & Ocholla, 2017). Noh (2015) asserted that libraries cannot be considered intelligent systems without integrating innovative technologies. Library management should endeavor to bring in Lib 4.0 technologies to enhance the provision of library services, making resources accessible irrespective of the geographical location and time of the day, and allowing for retrieving relevant information to meet information needs (Lewis, 2019; Manda & Dhaou, 2019; Dempsey & Malpas, 2018). Tucker and Kimbrell (2013, p.1) profoundly presaged that libraries focusing on bringing in modern technologies to enhance their services should shun technology tools that are “difficult on technical glitches, focused on being placed more on quantity as opposed to quality, making the library staff having difficulty in keeping up with the technology and having to spend instructional time familiarizing themselves with that technology, minimizing library business efficiency and increase maintenance cost, and poor in performance, with loose security, less ownership, and high limitations”.

2.7.4: Task and environment

In the context of this study, the task refers to the work activities that library staff undertake due to the demand of the disruptive change of the 4IR, while the environment captures the surrounding within which the task operates. Pascual (2019) posits that the task demanded by the 4IR needs

constant review, making sure that library professionals are conversant with recommended Lib 4.0 tools. To achieve this, constant training and retraining to attain relevant Lib 4.0 skill-sets should be prioritized (Ocholla & Ocholla, 2020). In effect, this will alleviate the issue of library professionals resisting embracing new technology compelling in the 4IR era (Ahmat & Hanipah, 2017).

A risk assessment should be conducted to make sure library staff works in a conducive environment. An overall assessment of environmental changes considering both internal and external factors is needed (Ahmat & Hanipah, 2017). External factors are regarded as opportunities and threats from outside the organization, while internal factors are capturing strengths and weaknesses within the organization. The authors concluded that to undertake a holistic assessment of the environmental changes brought by the 4IR, it is critical to consider Political, Economic, Social, Technological, Legal, and Environmental factors. These factors must be considered before deploying and incorporating disruptive technologies (Tella, 2020; Ahmat & Hanipah, 2017).

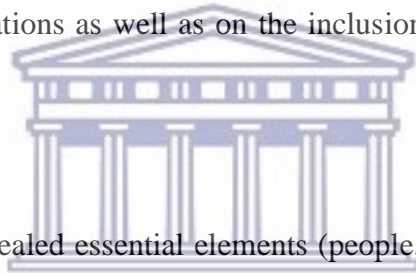


2.7.5: Library Policies

Ahmadian (2019) delves into 70 school library policies in universities in the United States and brought to bear that there are fundamental principles for planning and managing libraries as a policy provides a framework for the underlying principles and guidelines in the selection, acquisition, evaluation, and maintenance of library resources. As the 4IR messages libraries to incorporate technologies to enhance their services, implemented library policies must regularly be reviewed and amended (Ahmadian, 2019). Baker (2013) also undertook a content analysis on library privacy policies. The study asserted that the policy of the academic library should be clear and easy to access by library users, updated frequently regarding technological changes, and

disseminate effectively. This move will not only keep the library active amidst technological disruptions but also keep them on their toes to provide smart services to survey technologically savvy patrons.

Manda and Dhaou (2019) call for a library policy that focuses on good leadership to support the implementation of digital transformation technologies in the era of 4IR. The library policy should be restructured to encapsulate attributes of skills that match with skills needed in the digital transformation era, good financial budget, new business model, positive organizational behaviours, and new job descriptions (Ahmat & Hanipah, 2017). Tella (2020a) added that there should be innovative policies in academic libraries focusing on reducing barriers to implementing Lib 4.0 technologies and applications as well as on the inclusion of constant training of library staff.



The literature review section revealed essential elements (people, organization structure, Lib 4.0 technologies, tasks, and library policies) that need to be incorporated effectively to enhance an academic library's effort in leveraging 4IR technologies. To attain this success, it was suggested that academic libraries should adopt the Transtheoretical Model, leading to a paradigm shift in people's minds. Embracing this new mindset will be essential to effectively guide librarians through the process of digital transformation. While effort is being made to change the mindset of people, it is also pertinent for library management to embrace effective organization structures, especially ones that will involve library staff in decision-making. Not only will this move motivate staff to support the idea of embracing Lib 4.0 technologies, but it will also stimulate their mindset to maximize their skills to support this digital transformation agenda. In doing so, it is apropos for

library management to consider the demand for the Lib 4.0 technologies necessary to be adopted. A proper preliminary needed to be conducted, starting from planning and preliminary investigation, critical system analysis, testing, adopting, and implementing Lib 4.0 technologies based on local needs, and factoring in maintenance to keep up the technologies running. It was worth noting that the library cannot smoothly navigate in this digital transformation in the epoch of the 4IR without library policies tailored toward Lib 4.0. The policy needs to be adjusted to match up with new demands, for instance, what kind of new skills attitudes, leadership, financial budget, new business model, and new job descriptions are needed. It can be inferred that all the aforementioned factors are elements that form a system to harness this industrial revolution in the academic library.



2.8: Actions towards 4IR disruptive changes in academic libraries

Academic libraries need to reposition themselves with well-planned actions to deal with the associated challenges, opportunities, and emerging trends of the 4IR. Dempsey and Malpas (2020) observed that the 4IR in this digital-driven era comes with complex demands forcing academic libraries to take strategic actions to control its inherent disruptive changes. Both Majdalawi et al. (2015) and Manda and Backhouse (2017) stressed that context-specific strategies are crucial as not all libraries can blindly copy from the Westernized world. Schwab (2018a) also stressed that constantly adapting, engaging in partnership with other entities as well as shifting from reactive to proactive strategies will help organizations to cope well in the 4IR era. As early as 2009, Chad (2009) profoundly avowed that innovative services from outside the traditional library domain will help the library in the era of the 4IR. These services have substantially grown the total ‘library’

market but have taken ‘market share’ away from conventional libraries. Consumers like the new services and often prefer them to the services offered by ‘new conventional’ libraries” (Chad, 2009).

The next sections will discuss actions deemed critical for libraries to survive the 4IR disruptive changes.

2.8.1 Provision of ICT infrastructure and emerging technologies

Over the years, the profuse use of ICT has performed incredible roles in augmenting the academic library as its ultimate aim is to help its parent institution to accomplish its goals and vision (Rajni & Khan, 2019). Research by Zielinski et al. (2018) at a community college in upstate New York explored college student feedback about librarian-created instructional videos. The study concluded that academic libraries are vastly exploiting ICT to undertake information literacy programmes to enhance teaching and learning. This latches on to what Osborn (2017) said that librarians are facilitators and content developers rather than mere providers of information. ICTs help academic librarians and information seekers acquire, organize, preserve, retrieve, and disseminate needed information quickly and easily (Sangale, 2015).

The study by Ocholla and Ocholla (2019) explored South African libraries and analyzed 26 academic library websites. The study found that the unparalleled disruptive technologies of the 4IR have awakened the interest of academic libraries to invest more in the provision of ICT infrastructure. For instance, the results demonstrate how well libraries are adapting to the transformation through their offerings, showcasing impressive innovation and ingenuity. The

study realizes that libraries have begun to incorporate 4IR technologies such as robotics/AI, maker space e-catalog, and e-resources to provide smart library services. It then recommended that Academic libraries need to be better resourced, utilized, and accessible, and their web presence needs to be increased to keep up with trends.

On the contrary, Mashiyane et al. (2020) found that the North-West University in South Africa, academic librarians were not utilizing the ICT facilities on which the library management has spent a quantum of money. The reason for non-use was attributed to inadequate skills. Similar findings were recorded in the study by Mahlangu (2018) who explored the good, the bad, and the ugly of distance learning in higher education. The author believes that, after spending limited funds on making emerging ICT infrastructure available in the library, users failed to utilize it. Meanwhile, emerging technologies keep the library revived, reformed, and activities to meet the myriad needs of patrons. Likewise, Anyim (2018) revealed in the study that discusses multimedia instructional resources for effective library user education programmes in Universities in North-Central, Nigeria that with appropriate strategies such as making an effort to promote the invaluable benefits of utilizing the adopted ICT infrastructure with time library users will appreciate them.

2.8.2 Education and training

Education and training are needed especially during the implementation stage of any new digital system. According to Ocholla (2013, p. 2), education and training should include “information on content, purpose, method, time/education, trainers and location or situation of a programme or course all of which are essential in a successful dispensation of human”. Tait, Martzoukou and Reid (2016, p.7) also posit that academic libraries should carry out education and training as well as “making available continuous professional development opportunities for existing

professionals”. In a recent review, Yusuf, Walters and Sailin (2020) contend that education and training enable graduates and professionals to provide the golden opportunity to obtain the right skills essential to improving the sustainability of future technologies.

Du Toit (2019) postulated that the library should focus on creating digitally literate individuals and that 4IR patrons, especially students, should be trained to work with different new technologies and to make connections with information and digital technology in creative ways so that the intended outcome can be applied across different information environments. Ayinde and Kirkwood (2020) studied rethinking the roles and skills of information professionals in the 4IR and also suggested that due to the anticipated disruptive changes of the 4IR, librarians are compelled to strive to acquire required new skills and be adaptable in taking new roles. The finding agrees with the work of Park (2018) as well as Park et al. (2018) who emphasized that libraries should reconsider their job and employment structure as the 4IR will not allow them to remain unchanged if they want to keep their role in active services. Findings by Noh and Chang (2020) delve into “selected various factors that influence the satisfaction and use of public libraries through reflecting social changes led by the fourth industrial revolution. The study emphasizes that information professionals need to act swiftly to accommodate the new trends using modern technology and training and education cannot be left out of the equation. The authors further concluded that training and education are compelling for all libraries to survive amidst the disruption caused by 4IR. For instance, training will help the library to deliver the core information needed to draw patrons to libraries and increase the rate of utilization by offering library services based on the needs of varying needs of users in the rapidly technology-changing environment.

Ahmat et. al (2016) explored the strategic program for research support services introduced by the Malaysia University Library. The study found that the academic library cannot survive without education and training. Given this, management has planned to incorporate training as part of its programme to enable patrons to acquire skills and knowledge to use modern applications such as Mendeley, Open Access Publication, and Google Drive. Frahm-Arp (2018) undertook an extensive study investigating how the 4IR is changing jobs and its inherent challenges in 4IR library science using the University of Johannesburg as a focus. The study also brought to light that management is unremittingly focusing on re-skilling staff members and re-shaping positions so that they are more relevant through education and training.

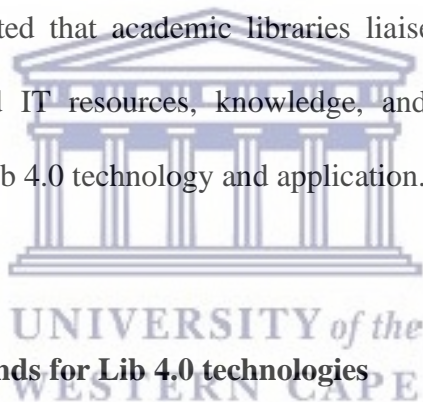
Ocholla and Ocholla (2020) investigated the readiness of South African academic libraries to supply research, teaching, and learning support in the 4IR. The study concluded that academic libraries in South Africa are making great efforts to expeditiously upgrade their services through training and education. For instance, focusing on 26 university library websites, it was found that the recruiting managers of the various libraries are focusing more on raising librarians who are smart, qualified, competent, adaptive, creative, innovative, critical thinkers, complex problem solvers, and self-learners ethical. These findings confirm the findings of earlier studies by Ahmat and Hanipah (2018) who investigated how prepared libraries for the 4IR and Ocholla (2016) who investigated the new roles of university libraries in supporting scholarly communication and research. Ocholla and Ocholla (2019, p1.), as well as Oke and Fernandes (2020), arrived at a consensus that academic libraries are championing information literacy programmes via in-person and virtual based fueled by the need to raise smart library professionals as well as patrons.

2.8.3 Innovation strategies implemented in academic libraries

The fourth industrial revolutionary change will be unprecedented due to its envisioned multifaceted impact (Schwab, 2016). Almost every facet of the economy has been signaled by the impending disruptive changes that the 4IR may bring and the need to quickly restructure business workflow-focusing more on innovation (Tella, 2020a). Carvalho (2010) asserted that implementing innovation strategies will be an apt way for academic libraries to survive amidst inexorable disruptive changes. Mhlanga and Moloji (2020) maintained that innovation capacity is needed in South Africa to create the chance of standing strong in the global competitive market. In the context of the library, the academic library is an institution that has made a great effort by embracing emerging technologies needed and applicable in the provision of library services to cause a momentous positive change (De Jong, Munnik & Will, 2019). This assertion is confirmed by the study of Ntlotlang (2019, p.6) who found that the Botswana International University of Science and Technology library has developed technology-mediated tools such as “Library guides, podcasts, pallets, Facebook, blackboard, Twitter, WhatsApp and institutional repository (IR) with multiple interfaces” as a strategic action to respond to the demand of the 4IR. The author further added that quite a number of libraries have been fueled by this move to harness access and usage of research management tools in the digital transformation era. For instance, the academic library has prioritized the so-called “open Access information highway” and researcher collaboration to augment the library to drive the unprecedented changes of the 4IR. This initiative as observed will support the academic library to respond adequately to their technology-driven users, by helping them to easily access relevant information, robustly and conveniently (De Jong, Munnik & Will, 2019). Khan and Bhatti (2017) also concluded after conducting a study on academic libraries in Pakistan, that for the academic library to upgrade to the expectation to welcome the disruptive

change of the 4IR, stakeholders such as the Higher Education Commission as well as local and international library associations have initiated innovative ICT training programmes that create invaluable opportunities for librarians to acquire necessary digital competencies.

Another innovation strategy that has been prioritized by the academic library needed in the era of the 4IR is collaboration and partnerships (Ntlotlang, 2019). This pragmatic approach has been viewed as an indispensable driver for an academic library to provide quality services and to stay relevant and strong in the digital transformation era. The author further avowed that collaboration and partnerships enable the academic library to leverage expertise and resources if they are not capable of providing from members in the same consortium. These findings are akin to the work of Atkinson (2018) who indicated that academic libraries liaise with other libraries to share resources such as sophisticated IT resources, knowledge, and competence to expedite the implementation of compelling Lib 4.0 technology and application.

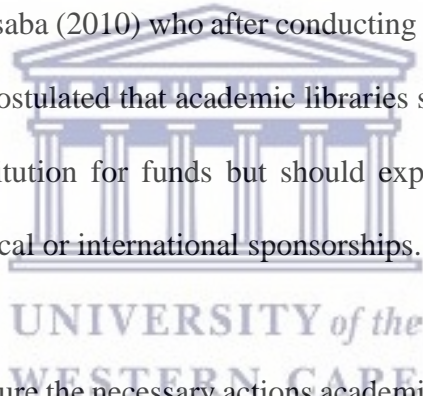


2.8.4 Allocation of adequate funds for Lib 4.0 technologies

Over the years, academic libraries in Africa have been battling with limited funds (Dadzie & Van der Walt, 2015, p.20; Ubogu & Okiy, 2011) resulting in financial constraints making it difficult for libraries to materialize their plans of ensuring the implementation of Lib 4.0 technologies and applications. To remedy this, there is a need for separate policies focusing on the allocation of funds for Lib 4.0 technologies and applications (Dadzie & Van der Walt, 2015).

Dadzie and Van der Walt (2015) did a study on planning for the digitization of university libraries in Ghana. The study's findings indicated that 16.6% to 50% of the total budget is allocated to

digital transformation. The study recommended that academic libraries should expand their budgets by including internally generated funds from leasing out auditoriums and other premises for activities. The study emphasized the value of a separate policy on fund generation to be allocated for digital transformation and strong leadership to make university libraries financially grounded for the future digital revolution. The study recommended that academic libraries should seek partnerships with local and international organizations especially those that focus on education as their social responsibility creating strong lobby groups to win the attention of the government to be supported with regular funds. This recommendation is in line with the plan suggested by Murimbika (2018) which revealed that a concerted effort from stakeholders of libraries in South Africa is needed to support libraries financially. This finding echoes earlier recommendations of Baro and Asaba (2010) who after conducting a study on internet connectivity in Nigerian academic libraries, postulated that academic libraries should not solely depend on the government and the parent institution for funds but should expand their sources for example internally generated funds and local or international sponsorships.



Findings from these sections capture the necessary actions academic libraries have initiated toward the demand of the 4IR. As part of the GCI, the provision of ICT infrastructure and emerging technologies, training and education, availability of adequate funds, and innovation strategies are compelling factors for every country to thrive in a digital transformation era. Relating to these constructs, it can be inferred from the findings that academic libraries have realized they cannot thrive without responding to the demand of 4IR. This has been evident in most South African University libraries as revealed by Ocholla and Ocholla (2019). However, the study by Mashiyane et al. (2020) confirmed that the North-West University in South Africa is spending a great amount

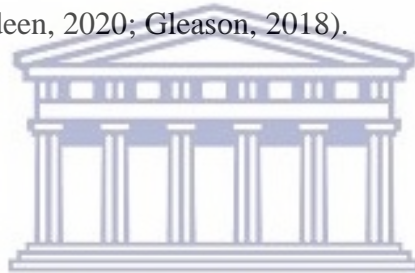
of money investing in Lib 4.0 technologies, unfortunately, library staff are not cooperating and utilizing these technologies as envisioned by the library. This can be ascribed to the fact that the human capital of the various libraries has not been fully developed to face the new reality. Other authors including Ayinde and Kirkwood (2020); Park (2018) and Park et al. (2018) have also found that education and training is the best way to remove staff resistance to change, motivate and help them acquire the needed skill set to be smart, qualified, competent, adaptive, creative, innovative, critical thinkers, complex problem solvers, and self-learners. It was also found that academic libraries need to work smartly with innovative strategies such as open Access information highway and researcher collaboration. The partnership will not only open the door for members to leverage each idea but also helps academic librarians to acquire the necessary digital competencies to thrive. In doing so, it was found that innovation strategies, education and training, and provision of Lib 4.0 technologies will be materialized if there is adequate funding and judicious use of available funds. It is therefore crucial for academic library management to strategically look beyond their immediate sources of funds to create ideas to attract more funds from other avenues. Dadzie and Van der Walt (2015) emphasized the need for academic libraries to have separate policies on fund generation for digital transformation. Also, strong leadership makes the libraries financially grounded for the future digital revolution cannot be underscored.

2.9 4IR in Africa

Africa is at the dawn of the 4IR, given this, African leaders need a pragmatic approach to attempt to catch up with the Westernized world. This will put them in a better position to leverage the great fiber of the transformational change caused by the 4IR disruptive technologies including AI, robotics, IoT, big data, and 3-D printing (Ocholla & Ocholla, 2020). However, Brown (2020, p.1)

observed that Africa is far not ready to leverage the disruptive technologies of 4IR. The author further buttressed this assertion by making an inference to the fact that Africa has begun to witness the reality of the challenges posed by 4IR including unemployment, infrastructure deficits, limited use of modern technology, and a workforce that is over 80 percent active in the informal sector, with women overrepresented. A classic example is a clear mismatch between skillsets and the current job demand caused by the 4IR rendering unqualified and irrelevant persons to occupy vacant job positions (Oxford Business Group, 2020). It can therefore be observed that the incorporation of the 4IR disruptive technologies is still in its nascent, all information professionals should be provided with 4IR skillsets including critical and analytical thinking (Ocholla & Ocholla, 2020) problem-solving abilities, leadership and collaboration, creativity, and practical reasoning, and teamwork (Mohideen, 2020; Gleason, 2018).

2.9.1: 4IR in South Africa

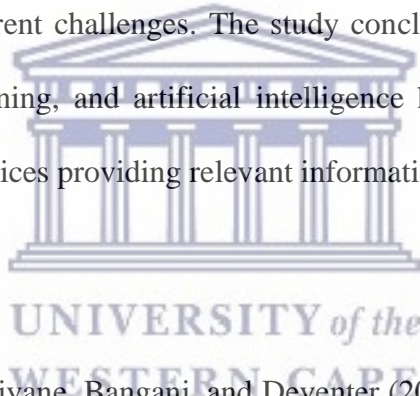


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South Africa is known to have been tempted to profusely adopt 4IR technologies to transform its economy, especially in government, the educational sector as well as businesses (Ocholla, 2016). This finding is in line with the later work of Murimbika (2018) who found that South Africa has adopted a lot of disruptive technologies be it robotic, cloud computing, AI, big data, Blockchain, and others to boost the growth of its economy. For instance, over 50% of businesses in South Africa are already using cloud services, and South Africa is leading Africa in the adoption of cloud computing technology (Muhammed et al., 2015). The World Economic Forum's Global Information Technology report of 2015 ranks South Africa among the top twenty of the top cloud computing export markets for US-based ICT development companies (Dutta et al., 2015).

With regard to the educational sector, Ocholla and Ocholla (2020) explored the readiness of academic libraries in South Africa to support research, teaching, and learning in the Fourth Industrial Revolution. The study confirmed that South Africa has been proactive in championing the incorporation of Lib 4.0 to enhance teaching and learning. For instance, the University of Pretoria and the University of South Africa have incorporated Lib 4.0 3D technology, Makerspace, IA, robots, and virtual reality into their library services. Ocholla and Ocholla (2019, p.2) compared 26 South African academic library websites and concluded that academic libraries are responding with remarkable innovation and creativity to the revolution.

Frahm-Arp (2018) undertook a study on how the 4IR is changing jobs and how libraries in South Africa are coping with the inherent challenges. The study concluded that technologies such as Blockchain, big data, deep learning, and artificial intelligence have been implemented where necessary to enhance library services providing relevant information to information seekers in the new technological trends.

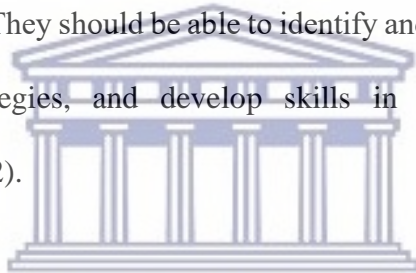


In contrast, the findings of Mashiyane, Bangani, and Deventer (2020) investigated the awareness and application of multimedia tools for information literacy instruction at an African University. The study exposed the South African academic library as being ill-prepared to leverage the various multimedia tools relevant to the 4IR to handle the recent COVID-19 pandemic where physical contact was not encouraged.

In terms of scholarly research, several authors in South Africa including Chiware and Becker (2018); Hodonu-Wusu and Lazarus (2018); Kwanya and Stilwell (2018); Onyanha (2018); Ocholla and Ocholla (2017); Raju (2017); Ocholla (2016) as well as; Wilson et al. (2010) have

developed a key interest with the intent of helping to build and shape new libraries that will meet the demand of the 4IR as far as the provision of technological bias resources and services are concerned.

Du Toit (2019) undertook an extensive study about the Big 6 information literacy skills still relevant within the 4IR. The study affirms that academic libraries have realized the unavoidable disruptive changes of the 4IR, and they are sedulously championing the incorporation of Lib 4.0 technologies and applications. The author emphasized that implementing advanced Lib 4.0 technologies and applications is a call for libraries to adequately train their patrons, especially students to acquire the necessary skills to use Lib 4.0 technologies to access relevant information to meet their information needs. They should be able to identify and “define information problems, learn information-seeking strategies, and develop skills in organizing and disseminating information” (Du Toit, 2019 p.12).

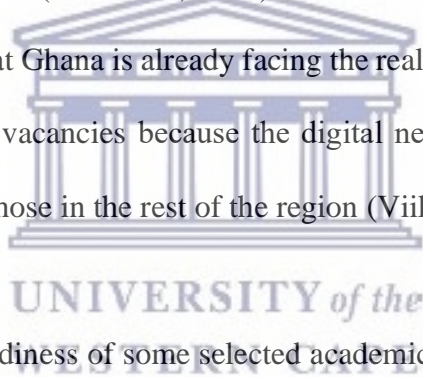


The study of Ocholla and Ocholla (2020) on the responsiveness of academic libraries in South Africa to Research Support in the 4th Industrial Revolution. The study unraveled that Lib 4.0 applications such as robotics and Makerspace are now emerging in the various academic libraries as they appeared with 4% and 8% respectively as compared to other applications such as Ask-a-librarian (62%), Libguides (73%), and other which have currently dominated in the libraries. The study further reported that the University of Pretoria Library is one of the libraries in South Africa that vastly focuses on the implementation of Lib 4.0 technologies and applications. They have, for example, incorporated a robot named “Libby” or “humanoid librarian” that assists in the reference services (Ocholla & Ocholla (2020). This humanoid librarian is considered to be the first of its

kind in Africa. The authors emphasized that such new technology is envisioned to transform the library services and alert other South African academic libraries to follow suit. The study concluded that libraries are steadily incorporating and variably applying Lib 4.0 technologies and applications (Ocholla & Ocholla, 2020). The University of Johannesburg has the highest number of library staff members with Ph.D. qualifications and a concentration in AI (Marwala, 2019).

2.9.2: 4IR in Ghana

Ghana is still battling with the social issue of the digital divide, however, some sectors of Ghana's economy such as education, government, and industries have made efforts to leverage the application of modern technologies (Viik et al., 2020). In contrast, the Global Business Coalition for Education (2020) reported that Ghana is already facing the reality of advanced skills shortages making it difficult to fill in job vacancies because the digital needs of Ghana's economy have progressed at a faster pace than those in the rest of the region (Viik et al., 2020).



Esew (2019) investigated the readiness of some selected academic libraries in Sub-Saharan Africa focusing on Nigeria and Ghana. The study emphasizes how they are coping with the 4IR changes. The study found that academic libraries are yet to incorporate Lib 4.0 technologies and applications to provide effective and efficient services, but that digital services are provided in which the disruptive challenges of the 4IR could fit. The study concluded that to survive constant updating must be a priority for these academic libraries.

Although the application of 4IR technologies is at the dawn in Ghanaian academic libraries, the University of Ghana recently launched the Makerspace initiative to harness the interest of users

and enhance teaching and learning (University of Ghana, 2020). Also, in 2019 the Ashesi University in Ghana launched an initiative that will encompass Assistive Technology Makerspace and 3D printing with the aim of helping the youth in capacity building and practical skills to harness innovation (Willsher, 2019).

2.10 Concluding summary

This chapter discussed pertinent related literature on the readiness of academic libraries towards the 4IR in Africa specifically focusing on Lib 4.0 technologies and applications, required Lib 4.0 knowledge, skills and competencies, inherent challenges, as well as recommended strategies, policies, and actions.

The literature reflects the ongoing discussions on the 4IR and its inherent disruptive changes. These changes have affected almost every facet of society, but the impact on academic libraries is remarkable. While in the lens of some authors, the disruptive technologies of the 4IR pose a challenge to academic libraries, others see it as an opportunity to exploit and enhance their services.

As evident in the literature, academic libraries are duly informed about the fact that they are no longer only fighting with their usual competitors such as search engines like Google in the provision of information, but also with the disruptive changes caused by the 4IR which has the potential of rendering the job of the librarian irrelevant. Internationally, academic libraries have initiated actions to catch up with 4IR technology and application as well as in training librarians

in the use thereof. African developing countries such as South Africa and Ghana are, however, slower in initiating quick and strategic incorporation of these disruptive technologies.

The literature also revealed that academic librarians need the training to fill critical skillset, competence, and ability gaps as well as policies to minimize and embrace the disruptive effects of 4IR technologies and applications. Critical challenges such as inadequate funds, ICT infrastructure, institutional support, and policies are evident in academic libraries. Although academic librarian's attitudes of resistance to changes, fear of losing jobs as well as technophobia and technostress have been reported, strategic moves initiated by academic libraries towards 4IR are prioritizing the provision of ICT infrastructure, emerging technologies and training, job motivation, innovation strategies, policies on emerging technologies, and budgetary allocation.

The next chapter discusses the adopted theoretical and conceptual framework which elucidates the critical constructs which are compelling for academic libraries to consider in the unpredictable disruptive technological changes of the 4IR...



CHAPTER THREE: THEORETICAL PERSPECTIVE AND CONCEPTUAL FRAMEWORK

3.1 Introduction

This chapter encapsulates the theoretical perspectives and conceptual framework that helped to underpin the study. It introduces the overview of the theoretical framework and conceptual framework and their relevance to the study. It further gives a succinct explication of why the researcher was driven to employ the chosen theoretical perspective as well as the conceptual framework to underpin this study. It also captures critical critiques of conceptual and theoretical frameworks, their major strengths, and applications to others in the field of library and information science field.



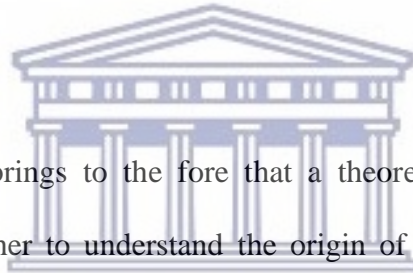
3.2 Overview of Theoretical Perspective and Conceptual Framework

Theoretical perspective and a conceptual framework are akin to that of a “blueprint” of a house, in other words, a drawing plan of a house (Creswell & Poth, 2017; Grant & Osanloo, 2014). Sinclair (2007) related theoretical and conceptual frameworks to a map that gives a direction to a traveler. The map directs or navigates a traveler through an already known path with the intent of arriving at a specific destination. In the same vein, the works of Dankasa (2015), explicate with plausible reasons the relationship among variables of a study. The lens of Grant and Osanloo (2014) reflected that a framework of research consists of theoretical doctrines, constructs, concepts, and tenants of a theory. These authors further aver that a theoretical framework or conceptual framework guides researchers to delineate their philosophy, epistemology, methodology, and analytical lens (Grant & Osanloo, 2014). Further, a defined concept helps to espouse the association that exists or is

expected to exist among variables (Creswell & Poth, 2017; Anfara, 2012; Luse, Mennecke & Townsend, 2012). Thus, it helps to elucidate the relationship that exists between dependent and independent variables, bringing to light the causative effect and giving details to the origin of a particular construct affecting the other and how it can be extrapolated to other studies (Wentz, 2017). Moreover, a theoretical or conceptual framework helps the researcher not to deviate from a delineated accepted path to undertake a study as also concurred by Creswell (2018) who asserts that a theoretical perspective or conceptual framework serves as a foundation and credibility upon which a study is guided, shaped, and developed. In the same vein, Adom, Hussain and Agyem (2018) assert that theoretical perspectives or conceptual framework serves as a guide and ensures that the credibility of scholarly sound research is undertaken. This also as resonated with Akintoye (2015) who asserts that a theoretical or conceptual framework or both used in a scholarly research study is an epitome that the research expedition was not undertaken by one's instinct or subjective lens but rather rooted in credible but rigorous principles, hence enriching the study leading to evidential findings. For instance, the constructs or variables of the adopted theoretical framework or conceptual framework give insight and buttress the findings of a study and provide a foundation for modification for other related studies to be undertaken (Wentz, 2017).

Nonetheless, Grant and Osanloo (2014) contend that a theoretical perspective and or conceptual framework is one of the most critical components in the research process of a master's or a doctoral dissertation/thesis course work, however, much priority has not been given to its importance, yet it very crucial to be ignored (Chang, 2007). Similarly, Grant & Osanloo, (2014); Imenda (2014) as well as Anderson, Day and McLaughin (2006) succinctly maintain that it will be highly inappropriate, especially undertaking any sound dissertation or thesis for a postgraduate degree

without theoretical underpinning. As Imenda (2014, p.154) asserted, “I don’t see how you can do a good piece of work that’s atheoretical”. In confirmation of the relevance of a theoretical framework or a conceptual framework to scholarly research studies, McDonald (2014) as well as Ravitch and Carl (2016), assert that, right from the inception of any research, it is pertinent for the researcher to painstakingly identify apt related theoretical or conceptual framework, having in mind the purpose of the study, statement of the problem, research objectives, or research questions or hypothesis and significance of the study. Grant and Osanloo (2014) also added that the framework of a study provides a groundbreaking, and anchor to the literature review as well as the methodology, analysis, and discussion of findings. Further, in the lens of Akintoye (2015), as well as Bernard (2013) a theoretical framework serves as a guide for possible generalization of the findings of research studies.



Additionally, Dzandza (2019) brings to the fore that a theoretical framework or conceptual framework enlightens a researcher to understand the origin of some phenomenon in research findings. This background also gave the impetus for Adom et al., (2018) without exaggeration to conclude that, scholarly research without a theoretical or a conceptual framework leaves the readers to have a blurred focus on the foundation, completely leaving the reader at sea concerning the researcher(s)’ assertions or hypothesis.

It, therefore, can be observed from the ongoing dialogue that the need for a theoretical framework or a conceptual frame is germane for research studies, therefore, cannot be underscored.

3.2.1 Dissimilarities between Theoretical Perspectives and Conceptual Framework

A theoretical perspective or frame or the scaffolding of a study is not synonymous with the conceptual framework and therefore should not be used interchangeably, but rather either one of them may be espoused to underpin a study based on what the researcher wants to investigate (Grant & Osanloo, 2014). This avowal is in agreement with the study by Wentz (2017) who bring to the fore that the theoretical framework and the conceptual framework are different, thus, it is based on the original intent of the choice and how it is applied to the process of research. Adom et al. (2018) also conjectured that the differences can be seen based on the concept and their role in research inquiry. An opposing view of Anfara (2012) argues that the theoretical framework is analogous to that of the conceptual framework in research as both help to underpin research findings.

More researchers have arrived at a consensus that it is worthwhile to know that they are not the same as Wentz (2017) as well as Adom et al., (2018) provided a concise enlightenment to their avouchment, stating that, the theoretical frameworks are derived from the already existing theories that have been scientifically and rigorously validated by several researchers and generally accepted to underpin scholarly research studies. For example; the Technology Acceptance Model (TAM) (Davis, Bagozzi & Warshaw, 1989) has been used to elucidate why users elect to use or not to use a particular technological system (Suorsa & Eskilsson, 2014), the DeLone and McLean Information Systems Success Model (Bernroider, 2008) has also been used to understand information system management and investment (Dzandza, 2019), the Socio-Technical Theory (Bostrom & Heinen, 1977) helps understand complex systems (Nieminen & Hyytinen, 2014). On the other hand, a conceptual framework may not be built on an existing theory, sometimes it is originally developed by the researcher which serves as a sound approach to solving a particular

problem under investigation in a unique way. It is typically originated from observation and difficult to verify or test (Wentz, 2017) as echoed by Adom et al., (2018, p. 4) who emphasized that a conceptual framework is “based on the concepts which are the main variables a study”. However, the understanding from Fain (2004) shows that when concepts are used to underpin a study it then becomes a conceptual framework but when a study is based on theories, it is considered a theoretical framework. Also as resonated by Green (2014), conceptual frameworks are built on the concept of ideas from theories and or the research findings while a theoretical framework is built on theories.

3.2.2 Reason(s) for adopting both theoretical perspectives and conceptual framework for the study

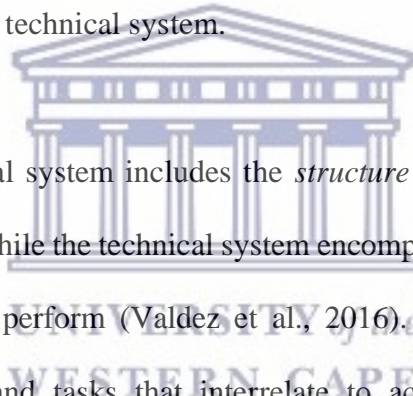
Theoretical perspectives and the conceptual framework were espoused to underpin this study on the premise that, the constructs of the theoretical framework cannot holistically address all the issues undertaken; therefore, it was deemed cardinal to support the study with a conceptual frame to carry out this research expedition. This stance by the researcher is echoed by Akintoye (2015) who professes that a conceptual framework is mostly used by researchers when existing theories are insufficient in creating a firm structure for the study. In light of this backdrop and based on the focus of the study, the researcher purposefully espoused the Socio-Technical Theory (STT) as the theoretical frame and also adopted the Global Competitiveness Index (GCI) as a conceptual frame to underpin and illuminate the findings of this study. The following explains and details STT as well as GCI and how they relate to this study.

3.3 Theoretical Perspectives: Socio-Technical Theory (STT)

According to Mumford (2006), the STT was originated by a renowned professor at the Tavistock Institute of Human Relations in England. His mission was to join a technical and social subsystem together because both constructs have a high propensity of helping an organization work effectively and efficiently to achieve its ultimate goal (Nieminen & Hyytinen, 2014; Mumford, 2006). This theory helps to understand a complex system and why it is plausible to consider in the work process. The theory was developed to help create a holistic view of why it is prime to involve the human force in the system design process while it was previously eschewed in the system design process. This move, according to Mumford (2006), in effect, ensures job satisfaction especially when a new technological system is implemented as hypothesized.

According to IGI Global (2020, p.1), STT is “an approach to understanding the relationship between technology, individuals, organizations, and society in workplace design”. Similarly, Cummings (1978) as well as Valdez, Brauner and Ziefle (2016) also stressed that the idea of STT states that, people, environment, technology, and structure work interdependently, therefore, none of these factors should be left out in the equation when embracing any new technology. According to Sawyer and Jarrahi (2014), the socio-technical lens picked up ubiquity in organizational studies amid the labor movement during the 1960s and 70s (Trist, 1981). Currently, it has been immensely applied in the field of information systems especially focusing on emerging technologies (Manda & Dhaou, 2019). This move was fueled by the failure of the inclusion of the behavioral and social elements that are pertinent in the selection, adoption, and implementation of emerging technologies (Sawyer & Jarrahi, 2014; Bostrom & Heinen, 1977).

According to the socio-technical perspective, in the quest to embrace any technological system, it is fundamental to consider both social and technical factors (Simpson, 2017; Valdez et al., 2016). Social factors have to do with the behavioral individualities (people or actors) considering factors such as their skillset, attitude, values, and structure which emphasize the workflow (Valdez et al., 2016) while the technical system refers to the tasks, and technology required to transmute inputs into outputs (Manda & Dhaou, 2019; Valdez et al., 2016; Nieminen & Hyytinen, 2014; Cartelli, 2007). The choice of STT is primarily driven by its original focus on how digital transformation is affected by “socio-economic, socio-political and socio-historic context” (Manda & Dhaou, 2019, p3.). The STT has two main constructs that interact or in other words, benefit from each other to make the adoption of digital transformation systems successful (Valdez et al., 2016). It is made up of a social system and a technical system.



As seen in Figure. 3.1, the social system includes the *structure* and the *people* involved in the implementation of the system. While the technical system encompasses the *technology* (Sawyer & Jarrahi, 2014) and the *tasks* to perform (Valdez et al., 2016). The theory brings to light the structure, people, technology, and tasks that interrelate to accomplish a particular purpose (Gorejena, Mavetera & Velepini, 2016; Trkman, Blazic & Turk, 2008; Appelbaum, 1997). Thus, it is an innovative approach as it brings together pertinent factors that ensure the optimal performance of any new technological system. This is due to its generality in nature and ability to adapt with ease to almost any organizational situation and it remains open to continual improvement and revision (Siruri & Sma, 2014). STT, unlike the conventional approach where the technical elements are considered and designed and are then followed by the people who are forced to fit into a box which usually leads to abysmal performance or sub-optimal (Morris, 2009).

Gorejena et al., (2016) asserted that STT is best suited to deploying emerging information technologies in an organization. Besides, Kopackova and Libalova (2017) concluded that a shift or neglect of any of the four constructs of the STT will result in negative repercussions on the organization. Likewise, Sony and Naik (2020) contended that “there is a general agreement that for Industry 4.0 to be sustainable, the social and technical elements should be considered in tandem”. Figure 3.1 shows the STT and the relationship between its various constructs.

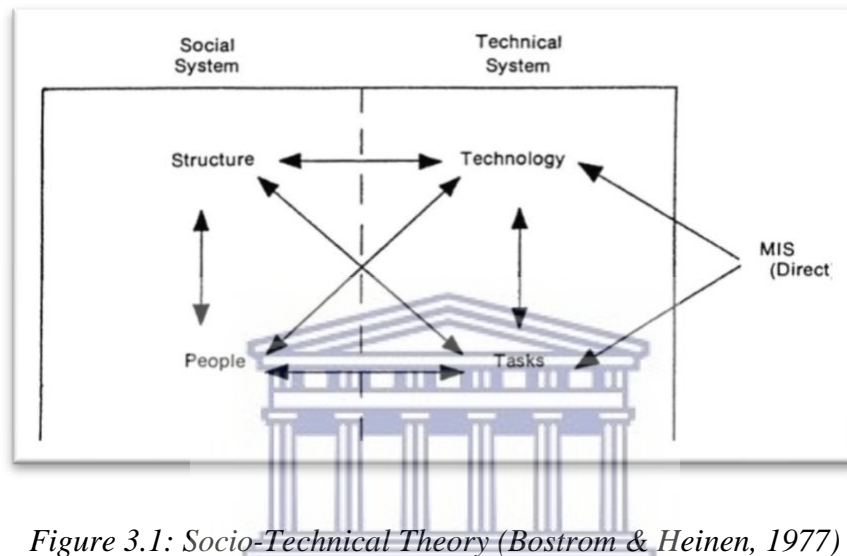


Figure 3.1: Socio-Technical Theory (Boström & Heinen, 1977)

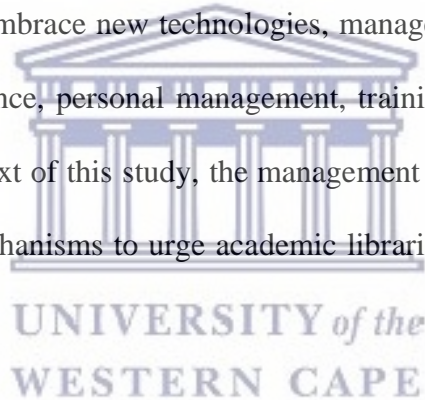
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3.3.1 Technical sub-system

The technical sub-system deals with the equipment and tools in the environment and the process in which input goes through to become output as intended by the adopters of the technological system. The technical sub-system comprises technology and tasks (Manda & Dhaou, 2019).

Technology

Technology, as part of the STT, refers to the tools, digital devices, machinery, mobile technology, information technology, and network infrastructure (eg. cable transmission, optical fiber, and wireless networks, such as Wi-Fi, 3G, 4G, or radio needed for a system to operate (Kopackova & Libalova, 2017; Morris, 2009). Appelbaum (1997) elucidated some prime factors that need to be incorporated considering technology as part of the constructs of the STT. The author capitalized on the fact that since change is inevitable in any organization, it is imperative to consider the best procedure and support system to encourage potential employees or users to embrace any new technology. It is anticipated that this move will help reduce resistance to change in case they occur, which is considered detrimental during the implementation stage of new technology. The author further added that to carefully embrace new technologies, management should prepare users for technological changes, for instance, personal management, training, and participatory decision-making. Practically, in the context of this study, the management of academic libraries must pay critical attention to the best mechanisms to urge academic librarians to embrace the adopted lib 4.0 technologies.



Tasks

Tasks have to do with the purpose or mission of why the institution or organization exists to operate (Valdez et al., 2016). It could be rendering a service, producing goods, teaching students, humanitarian works, and civil services, among others (Kopackova & Libalova, 2017). The tasks and technology work hand in hand. The adoption of any technology or system is fueled by the tasks it intends to perform (Kopackova & Libalova, 2017). More importantly, it is the gap and or

constraint that has been identified by management for which adopting or incorporating a new innovative technology will help to remedy the issue (Valdez et al., 2016).

3.3.2 Social sub-system

The social sub-system emphasizes the relationship that exists between the people (workforce) and the structure of an organization. It shows how people interact with technology to perform tasks through the use of the adopted structure in an organization (Kopackova & Libalova, 2017). The social sub-system includes the structure and the people involved as follows:

Structure

Structures delineate how the workflows occur in an organization and they could be formal and informal structures (Manda & Dhaou, 2019). It captures everything that goes on in an organization such as communication channels, processing, and organizational hierarchy (Kopackova & Libalova, 2017). Valdez et al. (2016) found that, with regard to structure, it deals with responsibility, delegation, and the form of communication of an organization.

People

People as a construct deal with the workforce in an organization, including superiors, subordinates, and users. They work together to ensure the realization of the organization's set goals. People, as part of the constructs of the STT, are centered on the employees that are affected by the technological change in the organization (Kopackova & Libalova, 2017). Appelbaum (1997, p.461) again, advanced the basic attitude of various employee groups towards the organization

needs to be known, also how the employees feel about the structures, technologies, and procedures that need to be shaped towards the implementation of lib 4.0 technologies.

3.3.3 Application of the STT in related studies

Carbone and Burgess (2008) aver that STT is one of the best-suited theories used to guide change management, especially in the course of introducing a new technological system or entering an era where new ICT technology is implemented. Looking back, Pasmore (1995, p16.) maintains that “whatever the future may hold, the basic challenge of STT design is still relevant: humanism and effectiveness must be linked together in the design of work and work systems”. Cartelli (2007) maintained that in examining the resistance of workers towards new technological systems, it is invaluable to consider the social system and technical system to remedy work snags and to pave the way for a successful implementation of a new system. Sony and Naik (2020) succinctly assert that in the quest to achieve a common goal in the era of Industry 4.0, both the human factor (socio) and nonhuman (technical) need to be considered. Thus, any change in one aspect of the variables will result in a change in the other variables making them interdependent on each other.

Manda and Dhaou (2019) explored ways developing countries respond to the challenges and opportunities posed by the 4IR which was underpinned by the Socio-technical perspective. The study concluded that South Africa, as a country, should adopt the best structure that best suits its local context rather than blindly copying the so-called “exemplary models” driving in other countries. Focusing on people, the study found that it is crucial for the management of an organization to focus on obtaining future skill-sets as the 4IR is projected to demand labor force with new skillsets, innovation, and technologically savvy (Manda & Backhouse, 2017). This

proposition is critical in the field of the academic library where library services are steadily shifting from manual to digital services. Therefore, new breeds of information professionals and those with new skillset will be pertinent for the academic library to stay relevant in the quest to embrace the disruptive change of the 4IR (Ahmat, & Hanipah, 2018).

3.3.4 Criticism of the STT

Even though there are still no standard evaluation criterion or matrices for assessing the quality of the STT (Simpson, 2017), several authors have critically critiqued the STT pointing out some critical limitations not to be ignored. Gorejena et al. (2016) criticized that it is not appropriate for the Socio-Technical theorists to place people equal to other factors, such as technology because for instance, technology is meant to serve the people and as such, it will be manipulated by a human being with regardless the role of the technology. On the contrary, Sony and Naik (2020) accentuated the fact that as the world is moving faster toward the 4IR and automation is now ubiquitous, it is an indication that there will be less human interaction, therefore, the human factor should not be placed on the same level as compared to that of the technological factor.

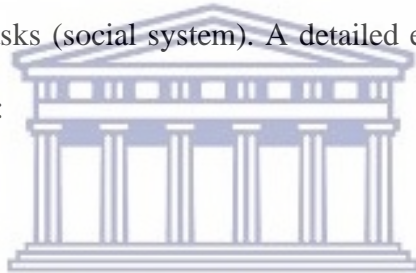
Trist (1981) reiterated from other scholars that the STT is general rather than adaptive; therefore, it should have paved the way for the uniqueness of adopters, including policies that will augment in contributing to the goal of any new technological system. Appelbaum (1997) argued that the social-technical theories highlight the four critical constructs (technical, people, tasks, and structure) but failed to include vital factors, such as special education and training as well as policies that have the propensity of giving leaders or management the head start to coach their members to use a new system. The author added that there is a need to amend the change management philosophy to make the implementation of the new system or technology possible

and successful because the team members may not be in the best position to know how to implement the tasks. Simpson (2017) also critiqued that, the STT fails to capture the key functionality of each construct and how they should interact to successfully make a system or a new technology work. The author also quizzed about what will happen to the old operational procedures and how they can reconcile with the new system or technology. Sony and Naik (2020) argued that the conventional socio-technical constructs (people, structure, tasks, and technology) alone cannot serve as a theoretical underpinning for incorporating 4IR technologies and applications, but more importantly, should holistically consider these six constructs which comprise infrastructure, people, technology, process, culture, organizational goals, and economic situation. The authors further argued that these six constructs or variables will be more comprehensive, and detailed, and eventually lead to the successful implementation of any new system. For instance, it would be difficult to succeed in implementing any new system or technology without bringing to light the infrastructure that will be needed, detailing the processing (*objectives*) of transferring ideas into reality. Also, the author reiterated that the socio-technical perspective is too generic, therefore, it is expedient to consider the culture, organizational goals, and economic situations before implementing any new system realistically.

Despite all these criticisms, the STT is suitable for this study because its main constructs (people, structure, tasks, and technology) are enough as it relates to the main objectives of the study, apt and adequate to underpin the study in a successful discussion and conclusion.

3.3.5 Application of the STT to the study

Over the years, the STT has widely been used in several institutions and businesses in their bid in introducing new information systems and even more as they are embracing the industry 4.0 technologies (Manda & Backhouse, 2016). The 4IR gives a signal about the revolutionary waves in the field of Library and Information Science where the nature of library services will inevitably change as well as the demand for new skill-sets from library practitioners (Manda & Dhaou, 2019). Likewise, Manda and Backhouse (2016) asserted that the 4IR will demand that academic libraries introduce Lib 4.0 technologies as well as Lib 4.0 librarians to survive. According to Bostrom and Heinen (1977), the STT requires that in the bid to introduce any new technological system, it is imperative to consider four main constructs which comprise technology and tasks (technical system) as well as people and tasks (social system). A detailed explanation of the constructs as applied to the study is as follows:



Technology

Technology, in the context of this study, focuses on 4IR technologies and applications, such as IoT, Robotics, Augmented and virtual reality, 3D printing, Blockchain Technology, cloud computing, and Big data necessary for the provision of academic library services. These technologies and applications are anticipated to enhance the provision of academic library services and its relevance needs to be maintained. As the STT brings to the fore, every organization is bound to experience a technological change to grow, therefore, library management should consider a change in technology by introducing some of the 4IR technologies as the world is gradually revolutionized not to stay behind (Cronje, 2018). It can be extrapolated from the STT that any new technologies that academic library management intends to adopt should be one that

will add value and enhance productivity in library services. Given this, it is expected that academic library management should strategically focus on deploying relevant 4IR technologies and applications into the provision of library services for the academic library to stay productive and relevant. This construct intends to underpin the second research question of the study which focuses on the Lib4.0 technologies and applications that are used in the academic libraries in Ghana and South Africa as they prepare for the 4IR.

Tasks

Tasks in the context of this study focus on the purpose of incorporating 4IR technologies or applications into academic library services. Given this, it is required of the academic library to deploy relevant Lib 4.0 technologies and applications and exactly delineate what these tools seek to achieve. This construct was anticipated to help the management of academic libraries to make an informed decision based on the gap or constraint or problem identified. Given this explication, defining the tasks will help academic library management to identify the challenges the adopted Lib 4.0 technology and applications will solve. Hence, this is in line with the fourth research question of the study that focuses on the challenges that propel academic libraries in Ghana and South Africa to incorporate 4IR technologies and applications into the provision of library services.

Structure

Structure in the context of this study informs about the workflow of the organization. It also brings to mind the organizational structure, levels of management, delegation, and how decisions are made. This construct recommends that in the bid of embracing any new system or technology, it

is pertinent to consider the structure in which the technology is implemented to achieve the organizational goals (Valdez et al., 2016). Given this, the academic library management should endeavor to consider the structure that will best suit the adoption of Lib 4.0 technologies and applications and how they will be put to use to work towards the ultimate goal of expanding their clientele. This construct claims that, if academic library management employs any technology to remedy any identified problem in the library, without considering the best structure, there is a high propensity that the intended purpose will not be achieved. This is because employees may lack a sense of direction, will not be abreast with the policy to guide them, and perhaps the mission and vision that will be projected to them may seem blurred. Consequently, the academic library will run at a loss since the envisioned purpose may not be achieved. As already known, before the adoption of any new system, there should be a preliminary investigation, thus, inquiry into the problem, analyzing the problem if it is worthwhile pursuing, considering the cost-benefit analysis, implementing, and putting measures in place for periodic review and maintenance. All these processes are critical if academic library management plans to deploy any Lib 4.0 technologies and applications to enhance its services with the motive of staying relevant as they prepare for the inevitable 4IR disruptive change. It is also important for academic libraries to reduce their bureaucratic process to expedite the implementation of 4IR and to overcome the issue of technological obsolescence.

People

One of the critical constructs of the STT is the people. Considering all other constructs such as structure, technology, and tasks, they cannot function without people (Valdez et al., 2016). People have to identify the problem, carefully select the best technology, and put together the structure to

get the organization running. Emphasizing the people in relation to this study cannot be underscored. With reference to the literature review where a number of authors hinted that the 4IR disruptive changes will require a tremendous change in the employees in terms of skillset, qualifications, and attitude. Contextualizing this concept to the study, the theory claims that, the following questions should be answered: what skillset, abilities, and competence that Lib 4.0 technology and applications will demand information professionals to possess? How will they be able to transition from their conventional way of providing library services to digitally innovative ways without being resistant to change? What motivational factors to consider will propel information professionals to work towards the mission and vision of the library? Considering the present state of information professionals, the theory recommends that academic libraries should consider programs such as workshops, conferences, and webinars that will be needed for information professionals to work effectively and efficiently with Lib 4.0 technologies and applications. This construct informs the academic library management to consider the breeds of employees that should be recruited. Questions to consider are what should be encapsulated in the curriculum to produce graduates of information professionals, who are IT literates to expedite the agenda of fully utilizing Lib 4.0 technologies and applications to make library services stand tall among its competitors and to stay relevant in the anticipated era of the 4IR where disruptive change will be inescapable. This construct relates to the first research question of the study that focuses on the academic librarians' awareness and knowledge about the 4IR. In effect, this construct will help expound the level of the academic librarian's knowledge, skills, and competencies in the application of 4IR technologies which is the third objective of the study.

3.4 Conceptual Framework: Global Competitiveness Index (GCI)

Competitiveness according to Sala-i-Martin et al., (2019, p.2), is defined as “the set of institutions, policies, and factors that determine the level of productivity of a country, conditions of public institutions, and technical conditions”. According to the World Economic Forum (2010), competitiveness is defined as the set of institutions, policies, and factors that determine the level of productivity of a country. The manifestation of the 4IR has created enormous opportunities for every facet of an economy to advance, however, these opportunities cannot materialize without surmounting its inherent disruptive challenges (Schwab, 2019). This phenomenon has ignited the interest of scholars, policymakers, stakeholders, economists, educational practitioners, and others to engage in several intellectual discussions during economic forums and others to learn how to leverage the new opportunity of the 4IR (Schwab, 2019; Buche, 2018). The competitiveness report by the GCI gives an idea about the extent to which a nation provides an enabling environment to its citizenry (Schwab, 2019).

The first Global Competitiveness Index (GCI) was developed in 1979 during the World Economic Forum and has annually been refined as the world is being progressively affected by several innovations and inventions, especially in ICTs (McMillan.com, 2008). For instance, in the works of Lopez-Claros et al., (2007), it was reported that the GCI underwent a massive revision as the result of its failure to capture a global effect, yet still, it is regarded as an authoritative matrix and widely accepted in measuring the economic standing of countries (Bowen & Moesen, 2011; Soo, 2005) due to its comprehensiveness. The original intent of the GCI also known sometimes as Index 4.0, is meant to measure the competitiveness of countries and how they are thriving in economic terms (Schwab, 2019). The purpose of the annual release of the GCI is to provide a standardized benchmarking tool to enhance the competitiveness of nations usually identified by policymakers,

leaders, and stakeholders (Schwab, 2010). In the GCI Report -2019, it was found that over 200 leaders from business, government, and civil society deliberated on the pillars of the GCI, and investigated how the various sectors of an economy can benefit from it (Schwab, 2019).

The GCI is annually developed by the World Economic Forum and has been used as a standardized criterion to measure the competitiveness of a country that focuses on economic growth and strength and can foretell the economic growth and possible setbacks (Xia et al., 2012). The GCI had 98 indicators or indices or constructs which were obtained from the World Economic Forum's Executive Opinion Survey and international organizations but have been reorganized into twelve (12) main pillars that encapsulate the entire indicators (Schwab, 2019). The twelve (12) main pillars or matrices for this measurement or as the determinant is shown in Figure 3.2 are institutions, innovation, business sophistication, market size, technological readiness, infrastructure, financial and market development, microeconomics development, higher education, and training, health and primary education, goods market efficiency, and labor market efficiency (Schwab, 2019). Institutions, infrastructure, macroeconomic stability and health, and primary education are classified as *Basic Requirements* while higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, and market size are collectively known as *Efficiency Enhancers*. The category *innovation and sophistication factors* capture *business sophistication* and *innovation* (Razavi et al., 2012).

This study selected five critical constructs (innovation, infrastructure, technological readiness, higher education, and training as well as financial market development) to underpin the study and findings. These constructs were selected based on the research questions of the study to help

measure the strength of the academic libraries as they journey towards the 4IR and to face its inherent disruptive changes. It is worthwhile to note that, these variables are interdependent. For instance, the weakness of one negatively affects the other. Thus, if there is a lack of well-trained and educated staff, integrating innovation into working activities to embrace new technologies will be a big hurdle in terms of progress. This is because a member of staff may not possess the right competence to embrace new technology and will not be able to utilize them as expected by management (Schwab, 2010). Likewise, embracing new technology (Technological readiness) will be difficult without sufficient funding (Financial market sophistication). It is for this reason that Schwab (2016) postulated that every nation should make it a point to strengthen each pillar to score high in the GCI.



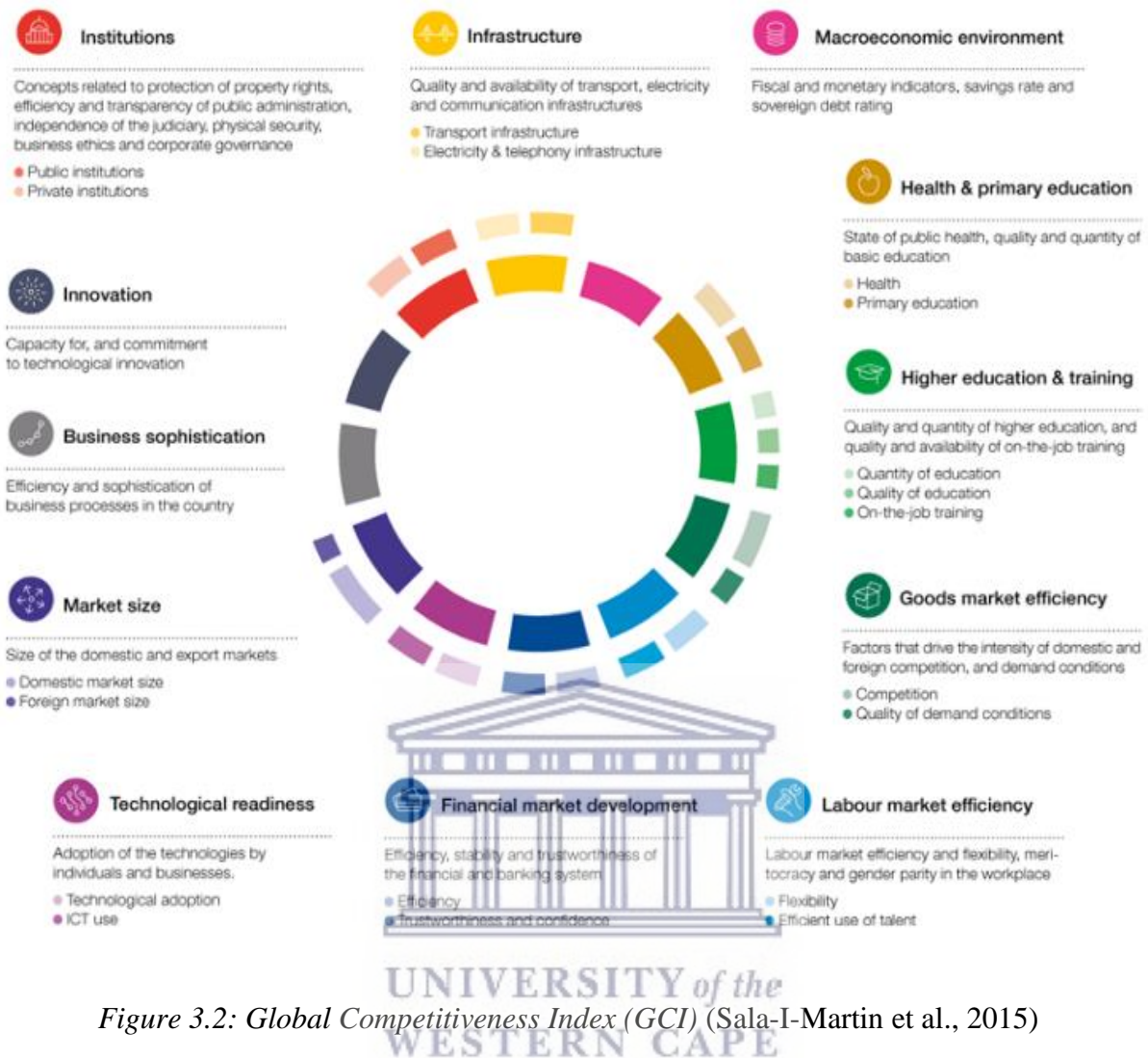


Figure 3.2: Global Competitiveness Index (GCI) (Sala-I-Martin et al., 2015)

These selected constructs have been detailed as follows:

Infrastructure

Bai (2009) concluded that infrastructure tremendously contributes to productivity as captured in the GCI. The GCI concept sheds light that every economy heavily depends on infrastructure, such as electrical power to virtually undertake all routine activities (Schwab, 2019). Mundial (2019)

also found that every facet of an economy be it business, government, non-governmental organizations, and institutions productively survives with adequate electricity without frequent interruptions. Schwab (2016) also maintained salient infrastructure such as internet facilities, and telecommunications networks in the impending era of the 4IR. They are more compelling amidst the novel COVID-19 where most activities are recommended to be carried out via online platforms to encourage physical distance with the prime objective of reducing the spread of the virus (Mhlanga & Molo, 2020).

Innovation

Innovation is crucial in all sectors of an economy as the world steadily keeps on unfolding with emerging technologies that require new breeds of employees with new skillsets and knowledge to make it thrive (Schwab, 2019). Tan et al., (2008) posited that any country that shows a high concentration on innovation can be assured of sustainable growth. According to Babalola and Raji (2018), innovation can be generated from two main dimensions such as non-technological knowledge and technological knowledge. Thusly, non-technological innovation refers to improvement in productivity measured by the extent of expertise, experience, and engagement. Technological innovation on the other hand has to do with improvement in emerging from new scientific breakthroughs in emerging technologies. The author further posits that it is compelling for countries to earmark programs that focus on innovations and creativity as it is a necessity to reposition their economic growth to a higher pedestal in GCI (Babalola & Raji, 2018). This denotes that all sectors, including education and the library, should focus on incorporating innovation in teaching and learning as well as providing library services in innovative ways to attract more

customers and maintain the existing ones (Sala-I-Martin et al., 2015). In effect, this move will contribute to the GCI at large (Adeoye, Babalola & Cole, 2015).

Technological readiness

Technology according to Babalola and Raji (2018) is the application of scientific knowledge to find solutions to problems in a practical way mostly in industry and commerce. In the 21st century, where most businesses and organizations are steadily incorporating and replacing services using digital means has made technology an important element to ignore (Razavi et al., 2012; Schwab, 2010) and more especially as the world is gradually affected by the disruptive changes of the 4IR (Schwab, 2019). Technological readiness as a pillar of the GCI measures the extent or the agility to which an economy embraces emerging and existing technology such as ICT to augment its efficiency and productivity, therefore, increasing its competitive advantage (Schwab, 2016). In this regard, technological readiness considers factors such as “availability of latest technologies; firm-level technology absorption; Foreign Direct Investment (FDI) and technology transfer; Internet users; Broadband Internet Subscriptions; and Internet bandwidth” (Porter & Schwab, 2008, p.18).

Technological readiness and innovation work hand in hand and this incited Razavi, et al. (2012) to propose a new model to elucidate their relationship as shown in Figure 3.3. The author’s exposition shows that the sub-variables of technological readiness affect innovations. The study found a positive correlation between technological readiness and innovation. This means that for a country or an institution to thrive well in its activities, it should adequately be ready in terms of technology before innovation can fully take shape as expected.

Jafarnejad, Ghasemi, and Abdullahi (2011) found a positive relationship between financial market development and technological readiness. This means technological readiness can be high if there is an adequate fund available as shown in Figure 3.3 and Figure 3.4

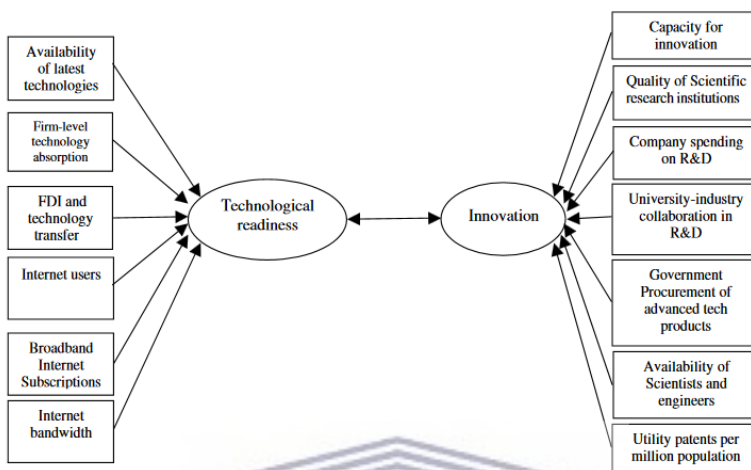


Figure 3.3: The relationship between technological readiness and innovation (Razavi et al, 2012)

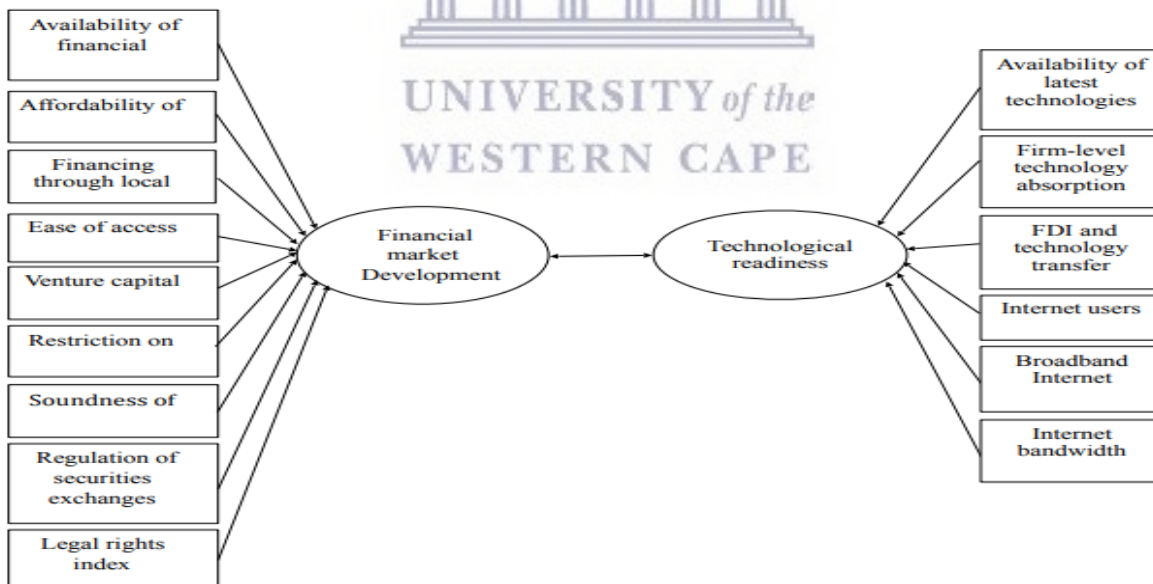


Figure 3.4: The relationship between financial market development and technological readiness. (Razavi et al, 2012)

Higher education and training

The need for education and training in every facet of an economy is very pertinent in this technological age. No matter how advanced a country or an organization may be it will be difficult to progress without well-trained staff (Razavi et al., 2012). Schwab (2019) maintains that new breeds of well-educated workers who are trainable and smart will be needed to manage disruptive technologies and applications of the 4IR which almost every facet of an economy cannot survive without as the industry 4.0 is progressively becoming the order of the day. Schwab (2016) postulated that, in this evolving environment, businesses, institutions, and governments will need to constantly focus on upgrading the skillset, competence, and abilities of workers through training, and a pause on this move will affect the growth of an economy and bring it to a standstill. This assertion supports the works of Porter and Schwab (2008, p.18) who profoundly maintained that “the extent of staff training is also taken into consideration because of the importance of vocational and continuous on-the-job training which is neglected in many economies for ensuring a constant upgrading of the workers’ skills to the changing needs of the evolving economy”. This background indicates that it is expedient for all sectors of an economy to pay critical attention to training and education. It can be inferred from this assertion that innovation and technological readiness will positively affect the GCI provided there are available well-trained and educated workers.

Financial market development

Financial market development is another cardinal factor to be considered. It can be ascribed as the most important of all the constructs of the GCI because all other constructs such as infrastructure, innovation, technological readiness, higher education, and training cannot survive without

adequate funds (Jafarnejad et al., 2011). Schwab (2010) also maintained that all sectors in an economy are largely dependent on the availability of adequate funds. Therefore, stakeholders need to put measures in place to fight for funds from all available sources to stay active in operation. Alomari, Marashdeh and Bashayreh (2018) investigated how financial market development contributes to GCI and revealed that funds play a pivotal role as all other constructs vastly depend on it. Therefore, it is incumbent for all nations, organizations, and businesses to fight for funds as it will pave the way for other constructs to survive.

3.4.1 Application of the GCI in related studies

The GCI was adopted to underpin studies by Bucher (2018) as an indicator of sustainable development, while Taskinsoy (2019) utilized it to compare the level of growth of two countries. Babalola and Raji (2018) also utilized the GCI to investigate the state of technological readiness and innovation in Ghana and Nigeria and found that technological readiness has a positive association with innovation. Similarly, Razavi et al. (2012) explored the relationship between technological readiness and innovation using the GCI and found that technological readiness positively affects innovation. Also, Jafarnejad et al. (2011) and Abdullahi (2011) investigated the association between financial market development and technological readiness and found a positive relationship between the two variables. This means that the extent of technological readiness is affected by financial market development. Thus, for nations, organizations, and businesses to thrive well in terms of technology there should be enough funds available. This sends a signal to all nations to allocate funds for emerging technologies, innovation, infrastructure as well as education and training to thrive well in the era of the 4IR. Chan and Chan (2018) underpinned their research using the GCI perspective and concluded that there is no doubt that

disruptive technology, such as AI and IoT raises educational standards marking it a smart campus. Therefore, it is recommended that academic libraries should incorporate Lib4.0 technologies to “strengthen learning capacity, happiness, and competitiveness for universities” (Chan & Chan (2018, p.547). Ghasemi et al. (2013) delved into the relationship between infrastructure and technological readiness among developing countries which was guided by the GCI. Their finding showed a positive relationship between infrastructure and technological readiness. This means that to score high in technological readiness there should be enough available infrastructure.

3.4.2 Criticism of the GCI

Bucher (2018) pointed out that in determining the GCI, all the twelve pillars need to be considered but it is regarded as unfair since nations are all not on the same playing field in terms of resources. This claim is supported by Sala-I-Martin (2015, p.2) who raised an argument that “while all of these factors are likely to be important for competitiveness and growth, they are not mutually exclusive.” Two or more of them can be significant at the same time, and that is what has been shown in the economic literature. Xia et al. (2012) held a reservation with the GCI as it fails to include the national culture as part of its pillars which is a good predictor of economic growth. Van et al. (2005) also saw that the GCI tends to become a bad indicator when combined with entrepreneurial factors and called for upgrading. Xia et al. (2012) disputed the potency of the GCI by bringing to the fore that it has two threats to its usefulness. First, it may not be a stable measure of competitiveness over time. Secondly, it has not succeeded in predicting short-term and long-term economic growth.

Despite all these loopholes raised by these authors, the GCI is deemed relevant to this study as the selected constructs relate to the 4IR and its inherent disruptive technologies in academic libraries.

The five main selected variables comprise; infrastructure, innovation, technological readiness, higher education and training, and financial market development and are deemed adequate to guide the academic libraries and signal them to reposition themselves to welcome the evolving era of the 4IR and as such to answer the research questions of the study.

3.4.3 Application of the selected constructs of the GCI to the study

The application of the selected constructs of the GCI for this study is explained as follows:

Infrastructure

In the field of libraries, ICT tools, and internet facilities with adequate bandwidth cannot be left unmentioned when assessing the completeness of the academic library (Noh, 2015). Adarkwah (2020) regarded ICT tools as a dependable vehicle for all academic libraries to survive. According to Tella (2020), digital library service is now becoming a necessity, and therefore, the library infrastructure should be adequate and readily available to provide dynamic service to clientele who are technologically savvy. The GCI concept considered infrastructure as one of the critical indices to measure the global competitiveness of a nation (Bucher, 2018). In the context of this study, for academic libraries to score high in terms of relevancy and their ability to outclass their competitors, then adequate infrastructure such as Lib 4.0 technologies including strong internet connectivity, ICT facilities, and stable power supply should be made available. The vision of the academic library cannot materialize without these infrastructures as stipulated in the GCI concept. It can be noted that the academic library will have to assiduously work to make adequate funding available otherwise the dream of staying relevant amidst the impending disruptive challenges of the 4IR will forever remain a dream. Consequently, the service of the academic library will be rendered

irrelevant. This construct relates to the research question which seeks to find out available actions for the provision of Information and Communication Technology (ICT) infrastructure and emerging technologies towards the disruptive changes by 4IR in academic libraries.

Innovation

The Innovation construct of the GCI stresses the agenda of championing innovation. It plays a pivotal role in measuring the global competitiveness of a nation. In the context of this study, innovation plays a cardinal role in the quest for the academic library to stay relevant by helping to provide innovative service to its clientele. For instance, focusing on Makerspace, 3D art through 3D printing, using Ask-a-librarian, Chatbot to conveniently communicate with clientele and among others. Ideas from the GCI denote that, it is through innovation that will enable the academic library to stay in the competition and help its institutions and the nation at large to sustain growth. In relation to the research questions of the study, innovation as a construct will help guide the last research question which focuses on the available actions towards the disruptive changes with innovation as part of the sub-criteria to measure the readiness of the academic library towards the 4IR. This construct is in line with the second research question of the study which is the Lib 4.0 technologies and applications used in academic libraries. Again, it also related to the last research question which sought to find out the innovation strategies implemented in academic libraries.

Technological readiness

As the world is steadily moving from physical or manual services, the need for emerging technology cannot be overemphasized. The GCI states that a nation should always be adequately

prepared with existing technologies as well as emerging technologies to score high in global competitiveness (Xia et al., 2012). Given this, the academic library should all the time be ready to invest in modern technology especially as they are in the action of making their services relevant during the disruptive change of the 4IR. Also, academic library professionals should possess a high level of agility in making funds available from several sources to expedite their readiness in technological wide; otherwise, if they fall short in technology, it will adversely affect innovation which is a fundamental pillar of the GCI. This construct guides the second research question which seeks to find out the Lib4.0 technologies and applications that are available and have been used in the academic libraries of South Africa and Ghana as they prepare for the 4IR.

Higher education and training

Education and training are inevitable factors as the world prepares for the disruptive change of the 4IR. An excerpt from the GCI reports shows that new breeds of employees, especially those who are technically inclined, and smart, need to be the top priority for a high score in global competitiveness. This is because new skillsets, competence, and ability will be needed as the world keeps on evolving with new digital systems. Given this, the onus lies on the academic library to provide constant and adequate training for library professionals and make it a point to quickly upgrade as demanded. The theory also heightened that, education and training is the gateway for employees, in this case, librarians to be aware of the 4IR and its demand as well as increasing staff motivation and lessening the fear of losing their jobs. This construct relates to the last research question of the study where the sub-variable focuses on education and training programs available for library professionals as they prepare for the 4IR. Also, higher education and training help guide the third research question of this study which seeks to explain how education and training affect

the level of the academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies and why it is compelling in the academic library service provision.

Financial market development

Finance in the context of this study states that all other factors, such as infrastructure, innovation, technological readiness, higher education, and training directly depend on the availability of funds. The academic library may have brilliant innovative ideas and envision having good infrastructure, well-suited technology, and strategic education and training methods, but this will not materialize without adequate funds. It can be inferred from this assertion that the academic library should consider funds as a prime factor to consider having put plans on paper. An academic library may deem innovations like robotics, Makerspace, 3D printers, and cloud computing infrastructure as critical to surviving in the era of the 4IR, but without adequate funds, this plan will not be materialized for the betterment of the academic libraries. This assertion behind the financial market development also helps to elucidate the preparedness of the academic library towards the 4IR in terms of available funds. This construct is in line with the last research question of the study which sought to find out the available actions such as the allocation of adequate funds for Lib 4.0 technologies towards the disruptive changes of the 4IR.

3.5 Proposed model to measure the readiness of the 4IR

Considering the main objectives of this study, it is deemed apropos to join the constructs of the GCI and STT together as they are all germane determinants of the readiness of academic libraries towards the 4IR. As can be seen in Figure 3.4, concerning the GCI and its constructs which comprise infrastructure, innovation, technical readiness, education and training, and finance, and

that of STT which is made up of technology, task, structure, people should be well prepared before academic libraries can stand tall and stay relevant amidst the disruptive changes of the 4IR.

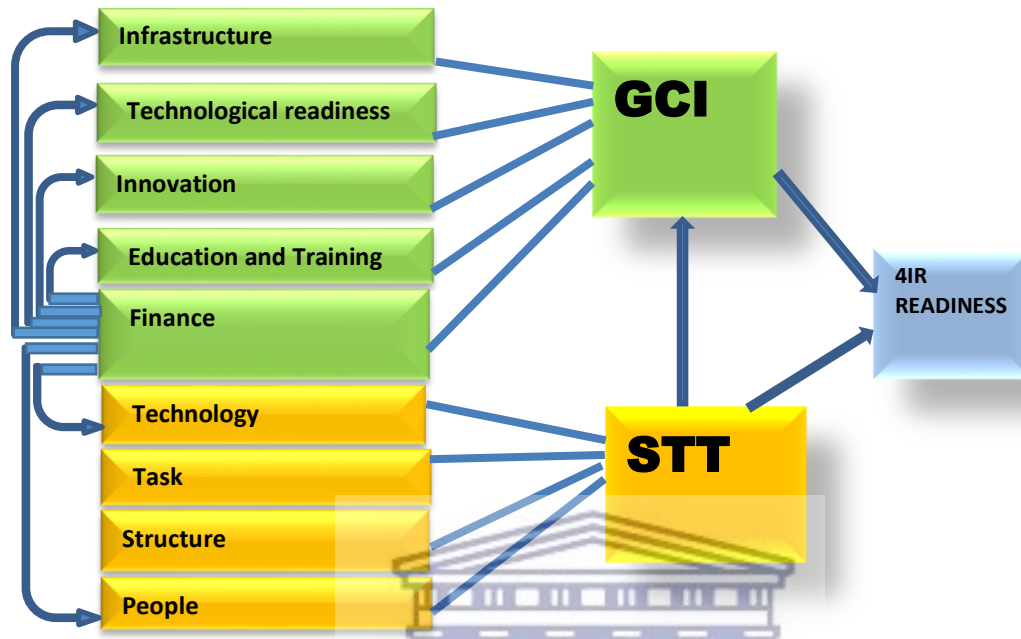
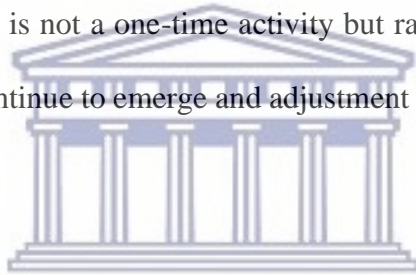


Figure 3.5 Proposed model to measure the readiness of the 4IR.
(Darko-Adjei, 2023)

The new model hypothesized that finance/funding directly affects the other three constructs of the GCI; infrastructure, technological readiness, innovation, education and training. Thus, the availability of funds at the disposal of academic libraries will determine the 4IR infrastructure that the academic library provides. Also, academic libraries cannot be technologically ready without adequate funds, and this will intend also affect innovation strategies as far as the 4IR is concerned. Further, education and training which is one of the fundamental factors of the 4IR cannot be materialized without funds. For instance, it is through education and training that will pave the way for academic librarians to acquire the needed new skillset through workshops, webinars,

seminars, local and international conferences, and refresher courses that are compelling in the era of the 4IR. Even if the academic library is rated high in terms of technology without the right skill-sets, the goal of the academic library staying relevant in the era of the 4IR will remain stagnated. Also, the readiness in terms of technology and people as espoused in the STT will be affected by the availability of funds for the academic library. For instance, implementation of Lib 4.0 technologies such as Makerspace, 3D printing, artificial intelligence embedded machines including library automated self-checkout, and sensor security alarm systems cannot be achieved without adequate funds. Likewise, peopleware in otherwise the academic librarians will need proper motivation to lessen resistance to change, hence, practical training will be indispensable to ensure smooth implementation of Lib 4.0 technologies. The proper motivation of people coupled with practical training in Lib 4.0 is not a one-time activity but rather a continuous process since new Lib 4.0 technologies will continue to emerge and adjustment of the library services and skills of librarians will be required.



Considering the new model developed to underpin the study, it can be realized that even though all the aforementioned constructs are critical in determining the readiness of the 4IR of the academic library, based on the propositions asserted, the availability of funds (finance) and the skills and attitude of academic librarians (people) plays super pivotal roles in this regard.

3.6 Concluding summary

This chapter detailed the adopted theoretical framework as well as the conceptual framework. It encapsulates a brief review of relevant studies and criticisms of related studies from scholars, mostly from those in the field of libraries. It illuminates the various variables or constructs of the theoretical framework as well as the conceptual framework and centers on the ones relevant to this study and how they relate to the research questions. The frameworks were then combined into a new model that helped underpin the study. The next chapter discusses the research design and research methodology of the study.



CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter details the research philosophy, research paradigms, research approach/design, population, sampling technique and sample size, data gathering instruments, and analysis of data of the study.

4.2 Research philosophy

Philosophy refers to one's way of thinking, values, or beliefs, and these variables affect life choices in one way or the other (Bamkin, Maynard & Goulding, 2016). In the same vein, a research expedition is usually guided by some logical system of beliefs or assumptions known as research philosophy (White, 2019). According to Saunders et al. (2019), research philosophy refers to the logical assumptions that guide scientific research expeditions. Through the lens of Maynard and Goulding (2018), a researcher's philosophy serves as a foundation upon which a research strategy is selected and guides the researcher in delineating the research problem, data collection process, and data analysis. In the same vein, Greener (2011) elucidates that research philosophy largely influences a researcher's systematic way of researching to investigate a problem and more importantly helps to determine the appropriate research methods for a study. Creswell (2018) also asserts that the philosophical assumptions of research are centered on ontology, epistemology as well as human nature. These philosophical assumptions are usually described using research paradigms (Creswell, 2018; Lincoln, Lynham & Guba, 2011).

4.3 Research paradigm

Paradigm simply means ways of viewing things in the world (Creswell, 2018). It provides a framework for viewing human experiences. According to DeCarlo (2018, p.1), “paradigms are a way of framing what we know, what we can know, and how we can know it”. Retrospectively, the term paradigm was coined from the Greek word “*paradeigma*” which means pattern (Creswell, 2013). It was initially used by Thomas Kuhn in 1962 as a form of a conceptual framework to elucidate research problems as well as findings (Creswell, 2018). The work of Baille and Miller (2011) explains that a research paradigm serves as a template used by a crop of community scientists that they follow to undertake a research study. Teddlie and Tashakkori (2017) also posit that research paradigms are believed to be adopted by a group of researchers in a discipline to carry out a study. As succinctly stated by Creswell (2018) research paradigm guides a researcher to understand a methodological path to help provide answers to research problems and research questions using a developed or adopted conceptual framework (Creswell & Plano-Clark, 2011). In most research according to Wahyuni (2012), research paradigms are implicitly presented but they affect the actions and outcome of the research. Nonetheless, several authors (Creswell, 2018; Saunders, Lewis & Thornhill, 2012; Neuman, 2011a) have recommended that it is imperative for researchers to explicitly declare the paradigms that are deemed appropriate for their study before they embark on it and the choice of any paradigm should be buttressed with practical justifications. Given this, the researcher explored the various paradigms and chose one that is considered apt for the study. There are three main kinds of paradigms which comprise; positivism, interpretivism, and post-positivism (Creswell & Creswell, 2018).

4.3.1 Positivism

The positivists' school of thought is guided by the principles of objectivity as their epistemological position is concerned (Rehman & Alharthi, 2016). They hold the assumptions that research should be carried out devoid of the researcher's personal biases (Panhwar et al., 2017). Thus, it should be carried out empirically and scientifically following a well-grounded systematic approach (DeCarlo, 2018; Creswell, 2018) and the researcher should be distanced from individual bias. In the same vein, Rehman and Alharthi (2016, p.53) posit that "positivism assumes that reality exists independently of humans". This probably elucidates why most studies which are undertaken from positivists' perspectives are more likely to be generalized (Neuman, 2011a). This assertion by Neuman was bolstered by Creswell (2018) who asserts that researches underpinned by positivists' perspectives are more consistent considering that when the same methodology is employed it is expected to arrive at the same findings in different settings. This philosophical assumption is what Wahyuni (2012), as well as Rehman and Alharthi (2016), describe as "naïve realism". The positivist believes in more cause and effect which provides the ground to predict with certainty the occurrence of future research findings (Adama, 2019). Chawinga (2019) adds that researches that are undertaken from a positivist lens are more quantitative, using statistical tests that make findings more reliable and again devoid of subjective conclusions.

Positivists also hold a strong belief that research findings are said to be quality if characterized as having internal and external validity, objectivity, and reliability (Panhwar et al., 2017). Furthermore, positivism research is done using the deductive approach, thus, it reasons from broad generalizations to specific observations (Creswell & Poth, 2017). It mostly deals with a testing

hypothesis, which may either be rejected or accepted based on an outlined proposition using statistical analysis (Cohen, Manion, & Morrison, 2007).

Nonetheless, the ideologies of the positivists have been subjected to criticisms by several scholars such as Rehman and Alharthi (2016), Uduma and Sylva (2015) as well as Grix (2004). For instance, these authors maintained that the application of rigorous scientific methods and objectives as a focus is appropriate for studying natural objectives and will be highly inappropriate to study social phenomena following the same approach. This is because, in the reality of idiosyncrasies, individual differences will make it problematic and likely not yield valid results (Creswell, 2018). It is against these flaws of the positivists' school of thought that the post-positivism and pragmatism paradigm emerged which allows for different research methods to be integrated in a single study based on their nature and focus. These paradigms have been explicated in further detail in the following sub-headings.



4.3.2 Interpretivism

The epistemological beliefs of the interpretivists are in sharp contrast with the tenets of the positivists. Interpretivists do not believe permanently and rigidly in gathering data as they hold the tenets that human beings are dynamic and change with the passage of time and background (Creswell, 2018). The interpretivists refuse “to adopt any permanent, unvarying (or foundational) standards by which truth can be universally known” (Guba & Lincoln, 2005, p. 204). In their view, in the quest of undertaking research, truth, and reality are generated or created but not discovered (Rehman & Alharthi, 2016). The epistemology of the interpretive approach is more subjective as researchers are directly part of the research as emphasized by Wahyuni (2012). Furthermore,

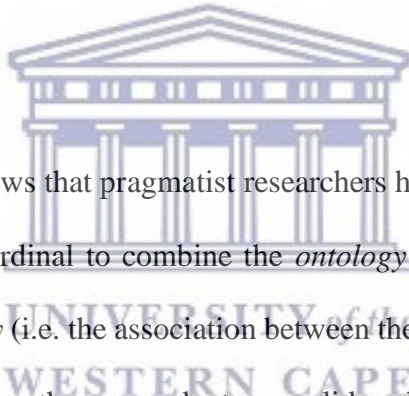
interpretivists believe that to obtain rich and detailed information on social reality, it is imperative to directly interact with the subjects of study interest individuals who are being understudied. This is because they interpret as they see it to give meaning to findings (Creswell, 2018). This submission was grounded by Grix (2004, p.83) who avowed that “researchers are inextricably part of the social reality being researched, i.e., they are not ‘detached’ from the population they are studying”. As a result, what is intended to be measured by the researcher ends up successfully leading to strong validity as compared to the positivist epistemology as the focus is centered more on objectivity (Creswell, 2018). As positivists reason deductively and based on theory to conclude their findings, interpretivists on the other hand reason inductively from specific to general and usually focus on developing new theories from patterns that may develop (Creswell, 2018; Neuman, 2011b).



Interpretivism is not immune from critiques since some scholars have sought to expose the weaknesses of the interpretive research approach mostly as it being subjective, not verifiable, and as such cannot be generalized (Rehman & Alharthi, 2016). Such research findings according to Grix (2004) are difficult to trust since the same methods in different settings with the same objectives have slimmer chances of yielding similar results. However, Richards (2003, p.6) refutes the assertion that the interpretive inquiry approach to research is not soft but rather demands “rigor, precision, systematicity, and careful attention to detail” (p.6). The author further added that not all social phenomena can be understudied quantitatively and the approach best suited for these kinds of studies may be qualitative, bearing in mind the complexities and conundrums of social phenomena.

4.3.3 Pragmatism

The pragmatism paradigm came to being as the result of the heated controversies between positivists and interpretivists. In the view of Chawinga (2019), the pragmatism paradigm intends to put an end to the ‘paradigm war’ between positivists and interpretivists. The epistemology of the pragmatism approach allows for the combination of the positivists and interpretivists lens to be incorporated into the same study. Thus, a combination of qualitative and quantitative research methods can be employed by the researcher based on the research problem as well as the research questions. One of the critical strengths of the pragmatic paradigm emphasizes the real problem and helps employ the appropriate method to remedy it (Creswell, 2018; Creswell & Plano-Clark, 2011; Tashakkori & Teddlie, 2010).



The work of Wahyuni (2012) shows that pragmatist researchers hold the belief that to holistically understand social reality, it is cardinal to combine the *ontology* (e.g the perception of research towards reality), the *epistemology* (i.e. the association between the subjects and the researcher and how the researchers see data from the respondents as valid and reliable) and *axiology* (i.e the ethical consideration governing the research) in the same study. It can be inferred from this proposition that the strength of the positivism paradigm offsets the weakness of interpretivism and vice versa. Similarly, Creswell and Plano-Clark (2011) postulate that the views of the pragmatism approach and interpretivism approach can be incorporated into the mixed methodology, hence, making a research study less being subjected to positivism and interpretivism criticism as the weakness and strengths counterbalance each other.

4.3.4 Post-positivism

The post-positivists who were known as the “protestant positivists’ advocated for the inclusion of both qualitative and quantitative methods in a single study (Creswell, 2018). They hold the tenets that it will be a big hurdle to prove the absolute truth about research findings, especially when dealing with human behavior in social science (Wahyuni, 2012). Post-positivism was birth as the result of the limitation of positivism (Creswell & Plano-Clark, 2011). Educational researchers arrived at a consensus that the positivism paradigm alone cannot satisfy the need for social research (Creswell, 2018). Because of this, they jointly brought to being the post-positivism which combines both ideological views of positivism and interpretivism called the “mixed paradigm” (Petter & Gallivan, 2004). The Post-positivists focus on conducting research from multi-dimensions and multi-methods, where different research approaches can be employed to help solve the problem under investigation, thereby accepting findings as important without undermining any research approach (Iilonga, 2019). According to Creswell (2018), post-positivism holds the belief that “there is no smoke without fire” which means there are causes and effects in every research finding which is underpinned by suitable theory(s) or conceptual framework and can be tested and verified and published.

The study was underpinned by post-positivism and the intent of this choice is detailed below.

4.3.5 Justification of Choice of Post-positivism for the Study.

As discussed earlier, several research paradigms were chosen based on the ideological stance of the researcher and the nature of the research (Creswell & Creswell, 2018). Having detailed the various paradigms earlier, the researcher chose the post-positivism paradigm based on the fact that,

it allows for the amalgamation of both qualitative and quantitative research approaches popularly known as the mixed methodology (Hicks, 2018). As is echoed by Creswell (2018) who brought to bear that the paradigm advocates for the methodological pluralism of combining or integrating both quantitative and qualitative research methods. More importantly, post-positivism is centered on research questions that are developed based on theory or a conceptual framework (Iilonga, 2019). Given this background and considering the research questions of the study which were generated based on theoretical perspectives (e.g. socio-technical theory) and conceptual framework (e.g Global Competitiveness Index (GCI)) which are the backbone and more valuable in this study that is making a substantive theory stance (Teddlie & Tashakkori, 2017). Therefore, the post-positivism becomes a more suitable paradigm for this study otherwise the pragmatism paradigm will have been equally appropriate since it also allows for the integration of quantitative and qualitative research approach and provide the latitude for researchers to deploy any suitable data gathering instrument, statistical analysis to holistically investigate research problems (Chawinga, 2019). Nonetheless, some scholars have critiqued the use of post-positivism as more quantitative bias. However, Pastore (2017) refutes this assertion with the stance that, even though the focus of the post-positivism is more quantitative, it also allows room for some qualitative data to be collected to help address the research problem understudied which cannot be easily elucidated quantitatively. Hence sporadic critique does not invalidate the justification of the post-positivism paradigms for this study.

Also, the assumption of post-positivism is in line with this study as it focuses on the use of a questionnaire to gather quantitative data from library staff and analyzed data gathered using statistical tools. Qualitative data was also obtained using semi-structured interviews to solicit data

from the Head librarians/directors of the four (4) universities where the study was carried out to provide answers to questions that cannot be ascertained quantitatively and also corroborate or refute the responses gathered through quantitative data thereby enriching the findings of the study.

4.4 Research design

Research design and research approaches are used interchangeably (Lapan, Quartaroli & Rieme, 2012; Henning, 2004). A research design refers to the overall strategy that is employed by a researcher to undertake a research expedition (Denzin & Lincoln, 2011). Research designs according to Creswell (2018, p.49) “are types of inquiry within qualitative, quantitative, and mixed methods approach that provides specific direction for procedures in a research study.” and also popularly known as “procedures of inquiry”. Creswell (2018) as well as Creswell and Poth (2017) posit that research design serves as a blueprint upon which a researcher follows to investigate a research problem, determine the research language, the data collection instrument(s), data collection procedure, data analysis and discussion of findings. The choice of research design is usually informed by the nature of the study as avowed by Creswell (2018). For instance, if the nature of the research is to inquire into a new area and to obtain new knowledge then the researcher will be propelled to adopt the qualitative research design. However, if the focus of the study is to test theories and make inferences, a quantitative research design will be employed otherwise, the mixed research design can be selected to obtain a complementing strength of qualitative and quantitative methods to enrich the research findings.

Furthermore, the characteristics of the intended respondents influence the decision of the researcher about the appropriate research design to choose (Campbell & Stanley, 2015). For

example, when research focuses on little children, it will be most appropriate to go by a qualitative design using observations or interviews, or other case scenarios. Likewise, when a study is focused on monkeys where the researcher needs to gather data from these animals in their natural habitat, the unobtrusive observation which is qualitative in nature will be ideal for the study. Again, the choice of procedures of inquiry (research design) can also be influenced by the research paradigm (Creswell, 2018). School of thought who holds the tenets of interpretivism will employ the qualitative research design which focuses on obtaining more detailed, rich, and highly valid data, while the positivists will employ the quantitative research design since they believe that findings should be more objective, and the researcher should be distanced from the research audience (Creswell & Poth, 2017; Pastore, 2017; Creswell, 2018). The pragmatists and the post-positivists who believe in the integration of qualitative and quantitative research design may opt for the mixed methodology (Creswell & Creswell 2018; Creswell & Plano-Clark, 2011; Tashakkori & Teddlie, 2010; Petter & Gallivan, 2004). Nevertheless, any research design adopted cannot be conclusively considered perfect since each can play a role of partially helping to solve the problem under investigation (Amaratunga et al., 2002). Given this, it can be realized that the onus lies on the researcher to adopt the best suit research design with practical justifications.

4.4.1 Types of Research design

As already indicated, there are three main types of research design in the field of social sciences and humanities which comprise: quantitative research, qualitative research, and mixed methodology (Creswell, 2018). The choice of any of these methods is dependent upon the research problem, the research questions under investigation, and the paradigm that the researcher holds (Kumar, 2011; Gray, 2014).

4.4.1.1 Quantitative research

The quantitative research design has been championed by the positivists who strongly believe in statistical data since it is characterized by its objectivity and its high propensity of yielding results that can be generalized and replicated in different settings (Creswell, 2018; Awodele, 2012; Amaratunga et al., 2002) since it follows a rigorous systematic approach, devoid of human subjectivity and usually uses large sample sizes which produce consistent data (Durrheim & Painter, 2006). It also focuses more on testing theories using statistical analysis methods such as regression, T-test, ANOVA, and Chi-square (Creswell & Creswell, 2018). For instance, confirmatory data analyses are used to calculate a confidence interval. It measures relationships using Pearson's or Spearman's coefficients, to obtain differences between Chi-square or student's T-Test, for instance, uses (Creswell, 2018). One critical advantage of the quantitative research design is the fact as several scholars including Creswell and Creswell (2018) as well as Flick (2019) have confirmed that, quantitative research design allows a questionnaire wherein the survey method gives the researcher the latitude to administer close-ended questions to generate data which is more objective, accurate. It also allowed for inferences to be made and at the same time can be supported and spiced up by earlier open-ended questions. In addition, the quantitative research design is hailed by scholars Durrheim and Painter (2006) as well as Creswell (2018) as cost-effective and less time-wasting as compared to qualitative data where interview consumes a whole lot of time. Creswell & Plano-Clark, (2011) however described the quantitative approach as weak in terms of its inability to obtain the actual voice of participants' "context or setting in which people talk" (p.12) and they have no or limited chance of expressing further views through to enrich the data which makes it more valid.

4.4.1.2 Qualitative research

The qualitative research approach is championed by the interpretivists who believe that the researcher and the research audience should not be distanced from each other (Creswell & Creswell, 2018). Given this, interviews are usually used to solicit data since it gives both the respondent and researcher the chance to seek clarification where in doubt which according to Creswell (2018) helps the researcher to obtain the exact data as outlined in the research questions. Qualitative research is characterized as investigative research as it inquires into new areas and tries to understand the social phenomenon with in-depth information about the research problem under investigation, and also helps generate theories for further studies (Gray, 2014; Creswell, 2018).

Qualitative research is lumbered with some limitations as several scholars have trumpeted. For instance, because of its subjectivity, there is a high propensity that data will be influenced by the researcher's personal bias when interpreting research results, therefore, such results cannot be reliable (Chawinga, 2019). This criticism was echoed by Pandey and Pandey (2015, p.20) where it was asserted that "a good research design minimizes bias and maximizes the reliability of the data collected and analyzed". Again, because of its nature of usually dealing with small sample sizes, it is usually impossible to generalize findings as compared to quantitative research which is normally undertaken using large sample sizes and analyses through rigorous systematic statistical tests (Creswell & Plano-Clark, 2011, p. 12).

4.4.1.3 Mixed methodology

A mixed methodology is a research approach that combines both the qualitative and quantitative lens in a single study called triangulation (Johnson, Onwuegbuzie & Turner, 2007; Creswell, 2018) and has been scored as one of the research designs which has attracted the interest of several researchers in social science (Molina-Azorin & Fetters, 2017; Creswell, 2018). The mixed methodology is championed by pragmatists and post-pragmatists who believe that combining the elements of both qualitative and quantitative will neutralize controversies among them. This means that the weakness of one method will be supported or counterbalanced by the strength of the other and vice versa (Turner, Cardinal & Burton, 2015; Creswell & Plano-Clark, 2011; Boyd, Finkelstein & Gove, 2005). Hathcoat and Meixner (2017) opined that the mixed-method approach solves the issue of the weakness of both qualitative and quantitative as it cancels out each method's imperfection making research findings more grounded and therefore can be generalized. In effect, this approach enhances the reliability and validity of the data of this study. For instance, the qualitative research approach is ascribed to have high validity than reliability while the quantitative research approach has high reliability than validity and, in this case, therefore, the advantage of one will complement the other rendering the mixed research approach less susceptible to scholarly scrutiny (Creswell & Poth, 2017; Carlson et al., 2011). Similarly, the choice of a mixed research approach is driven by the fact that it serves as a way of minimizing control bias in the research process (Thoman & Maggetti, 2017) as it puts together the best strengths of qualitative and quantitative to enrich research findings (Creswell & Creswell, 2018; Bergman, 2008). In addition, Morgan (2007) brought to bear that, mixed methodologists believe that the inherent bias and anomalies of both qualitative and quantitative provide a high-level

confident level by employing mixed methods to neutralize these challenges rendering the findings more reliable, valid, accurate, and provides room for the findings to be accepted worldwide.

4.4.2.1 Types of Mixed Methods

There are three (3) main types of mixed methods (Creswell, 2018; Creswell & Plano-Clark, 2011) as detailed below.

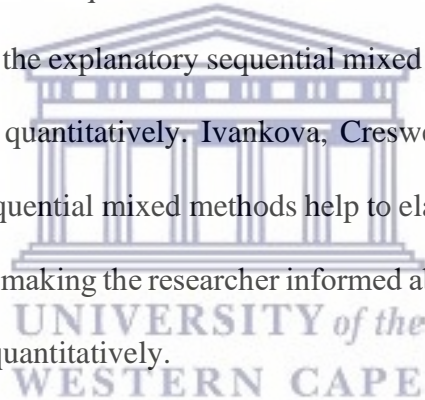
4.4.2.1.1 Convergent parallel mixed methods

The convergent parallel mixed method allows the researcher to integrate both qualitative and quantitative data in a single study. With regard to this type, both qualitative data and quantitative data are gathered concurrently or simultaneously (Creswell & Creswell, 2018) and this process is also known as triangulation (McMillan, 2004). In effect, it gives the researcher the leeway to compare both data where one serves to complement the other with the original intent of obtaining an all-inclusive understanding of the research problem under investigation (Creswell, 2018; Fetters, Curry & Creswell, 2013; Creswell & Plano-Clark, 2011). Thus, the researcher analyses the quantitative data separately and then analyses the qualitative data as well. The results are then integrated into the discussion stage of the study for a better understanding of the research findings (Creswell & Creswell, 2018; Creswell and Plano-Clark, 2011). This approach according to Creswell (2018, p. 300) is “to see if the findings confirm or disconfirm each other”. Creswell and Plano-Clark (2011) are of the view that convergent parallel mixed methods are the best approach, especially for researchers who are new to the mixed research approach. The authors further added that, since quantitative data and qualitative can be gathered independently, in effect, it enhances collaboration. In the sense that, an expert in the qualitative method can join a fellow researcher

who is quantitative biased to undertake a research project (Wahyuni, 2012). Creswell and Poth (2017) also maintain that convergent parallel mixed methods allow the researcher to holistically understand the research problem under investigation from multiple lenses. This helps the researcher to obtain a vivid understanding of the research and guides similar studies in the future.

4.4.2.1.2 Explanatory sequential mixed methods

With the explanatory sequential mixed methods, firstly, the quantitative research data are collected and analyzed statistically, followed by qualitative data which is also collected and analyzed subsequently (Creswell et al., 2008). This sequential approach intends to use the qualitative data to provide a detailed explanation of the quantitative data which is more statistical-based (Creswell, 2018). Dzanda (2019) posits that the explanatory sequential mixed methods help to justify, clarify, and enhance findings presented quantitatively. Ivankova, Creswell and Stick (2006) succinctly indicated that the explanatory sequential mixed methods help to elaborate on the numeric findings of the quantitative results, hence, making the researcher informed about the genesis of respondents' stance which has been reported quantitatively.



4.4.2.1.3 Exploratory sequential mixed methods

The exploratory sequential mixed methods according to (Creswell, 2018) is the direct opposite of the explanatory sequential mixed methods. Thus, the qualitative research data is solicited from the respondents, presented, and analyzed qualitatively. Subsequently, quantitative data is then gathered, presented, and analyzed with the prime purpose of validating the qualitative data (White, 2019). This approach according to Creswell et al. (2008) is to create the ground to generalize research findings.

Given this background on the various research approaches or designs, the researcher elected to employ the convergent parallel mixed methods also known as convergent design or triangulation mixed research design to carry out this research expedition. The intent of this choice is detailed below.

4.4.3 Justification of the Choice of convergent parallel mixed methods

The choice of the convergent parallel mixed method for this study was influenced by the problem statement and research objectives of the study. The researcher chose the mixed research methods because it allows both questionnaires and interviews to be integrated into the same study. Given this, since this study is a comparative one, the researcher thought it wise to administer questionnaires to the library staff to obtain quantitative data that can easily be compared statistically, make inferences, and possibly generalize the findings. Further, the researcher intended to solicit in-depth but rich information qualitatively using interviews from the four (4) academic library heads/directors and to help provide answers to the research questions and research problem which could not be obtained from the questionnaires. Again, the library heads were the right subjects who could provide holistic but detailed data needed by the researcher to supplement the study (Creswell & Plano-Clark, 2011), hence, it became inevitable to elicit qualitative data using the interview to help elucidate the quantitative data gathered earlier.

4.5: Population of the study

A population refers to a unit or group of research audience that the researcher elicits data from to undertake a study (Lepkowski, 2011; Sekaran & Bougie, 2010). These groups have similar

characteristics that are of interest to the researcher (Agbofa, 2012; Best & Khan, 2007). This assertion is in line with the works of Darko-Adjei (2018, p.83) who postulates that “population refers to the entire group of people, events or organizations or things that the researcher wishes to investigate”. Population gives a pool of lists from which elements are selected to represent the entire population of the study as subjects (Creswell, 2018; Durrheim & Painter, 2006). The element in a population of a study could be human or non-human such as objects or geographical areas (Sekaran & Bougie, 2010).

The population of this study consists of selected academic librarians from Ghana and South Africa. This study, however, was limited to only the academic library staff in a management position, senior members, and senior and Junior staff rank whose duties in one way or another is IT related and involve the use of IT equipment. This is because, in the view of the researcher, they possess information as far as the readiness of the library towards the 4IR is concerned. Senior members constitute the management of the library. They take decisions regarding procurement, installation, and all other processes that lead to the adoption and use of ICT systems. Although senior members do not directly provide services to students and faculty, the ICT systems inform their analysis of service provision and resource allocation. Also, senior members monitor other staff using the systems and, as such, are mostly responsible for resolving all issues that may arise from the use of these systems. Senior staff directly use the systems to carry out their routine tasks. For example, cataloguing library materials, acquisition of new materials, lending, and borrowing services all require the use of ICT systems. Senior staff also assume a supervisory role in ensuring that subordinates adhere to the proper usage of ICT systems in the library. Precisely, the academic librarians were selected from the University of Ghana library (Balme Library), and the University

of Cape Coast library (Sam Jonah Library) from Ghana. That of South Africa comprises the University of Johannesburg Library and the University of Cape Town Library.

4.5.1 Brief description of the research settings

To contextualize the research site, brief descriptions of each site are provided.

4.5.1.1 University of Ghana

The University of Ghana is the largest as well as the premier university in Ghana. The university was fully established in 1948 which was then called the University of College of the Gold Coast (Bailey, Cloete & Pillay, 2011) on “the recommendation of the Asquith Commission on Higher Education in the then British colonies” (Darko-Adjei, 2018, p.32) to provide quality education, learning, and research. The vision of the university is to become a world-class university in the next decade (University of Ghana, 2021). The mission of the university is to create an avenue to continue to be relevant to national and global development through cutting-edge research and by providing high-quality teaching, learning, and research. The university practices the collegiate system which comprises, the College of Basic and Applied Sciences, the College of Education, the College of Health Sciences, and the College of Humanities (University of Ghana, 2021).

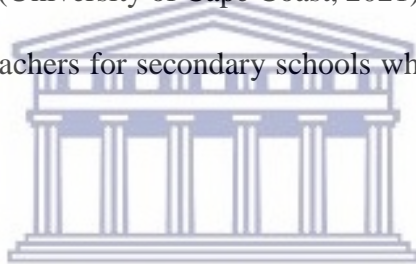
4.5.1.1.1 Profile of the University of Ghana Balme Library

The University of Ghana Balme Library was established in 1948 and was named after Mr. David Mowbray Balme who was then the first principal of the University of Ghana (Ahenkorah-Marfo, 2015). The Balme Library which is the largest library in Ghana and among the best libraries in

West Africa is well-resourced electronically (Amofah-Serwaa, 2018). The library has the best electronic resources as compared to other public universities in Ghana (Ahenkorah-Marfo & Akussah, 2016).

4.5.1.2 University of Cape Coast

The University of the Cape Coast is one of the largest universities in Ghana and was established in 1962 with the prime purpose of training highly qualified skilled workers in the area of education (University of Cape Coast, 2021). Initially, it was affiliated with the University of Ghana, Legon. Later on, the College attained the status of a full and independent university on October 1, 1971, to award degrees to its graduates (University of Cape Coast, 2021). One of the main focuses of the University is to train qualified teachers for secondary schools which are now called Senior High Schools.



4.5.1.2.1 Profile of Sam Jonah Library

The University of Cape Coast library, also known as the Sam Jonah Library was established in 1962, the library was named after Mr. Sam E. Jonah, the former chancellor of the University of Cape Coast (Ahenkorah-Marfo, 2015). The library has a mission of adding value to teaching, learning, and research publication and rendering quality information service (University of Cape Coast, 2021). The library started with a few collections which were centered on English literature, economics, history, and geography (Amofah-Serwaa, 2018). As of 2015, the library could boast of 249564 books and some volumes of periodicals. The library has also subscribed to numerous e-journals, databases, and other related electronic resources and it is counted among the advanced

library in Ghana providing excellent electronic services and keeping pace with the drastic change in technology (Amofah-Serwaa, 2018).

4.5.1.3 University of Johannesburg

The University of Johannesburg was established on 1st January 2005 due to the merger between the Rand Afrikaans University, the Technikon Witwatersrand, and the Soweto and East Rand campuses of Vista University. The University is one of the largest among the 26 public universities in South Africa with a population of 50,0000 where 3000 are international students from 80 countries (University of Johannesburg, 2021). The University's vision is to become an international University of choice, anchored in Africa, dynamically shaping the future, and with a mission of inspiring its community to transform and serve humanity through innovation and the collaborative pursuit of knowledge (University of Johannesburg, 2021).



4.5.1.3.1 University of Johannesburg Library

The University of Johannesburg library is recognized as one of the most advanced but renowned libraries in Africa and the world at large. It has a great focus on the 4IR and no wonder it has an ambition of having the largest collection of electronic books on the continent of Africa (University of Johannesburg, 2021). The library has a wide range of electronic and print resources available to patrons. The library can boast over 1000 electronic books and peer review articles available 24 /7 for access. Also, the library has a self-check-in for patrons to access library resources with ease and make quick access to the library. It also offers a desk-to-desk delivery service where patrons

can request a book which is usually delivered within 24 hours including other advanced electronic services (University of Johannesburg, 2019).

4.5.1.4 University of Cape Town (UCT)

UCT began as the South African College, a high school for boys, in 1829. After the discovery of gold and diamonds in the north in 1880, and the ensuing need for mining expertise, the College's small tertiary-education facility developed significantly, giving it the financial boost it required to expand. The College expanded into a full-fledged university between 1880 and 1900 as a result of increased support from both government and private sector (University of Cape Town, 2022).

The vision of UCT is to become an inclusive, highly research-focused African university that provides cutting-edge facilities, teaching, and research to solve current and emerging issues. As a university, they are dedicated to encouraging transformation, putting out great effort to ensure the long-term viability of the organization, and pursuing excellence in everything they do. UCT is the best-rated institution in Africa and one of the best universities in the world, it has a distinguished history of academic success. Their researchers are still working to provide African-based answers to the world's challenges, such as those related to urbanization, safety and security, education, and health, to name a few. Many UCT researchers are acknowledged as global leaders in their specialties, thus if one wishes to choose to (University of Cape Town, 2022).

4.5.1.4.1 University of Cape Town Library

The UCT Library is one of the most advanced libraries in South Africa and one of the best in Africa. It has several branch libraries that can boast cutting-edge equipment, sizable collections of reading and research materials, and the specialized services of a welcoming, effective, and accommodating staff. At the center of Upper Campus is the Chancellor Oppenheimer Library. Its eight branch libraries are located adjacent to the necessary academic institutions. There are more than 1.2 million print books in the library.

The library's website serves as a conduit to study materials like:

- Online citation tools, full-text databases, and bibliographies
- 87 350 articles from electronic journals
- Primo, a tool for book discovery and delivery, is a developing institutional digital repository for eBooks (University of Cape Town, 2022).



4.5.2 Target population for the study

The target population for the study was academic library staff whose services influence technological change as the library prepares for the 4IR and were selected from the various units of the library. Apart from library staff who work are IT related, the four (4) university librarians or directors of each library were included in the study population. This move was initiated by the fact that the researcher intended to get broader but detailed information on the preparedness of the academic libraries towards the 4IR. It is worthwhile to notice that, each library has unique units and or services descriptions and this accounted for the different unit names for each selected library as seen in Table 4.1.

As far as the target population is concerned, the University of Ghana Balme library has a population of 43 while the University of Cape Coast has a library staff population of 59. Also, the University of Cape Town and the University of Johannesburg Library have a population of 58 and 47 respectively.

Therefore, the total population for this study is 207; where 203 were librarians and IT staff and four were the University librarians or directors of each selected library. Table 4.1 shows the total population for the study.

Table 4.1: Study Population

Country	Universities	Position/Units	Number
Ghana	University of Ghana	University of Librarian (Head)	1
		Deputy University Librarian	1
		Students' Academic Computing Units	5
		Faculty/campus/ departmental heads librarians	8
		Digital institutional repository	4
		References services /Circulation/ information services	7
		Library system (Technical support units and Cataloguing)	6
		Electronic resources (research commons and knowledge commons)	9
		Webmaster (website)	1
		Total	43
	University of Cape Coast	University Librarian (Head)	1
		Deputy University Librarian	1
		Reference and student support	1
		Reader Services and circulation	1
		Cataloging and Library management system	6
		Preservation, and Curriculum Analysis (APCA)	12
		Library and information technology infrastructure support units	9

		Learning and research support units	14
		Electronic resource management and digital services	5
		Information literacy and distance library services units	6
		Scholarly communications units	3
		Total	59
South Africa	University of Cape Town	Executive Director	1
		Personal Assistant to Director	1
		Director: Research & Learning	1
		Director: Information Systems & Resources	1
		Digital library services	9
		Discovery services	3
		Scholarly communication	5
		Shared services	5
		Subscriptions & eResources (acquisition)	1
		Information desks	1
		Commerce, Centre for Higher Education Development (CHED) & Enterprise	5
		Subject-specific support	12
		Digital preservation	1
		Ask-a-Librarian	12
	Total	58	
	University of Johannesburg	Executive Director (Head)	1
		Directors	2
		Campus/faculty librarians	6
		Information services	18
		Library systems	8
Shared and support services		10	
Makerspace		1	
Webmaster		1	
Total	47		
Grand Total			207

4.6 Sampling Technique and sample size

Sampling is critical in almost every research process (Creswell & Creswell, 2018). This is where a portion of a population is carefully selected either using probability procedure or non-probability

procedure or both depending based on the nature of the study and as well as the population to be investigated (Creswell & Poth, 2017; Gray, 2014). In certain circumstances, sampling may not be needed for the study (Creswell, 2018). Examples of probability sampling include simple random sampling, systematic sampling, cluster sampling, and stratified sampling. Non-probability sampling on the other hand includes convenience sampling or accidental sampling, purposive sampling, and snowball technique (Sharma, 2017; Creswell, 2018). In order to determine the sampling size for a study, a sampling technique needs to be determined. The sampling technique refers to the process or procedure a researcher follows to select a sample to represent the entire population (Creswell & Poth, 2017). Sample size refers to the number of subjects that the researcher selects to participate in the research (Creswell, 2015). This study used the entire population for the study therefore there was no sampling technique, and the sample size will be the total population. This approach according to Shapiro (2011) is called the census approach or population sampling. The researcher elected to use the census approach based on the fact that, the population under study was too small to sample and as such, the researcher possesses the available resources such as time and funds to use for the entire population. Leedy and Ormrod (2010) also assert that where the population for the study is less than 200, the researcher could consider using the entire population for the study. For small populations, the sample ratio needs to be large to capture a sample that is truly representative of the population.

4.7 Data gathering instruments

Data gathering instruments refer to the tools that the researcher intentionally selects to solicit data from respondents (Sharma, 2017; Creswell, 2018). This decision is made based on the kind of data

needed by the researcher to answer the research question as well as the nature of the subjects of the study. It is also influenced by the research paradigm. Thus, as emphasized earlier, the positivists usually go by the questionnaire to gather quantitative data while the interpretivists make use of the interview for qualitative study. Also, pragmatists and post-positivists usually employ both questionnaires and interviews for a mixed research approach where one type of data serves as a complement to the other. There are several ways and sources of gathering data which includes the use of instruments such as; questionnaires, interview, observations, archival documents, government sources, laboratory experiments, and quasi-experiments (Creswell, & Poth, 2017). The two widely used data-gathering instruments in social science comprises; a questionnaire and an interview (Creswell, 2018) were employed to gather data for this study.

4.7.1 Questionnaire

A questionnaire is one of the data collection instruments that is used in the quantitative approach and the mixed-method approach. It deals with numeric values that help researchers to quantitatively analyze data using statistical means (Creswell & Creswell, 2018). A questionnaire according to Kumar (2011) refers to a list of structured questions that a respondent is required to complete. It could be closed-ended questions which the respondent has to select from and or open-ended questions where the respondent has the latitude to express his or her view briefly on given questions in a limited space. This assertion is a confirmation of what Rowley (2014) postulated when he states that, open-ended questions provide the opportunity for respondents to express their views which are critical in a research expedition. Also, the use of questionnaires makes it possible for researchers to distance him/herself from the respondents leading to a high propensity of data

collected being more objective, thereby creating qualifying findings to be generalized (Pandey & Pandey, 2015).

There are two different ways of administering questionnaires to respondents and either of them has its own impact on the outcome of the study. Thus, a questionnaire can be administered to participants by the researcher which is referred to as the face-to-face mode (Oyewobi, 2014). The effect of this strategy according to authors including Blaxter Hughes and Tight (2006), as well as Saunders et al. (2019), has a propensity of yielding a high response rate and as such is known to be one of the quickest strategies of data collection. Again, even though the face-to-face mode is time-consuming, the respondents may have the opportunity to seek clarification where necessary and provide valid responses to the questionnaire (Blaxter et al., 2006). The other mode of administering questionnaires to respondents is through Postal and internet-aided means. Researchers have concluded that even though this approach may help reach respondents who are geographically dispersed or difficult to reach the respondents do not get the opportunity to get clarification on a certain part of the questionnaire as compared to it being done face-to-face (Oyewobi, 2014).

Despite the phenomenal advantages of the face-to-face mode of administering questionnaires, the researcher opted for Web-based Questionnaires which can be administered online via email addresses.

4.7.1.1 Web-based Questionnaire

A web-based questionnaire is a form of questionnaire whereby questions are transferred onto google forms (Mabweazara, 2018) to be completed online by the respondents. Google Forms is a Google application and responses (completed set questionnaire) are stored on google drive and in Excel sheets. The questionnaire in the form of a URL is the same as the hard copy questionnaire however, the only difference is that it should be completed by the respondents online with the aid of the Internet (Bertot, 2009). Van et al., (2010) posit that one critical advantage of the web-based questionnaire is the fact that it helps to detect errors the moment the respondent key in with wrong data, therefore, helping in validation responses. Other advantages are that it is cost-free to create the questionnaire, it is easy and cheap to distribute the questionnaire, instant reminders can be sent to unresponsive respondents, and responses are captured automatically on Excel spreadsheets. There is no deniable fact that questionnaire distributed via web-based usually results in a low response rate. Given this, Van et al., (2010) proposed some plausible strategies that may be considered. One is to pre-notify the respondents about the questionnaire to get them duly informed and constantly send them reminders. Also, the questionnaire should be clear, concise, and precise and the respondents should be assured of confidentiality and anonymity. And if possible, the questionnaire should be straightforward, and not take a substantial time to complete.

The intent of this choice was influenced by the fact that the data collection was done during the COVID-19 pandemic when social and or physical distancing was recommended, and traveling was restricted resulting in the researcher's inability to visit the research sites in person. With COVID-19 protocols in mind, the researcher thought it the best practice to use web-based questionnaires to email to all the identified subjects and encourage them to return the questionnaires within a

certain period. To avoid delay and low responses rate, the researcher periodically sent a reminder to each respondent and also assured them of being on standby for any questions that may require clarification during the course of answering any part of the questionnaire.

4.7.1.2 Questionnaire Design for the study

The questionnaire was divided into eight (8) sections. The first section captures the demographic data of respondents, and the rest of the sections were based on the research questions of the study as follows;

SECTION 2.0 Demographic data of respondents

SECTION 2.1: Awareness and knowledge about the 4IR in libraries

SECTION 2.2: General features of a 'smart' library / modern libraries

SECTION 3.1: New Lib4.0 technologies and applications are available in your library due to the 4IR

SECTION 4.1: Reasons for using Lib4.0 technologies and applications in your library

SECTION 5.1: Level of academic librarian's knowledge, skills, and competencies in the application of Industry 4.0's technologies

SECTION 5.2: Level of computer proficiency

SECTION 6.1: Challenges academic libraries face in incorporating 4IR technologies and applications

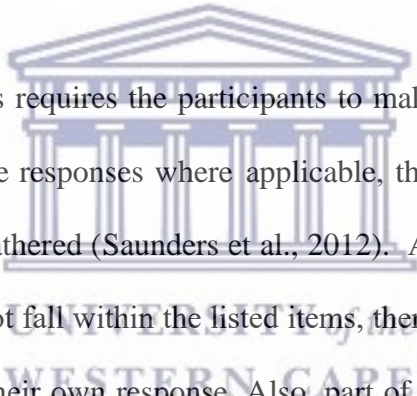
SECTION 7.1: Responsive structures needed

SECTION 7.2: Policies

SECTION 8: Available actions toward the disruptive changes

The questionnaire contained both closed-ended (fixed responses and opened-ended questions).

The latter allowed a text box for respondents to add answers or opinions. A variety of fixed-response type questions were included. Multiple choice (yes/no), multigrid (allowing more than one option to be chosen, ranking (Likert scale), and multiple-choice matrix allowed for variety to ensure interesting questions, limiting respondent boredom and fatigue as well as making it easy for the researcher to analyze and interpret data gathered (Saunders et al., 2012). All fixed-response questions included an “other” option allowing respondents the opportunity of providing their own responses. Ranking questions enabled the researcher to measure the intensity of views from respondents.



Part of the close-ended questions requires the participants to make a selection of only one item while others allowed for multiple responses where applicable, therefore, making it easy for the researcher to interpret the data gathered (Saunders et al., 2012). At a point where a respondent's suitable choice of answer does not fall within the listed items, there is an option of “other” which allows a respondent to provide their own response. Also, part of the questionnaire contains a 5-Likert scale which comprises, Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), Strongly Agree (SA) where SD=1, D=2, N=3, A=4, and SA=5. Other forms of the 5-Likert scale used were; Very Low (VL), Low (L), Neutral (N), High (H), and Very High (VH) where VL=1, L=2, N=3, H= 4, VH= 5

Using the Likert scale, therefore, enabled the researcher to measure the intensity of views from respondents which was used as a basis for the conclusion based on the findings. Also, part of the

questionnaire had Yes or No questions, and these were complemented with open-ended questions to justify the reasons for their choice.

4.7.2 Interview

An interview is one of the data gathering instruments that is usually used to gather data for a purely qualitative study or mixed research approach. According to Saunders et al. (2012, p. 372), an interview “is a purposeful conversation between two or more people requiring the interviewer to establish rapport, to ask concise and unambiguous questions to which the interviewee is willing to respond and to listen attentively”. An interview is among the data gathering instruments that help a researcher to gather in-depth but rich information as required (Wahyuni, 2012). The author further emphasized that “the use of an in-depth qualitative interview is considered as the appropriate format for case study research because in-depth questions cannot be answered briefly” (Wahyuni 2012, p. 74). Interviews have been hailed by several researchers as it provides the opportunity for respondents to express their views freely (Hancock & Algozzine, 2016). Brinkmann and Kvale (2018) advanced that interviews grant the opportunity for the researcher to have a personal interaction with the respondent(s) and also get to understand their real problem on the ground as far as the problem statement of the study is concerned (Creswell & Creswell, 2018). Given this, there is a high tendency that, valid information will be gathered, and a new pattern may be developed to serve as the foundation for further research to be undertaken.

4.7.2.1 Types of Interviews

A research interview can be grouped under three main categories which comprise; structured, semi-structured, or unstructured. Either of them or a combination is chosen based on the nature of

the data needed by the researcher having in mind the research questions/ objectives and research problem (Creswell & Creswell, 2018).

4.7.2.1.1 Structured interview

The structured interview contains predetermined questions that are presented to the interviewee by the interviewer in a well-defined procedure or structure guided by an interview schedule (Gill et al., 2008). One advantage of this type is the fact that it is quicker to gather data since the interviewee has a limited length of responses needed. This move allows the researcher to gather slightly quantitative data and as such helps to compare data with others (White, 2019; Kumar, 2011).



4.7.2.1.2 Semi-structured interview

The semi-structured interview is another category of the interview where a set of defined questions are presented to the interviewee and they have the opportunity to express themselves on a given subject or questions to obtain insight into the data required (Creswell & Poth, 2017; Valenzuela & Shrivastava, 2008). Wahyuni (2012) described the semi-structured interview as a hybrid because its nature is partly characterized by structured and unstructured interviews.

4.7.2.1.3 Unstructured interview

An unstructured interview contains an open-ended question that gives the latitude to the respondents to describe or narrate their feelings, thoughts, and perceptions on a given subject (Creswell, 2018). Gill et al. (2008) avowed that an unstructured interview should be encouraged

to use especially when nothing or little is known about the subject area and the researcher needs deep insight to fulfill the purpose of the study. Muijs (2010) also added that the unstructured interview set the pace for discovery and unplanned variables may emerge and will be crucial to the findings of the study.

The qualitative data of the study was gathered using semi-structured interviews supported by well-crafted interview guides. The intent of this choice was driven by the fact that in-depth information was needed from the various library heads or directors to complement the quantitative data which had already been gathered from the librarians for better discussion and understanding of the research findings (Connaway & Powell, 2010). The interview was structured into the following subsection;

SECTION 1: Awareness and knowledge about the 4IR

SECTION 2: New Lib4.0 technologies and applications

SECTION 3: Reasons for using Lib4.0 technologies and applications

SECTION 4: Knowledge, skills, and competencies

SECTION 5: Challenges

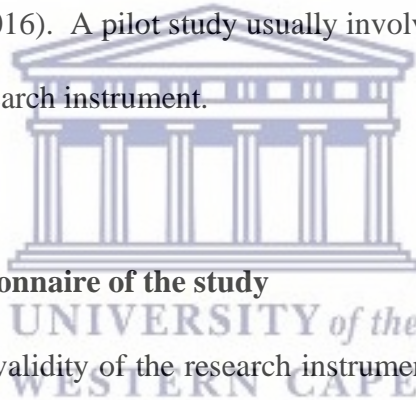
SECTION 6: Responsive structures needed and policies

SECTION 7: Available actions.

4.7.3 Pilot Study

A pilot study is considered one of the prime stages of a research expedition where the research instrument(s) are thoroughly tested to check for potential flaws before it is implemented into the full study (Hassan, Schattner & Mazza, 2006). A pre-test is usually conducted on a small portion

of a population with similar characteristics to objectively come out with obscure issues such as ambiguity, omission, and errors. According to Creswell (2018), a pilot study is considered a short survey that is conducted on a small similar group of the population understudied to cross-check data collection instruments such as a questionnaire, interview checklist, or observation schedule. The author further indicated that pilot exercises help to check for the reliability and validity of the study. Cadete (2017) asserts that it is worthwhile to test the feasibility of the study by testing the research instrument as Ismail et al. (2018) cautioned that a researcher must not take the risk by not piloting a research instrument first for a study. In effect, a pilot study helps the researcher to make informed decisions as in whether to ignore a research questionnaire and rather employ an interview and vice versa, therefore, it is practical and highly inappropriate to skip this crucial exercise during the research process (Lumpur, 2016). A pilot study usually involves pre-testing, checking for the reliability and validity of the research instrument.



4.7.3.1 Pre-testing of the questionnaire of the study

To check for the reliability and validity of the research instrument, the questionnaire, as well as the interview guide, were pre-tested. The questionnaire was distributed to 30 librarians at the Ghana Institute of Management and Public Administration (GIMPA). The choice of GIMPA was influenced by the fact that it has the attributes and characteristics of a typical academic library. Moreover, the GIMPA library had equally embarked on the deployment of some 4IR technologies and applications to support its library services, although not on as massive a scale as the libraries under study. The GIMPA library has electronic support units that stock a very large volume of computers, mostly connected to the internet, which users access for research purposes. Also, it has features of the Modern library and has steadily incorporated some Lib 4.0 technologies. This made

library staff at the GIMPA library reliably informed about emerging IT technologies necessary in the era of the 4IR. This exercise was worthwhile as participants helped to address the issue concerning the ambiguity of wording and omissions in the questionnaire. Repeated questions as well as those that did not capture the intended data needed were pointed out to be restructured or better still taken out.

4.7.3.1.1 Validity and Reliability of research instruments

Accuracy and consistency are an integral part of the research process which are usually referred to as reliability and validity (Lumpur, 2016). Wahyuni (2012, p. 74) postulated that “research should rely heavily on reliability and validity to ensure its replicability and generalizability”.



4.7.3.1.1.1 Validity

Validity refers to the extent to which a research instrument measures what it is supposed to measure (Creswell, 2018). Kumar (2010), Turner (2010), and also Jacobs and Furgerson (2012) postulated that; validity focuses on the appropriateness of research procedures use to elicit responses for a study. Creswell and Poth (2017) again, confirmed that to obtain a high level of accuracy of data, it is expedient to use the right procedure and strategies in research. In the same token, Gray (2014) emphasizes that an instrument is said to have a high level of validity if a construct/variable measured is actually what it was intended to do. This is also in line with Gibbert et al., (2008) who avowed that for a study to obtain a high level of validity it is cardinal to employ triangulation where different research instruments and different data sources are permitted to be integrated into a single study. Wilson (2010) argued that although reliability is cardinal in a research study, it cannot be trusted without testing for its validity.

4.7.3.1.1.2 Reliability

Reliability is the extent to which a measurement of a phenomenon provides stable and consistent results (McFarland, 2020). In this sense the instrument used to measure a phenomenon should yield the same results under similar conditions and methodology, hence, there should be a high level of consistency (McFarland, 2020; Creswell & Plano-Clark, 2011). In the same vein, Kumar (2011) avowed that reliability tests the stability and extent to which a research instrument produces similar findings in different settings. In the work of Anaman (2017, p.50) it was found that “the reliability of scales is at the heart of quantitative methodological research in social science that uses survey”.

The reliability of the research instrument is usually tested using the Cronbach Alpha coefficient specifically when testing for internal consistency (Darko-Adjei, 2018; (Lancaster, 2005) Robinson (2009) also posits that using the Cronbach Alpha coefficient is the most efficient and appropriate way of measuring the reliability of a research instrument, especially with the use of the Likert scale. According to Tavakol and Dennick (2011, p.53), Cronbach Alpha (α) ensures a “measure of the internal consistency of a test or scale and it is expressed as a number between 0 [zero] and 1 [one]”. There is no absolute rule in determining the appropriate Cronbach Alpha (α), however, most researchers have arrived at a consensus on a minimum least the reliability coefficient of 0.70 or above (Robinson, 2009; Tashakkori & Teddlie, 2010) is more reliable, 0.60 or more is adequate for exploratory study (Straub et al., 2004), 0.07-0.90 according to Hinton et al., (2004) can be considered as high reliability, 0.50-0.70 is suggested as moderate and below 0.50 is below average.

Furthermore, in determining the reliability of the study instrument, data on the Likert scale were entered into SPSS to test for the Cronbach Alpha coefficient. All constructs with a coefficient that fell below 0.70 were perfected. This created the assurance of high internal consistency (Choga, 2015). Based on the proposition by Robinson (2009); Tashakkori and Teddlie (2010) where 0.7 is more reliable and the coefficient of 0.07-0.90 affirmed by Hinton et al., (2004) as reliable. It can therefore be concluded that since all the sets of questions that were tested using the Cronbach Alpha have a coefficient value greater than 0.8 as shown in Table 4.2, the constructs of the research instrument have high reliability and are acceptable.

Table 4.2 Cronbach Alpha (a) coefficient of each construct.

Construct		Number of items	Cronbach's Alpha coefficient
General features of a 'smart' library / modern libraries		10	.839
Knowledge Abilities		12	.876
Skills abilities		27	.964
Challenges		15	.921
Responsive strategies		19	.884
Available actions toward the disruptive changes	Information and communication infrastructure and emerging technologies	9	.863
	Education and training programme organized by the library captures the following focus	15	.953
	Impact of library training programmes on the library staff	7	.908

4.7.3.2 Pre-testing of the interview schedule for the study

The semi-structured interview schedule was given to four (4) departmental heads at the Ghana Institute of Management and Public Administration (GIMPA) library. The intent was to check if the questions in the interview schedule produced data to answer the research questions of the study as planned. This exercise was successfully carried out and suggestions made by the participants were duly acknowledged where necessary.

4.8 Data collection procedure

Ethical clearance issues which are deemed critical in the data collection process was considered. Given this, the researcher sought permission from the authorities of the four universities. After sanction had been granted, the researcher proceeded with the data collection process by sending introductory letters to all the library heads of the four (4) university libraries to seek formal approval for the data collection to begin. The researcher then requested the email addresses of all the identified subjects. Again, the researcher sent messages to all the emails before the informed consent forms were added to the questionnaire and sent to the subjects to be completed. The researcher indulged them to complete the questionnaire within two weeks. To expedite the data collection process, the researcher printed some of the questionnaires out and printed them to subjects from the University of Ghana Balme Library and the Sam Jonah Library. This action led to a high response rate from these two research sites. Similarly, the consent form for the semi-interview was sent to the library heads before the actual interview took place. The researcher then scheduled an appropriate time to interview the subjects via the ZOOM platform and Microsoft Teams based on the preference of the interviewee. The intent of choosing these platforms enabled the researcher to have the chance to witness the facial expressions and body language of the interviewees in reaction to questions. The interviewees were asked permission to be audio/video-

recorded and assured of confidentiality and anonymity. The recorded interviews were grouped under one folder with special codes for all the responses. In the course of undertaking the data collection, the researcher kept in mind the codes and conducts of the University of Western Cape (UWC) governing research.

4.9 Analysis of data

Analysis of data is one of the integral parts of the research process as Adama (2019) emphasized, it is imperative to choose the right analysis technique to arrive at a valid finding to achieve the research aim. Simply put, Merriam (2009) postulated that the analysis of data is a way of making meaning out of data. Awodele (2012) also asserts that the right analysis technique gives the researcher high confidence in concluding research findings. This study employed the mixed method approach therefore data was collected and analyzed quantitatively as well as qualitatively.

4.9.1 Quantitative data analysis

Quantitative data analysis was undertaken with the idea of the positivists where the focus was centered on gathering objective data that are more reliable to be generalized. Data from the online questionnaire (google form) was exported into Excel and subsequently re-entered into the Special Package for Social Science (SPSS) version 25 for the analysis. The analysis was done using descriptive and inferential statistics. Descriptive statistics refers to the description, presentation, and summarization of a set of data to properly describe the various features of that set of data (Acheampong, 2016). Descriptive statistics included percentages, tables, pie charts, bar charts, and frequencies. Inferential statistics on the other hand allowed for association or relationship to be established among variables. Given this, inferential statistics allow deductive logic to be done in

data collection and gives room for findings to be generalized (Curtis & Curtis, 2011). The chi-square was used to test the relationship between the constructs of this study.

4.9.2 Qualitative data analysis

Qualitative data was analyzed based on the interpretivists' perspective using the principles of thematic analysis (Creswell, 2018; Braun & Clarke, 2012) also known as qualitative content analysis (Wahyuni, 2012), and supplemented with the Atlas TI software. Qualitative data can be analyzed by four main approaches which comprise the thematic, structured, discursive, and instrumental approaches (Madill & Gough, 2008). Among these types, the study adopted the thematic analysis approach. Thematic analysis is the process of converting narratives into textual smaller units, searching for patterns, and grouping them into themes (Braun and Clarke, 2012) where a similar trend is established to make means out of data (Ayres et al., 2007). In terms of strength, Joffe (2012) affirms that thematic analysis follows a laid down systematic procedure making it more scientific and transparent to comprehend. This process helps to bring unstructured data into an organized format to aid in the analysis of the study.

The study followed six (6) structured steps in analyzing the data for the study. Figure 4.1 reflects the six steps which comprise transcribing, coding, searching for themes, reviewing potential themes, defining themes, and obtaining results.

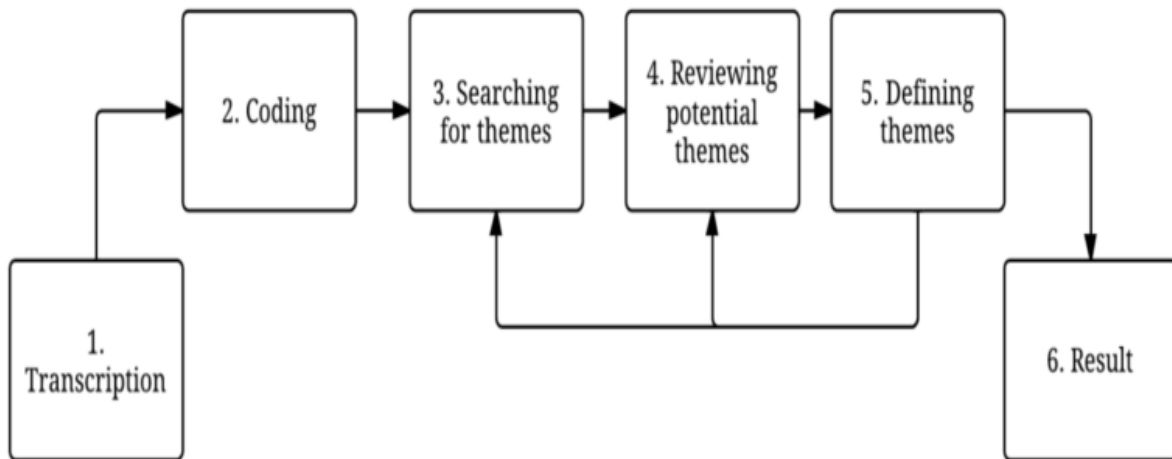
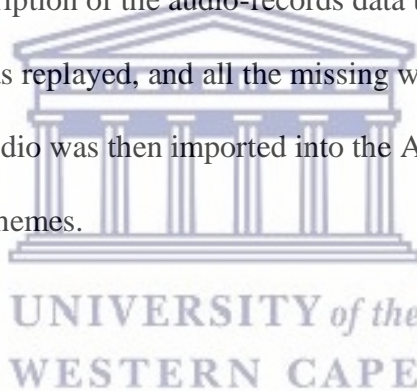


Figure 4.1: An Illustration of the Thematic Data Analysis (Braun & Clarke, 2012).

Transcription

The analysis began with a transcription of the audio-records data using Microsoft Word. For the avoidance of doubt, the audio was replayed, and all the missing words were inserted appropriately. The transcribed audio was then imported into the Atlas TI software to help group repeated responses into various themes.



Coding

Special codes were then assigned to responses that occur frequently. This helped bring together, the various responses from the interview in an organized form. Also, codes such as R1, R2, R3, R4, etcetera, were assigned to identify responses in that order.

Searching for themes.

Having organized the various responses into groups with special codes. The researcher then carefully read through the group responses and begin to identify themes with common patterns.

Review of potential theme

At this stage, reviewing potential themes made grouped themes more meaningful and helped in answering the research questions of the study. Those themes that were not good enough to stand on their own were kept as miscellaneous and later reallocated to appropriate groups. At least, every theme had some distinct characteristics and was linked to the research questions. Furthermore, all contradicting responses were removed and repositioned under themes where they best fit. The uncoded themes were double-checked to make sure relevant data were not left out.

Defining themes

All the identified themes were defined with good descriptions which helps in the interpretation stage of the study. This stage adds more meaning to the themes and also for better understanding and establishment of the relation among the various constructs. Adama (2019, p.144) postulated that “the process of defining theme is to ensure the “essence” of what the themes are all about and the aspects of the data that the theme covers.”. These themes were aligned with the research questions which were pivotal in the interpretation and discussion stage of the study.

Result

The last stage of the thematic process was to report the results and interpret them. The themes were reported coherently and logically making it easy for readers to comprehend. The report was presented based on the research questions.

4.9: Concluding summary

The study was based on the post-positivist paradigm where the convergent parallel mixed methods were deployed as the research design for the study. This research design allowed data to be gathered using both questionnaires and interviews. Given this, the data analysis was done quantitatively as well as qualitatively. This chapter was painstakingly supported by plausible justification for all the choices for items in the research process such as the research paradigm, research design or approach, data gathering instruments, and methods of data analysis. The next chapter presents data analysis in a graphic, tabular, and textual format.



CHAPTER FIVE: QUANTITATIVE DATA ANALYSIS

5.1 Introduction

This chapter captures the quantitative data analysis in a graphical, tabular, and textual format. As indicated in the previous chapter, the post-positivism paradigm which allows for the integration of both quantitative as well as a qualitative research approach was adopted. Against this backdrop, the quantitative analysis is presented followed by the qualitative data in the next chapter to explicate the study's research problem. The study compared the readiness of academic libraries in Ghana and South Africa toward the 4IR.

Responses obtained from library staff through a questionnaire were analyzed quantitatively using both descriptive and inferential statistics. The study utilized Special Package for Social Science (SPSS) Version 25 and supported by Microsoft Excel 202 to present data in graphic, tabular, and textual form. The Chi-square test was used to investigate the relationship among variables to underpin the major findings of the study. The analysis and presentation of results have been organized under the following sub-headings which are directly in line with the objectives of the study:

- I. Demographic data of respondents
- II. 4IR awareness and general knowledge
- III. Lib 4.0 technologies and applications
- IV. Librarian knowledge, skills, and abilities needed
- V. Challenges academic libraries face in incorporating 4IR technologies

- VI. Responsive structures needed and policies
- VII. Actions toward disruptions
- VIII. Hypothesis Testing
 - a. Relationship between technological readiness and innovation readiness.
 - b. Relationship between training on new technologies and interest in newly adopted technologies.

Response rate

The response rate in research refers to the total number of respondents who partakes in a study out of the total sample size study expressed in a percentage. Frey (2018) maintained that in an educational survey, a response rate is crucial as it has a high propensity to affect the validity of estimates, analysis, and inferences. For instance, a low response rate could lead to low data quality and response bias. The onus, therefore, lies on the researcher to devise mechanisms or strategies to obtain an appreciated response rate for a study.

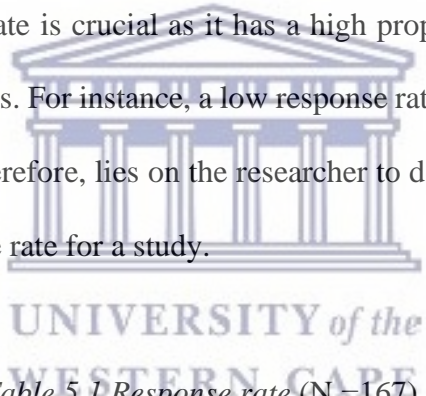


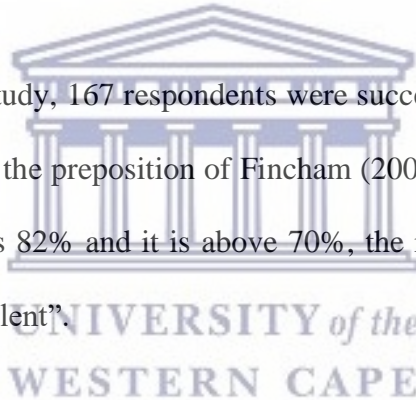
Table 5.1 Response rate (N=167)

Response rate by country		Total sample size (100%)	Response within libraries
Ghana	University of Ghana Balme Library	42	38 (90%)
	Sam Jonah Library	58	58 (100%)
Sub Total		100	96 (96%)
South Africa	University of Cape Town Library	57	39 (68.4%)
	University of Johannesburg Library	46	32 (70%)
Sub Total		103	71(69%)
Total		203	167 (82%)

As seen in Table 5.1, from the responses obtained, 38 (90%) out of the 42 total respondents were from the University of Ghana Balme Library, and 58 which represent a 100% response rate are respondents from the Sam Jonah Library. Also, the University of Cape Town Library and the University of Johannesburg Library had a total response of 39 (68%) out of 57 and 32(70%) out of 46 respectively. Putting them together, a response rate of 96 (96%) was obtained from Ghana while a 71 (69%) response rate was obtained from South Africa.

Fincham (2008) asserted that a 60% response rate is adequate for a study, and this is accepted by editors of most journals. In the same vein, in the works of Babbie (2001), it was postulated that a response rate of 50% is acceptable for scholarly research analysis and reporting; while 60% is remarked as “Good” and 70% and above is rated as “Excellent”.

Out of the 203 subjects of the study, 167 respondents were successfully obtained representing a response rate of 82%. Based on the proposition of Fincham (2008) and Babbie (2001) and since the response rate of the study is 82% and it is above 70%, the response rate for this study can therefore be remarked as “Excellent”.



It can be observed that the response rate from Ghana was higher than that of South Africa. These results can be attributed to the fact that the researcher was able to use both a printed and a web-based Google form questionnaire to obtain responses from Ghana based on the preference of some of the respondents. This move was not possible for academic libraries in South Africa due to COVID-19 pandemic restrictions. By sending them regular reminders through direct emails every week encouraging them to complete the questionnaire, the researcher was able to obtain an appreciable number of responses for the study.

5.2: Data demographic data

In scholarly research, the demographic data of respondents refer to the characteristics of the study population (Salkind, 2010). In research design, demographic characteristics are reported as independent variables that may be used to answer research questions (Salkind, 2010, Survey Monkey. 2020). It is germane to demonstrate the demographic data of respondents to enable the researcher to understand the characteristics of the respondents understudied for data analysis. For this study, the demographic data of the respondents which were of interest to the researcher were country, gender, the academic institution of work, educational level, and the section/unit of the library of work.

5.2.1 Country

Of the 167 completed questionnaires received, 96 were from Ghana and 71 from South Africa.

5.2.2 Gender

In the context of this study, gender shows the biological makeup of the respondent. Earlier researchers such as Davis (2000) have empirically proven that gender has a significant influence on the use of new technologies. Vekiri and Chgonaki (2008) avowed that there is a propensity for males to have more confidence and willingness to accept new technology than females. Since this study is in line with Lib 4.0 technology or 4IR technologies, the researcher deemed it relevant to have a clear picture of the gender characteristics of the respondents. Given this ground, respondents were asked to indicate their gender. Responses are shown in Table 5.2

Table 5.2 Gender (N=160)

Gender	Academic libraries of respondents							Total
	Ghana			South Africa				
	Balme	Sam Jonah	Subtotal	UCT	UJ	Subtotal		
Male	Count	29	35	64	10	18	28	92
	% Library	2.6	60.3	-	25.7	56.3	-	-
	% Country	30.2	36.5	66.7	14.1	25.4	39.4	-
	% Total	17.4	21	38.3	6	10.8	16.8	55.1
Female	Count	9	23	32	29	14	43	75
	% Library	23.7	39.7	-	74.4	43.8	-	-
	% Country	9.4	24	33.4	40.8	19.7	60.6	-
	% Total	5.4	13.8	19.2	17.4	8.4	25.7	44.9
Total	-	38	58	96	39	32	71	167

As shown in Table 5.2, 29 (17.4%) of respondents of the University of Ghana Balme Library were males, while nine (5.4%) were females. From the Sam Jonah Library, Cape Coast 35 (21.0%) and 23 (13.8%) of respondents were males and females respectively. The number of male respondents from the University of Cape Town Library was ten (6.0%) while 29 (17.4%) were females. Responses from the University of Johannesburg library show that eighteen (10.8%) were males while fourteen (8.4%) were females.



5.2.3 Academic institutions

Respondents were asked to indicate the specific academic institution with which they work. The intent of this is to find out the total number of respondents from each institution to present a clear ratio of how many respondents form part of the total response rate of the study. Responses are shown in Figure 5.1.

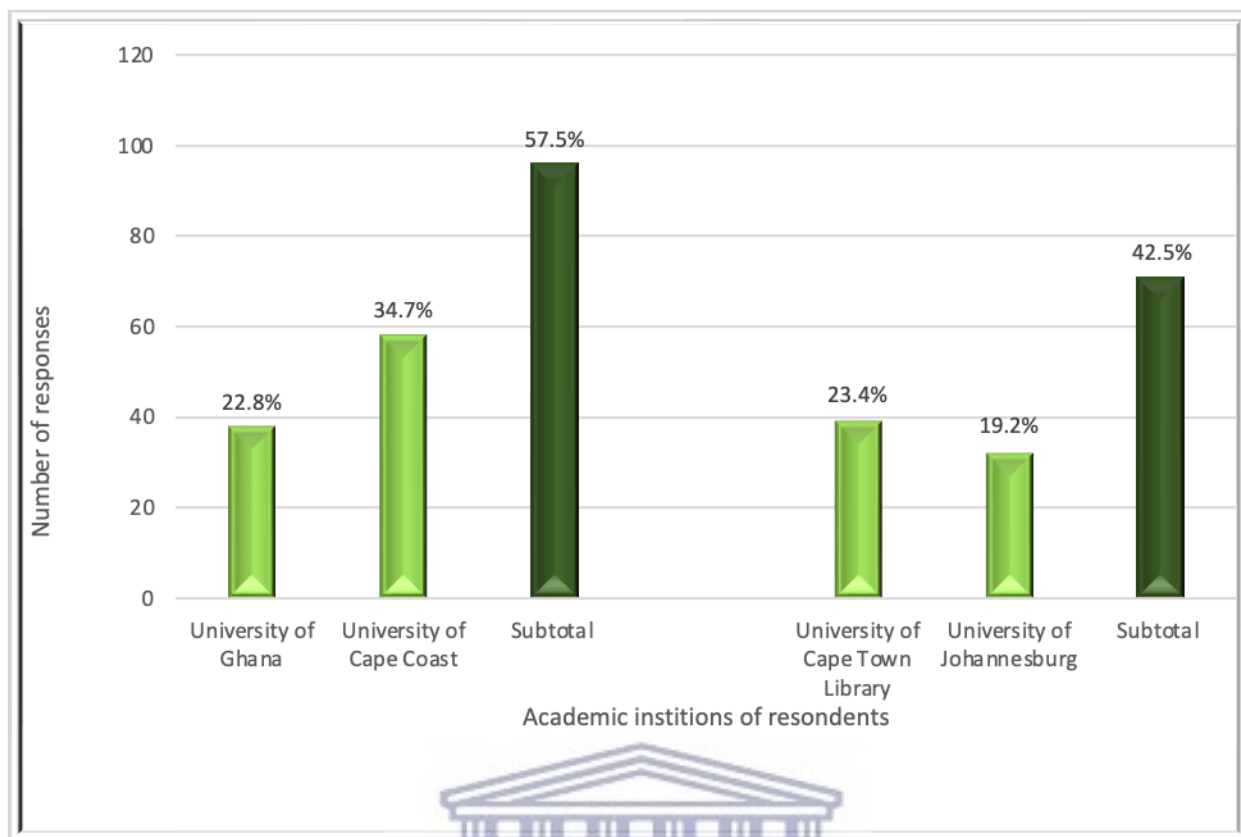


Figure 5.1 Academic institution (N=167)

Figure 5.1 shows that from the total of 167 respondents, 38 (22.88%) were from the University of Ghana, 58 (34.7%) were from the University of Cape Coast, 39 (23.4%) and 32 (19.2%) were respectively from the University of Cape Town and the University of Johannesburg.

5.2.4 Educational Level

Library staff in academic libraries have various levels of educational background. The educational level of library staff determines the kind of position that they qualify to hold. The researcher finds the educational level of library staff appropriate as it gives a picture of various respondents and

the level of education they have attained. In line with this, data on the educational level of respondents was solicited and the results are shown in Table 5.3.

Table 5.3 Educational Level (N=167)

Academic institutions of respondents	Educational Level of respondents						Total
	Doctor of Philosophy (Ph.D.)	Master of Philosophy (MPhil)	Master of Arts (MA)/Master of Science	Bachelor of Arts (BA)	Diploma		
University of Ghana Balme Library	Count	3	14	9	12	0	38
	% Library	7.9	36.8	23.7	31.6	0	-
	% Country	3.1	15.6	9.4%	12.5%	0	40.6%
	% Total	1.8%	8.4%	5.4 %	7.2%	0.0%	22.8%
Sam Jonah Library	Count	1	17	15	18	7	58
	% Library	1.7	29.3	25.9	31.0	12.1%	-
	% Country	1.0	27.0	15.6	18.8	7.3%	69.7
	% Total	0.6%	10.2%	9.0%	10.8%	4.2%	34.7%
University of Cape Town library	Count	0	0	15	24	0	39
	% Library	0	0	38.5	61.5	0	-
	% Country	0	0	21.1	33.8%	0	54.9
	% Total	0.0%	0.0%	9.0%	14.4%	0.0%	23.4%
University of Johannesburg Library	Count	2	0	17	13	0	32
	% Library	1.2%	0.0%	10.2%	7.8%	0.0%	19.2%
	% Country	6	31	56	67	7	167
Total	% Total	3.6%	18.6%	33.6%	40.1%	4.2%	100.0%

Table 5.3 shows that the majority of respondents 55 (23 University of Ghana Balme Library; 32 Sam Jonah Library) holds a master degree which occupies 57.3% of 96 total respondents representing Ghana and 32.9% out of the entire 167 total respondents. This is followed by bachelor degree holders 30 (31.2% of 96; 17.9% of 167). While in Ghana, the majority of respondents hold a master degree, a larger number of respondents 37 (24 University of Cape Town library; 13 University of Johannesburg Library) representing 52.1% of 71 and 22.2 % of 167 from South Africa are bachelor degree holders followed by 32 (45.1% of 71; 19.2% 167) are

master degree holders. It is also indicated that Ghana has seven Ph.D. holders and four diploma holders respectively while South Africa has two Ph.D. and no diploma certificate holders.

5.2.5 Section of work in the library

Respondents work in different sections of the library as far as their roles are concerned. The sections in academic libraries have part of their staff whose roles are IT-related and technologically influence the adoption and use of Lib 4.0 or 4IR technologies. Since not all library staff were selected for the study, it was pertinent to show members of the various sections in the library from which respondents were selected for the study. Some sections in libraries are subsumed with others. For instance, in the University of Ghana Balme Library, the circulation department and references services are incorporated as one unit. Due to the various division and names of sections in the various academic libraries among the four (4) institutions, respondents were asked to select the broad unit they belong to which includes reference services/information services, electronic resources, IT support unit/library system, cataloging, circulation, acquisition, and the digital institutional repository unit. Those whose units were not found in any of the aforementioned were instructed to select “Other” and specify it. Table 5.4 illustrates the demographic distribution by section/unit of work in the library.

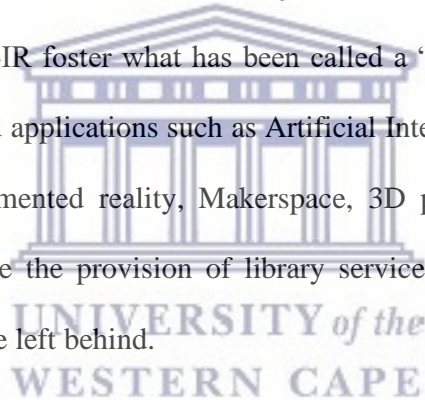
Table 5.4 Section/unit of work in the library (N=167)

Section of work in the Library	Academic Institution of Respondents					Total
	Ghana		South Africa			
	University of Ghana Balme Library	Sam Jonah Library	University of Cape Town Library	University of Johannesburg Library		
Reference services/information services	Count	13	16	20	7	56
	% Library	3.4	27.6	51.3	21.9	104
	% Country	13.5	16.7	28.2	9.9	68.3
	% Total	7.8%	9.6%	12.0%	4.2%	33.7%
Electronic resources	Count	6	10	10	8	34
	% Library	15.8	17.2	2.6	25	60.6
	% Country	6.25	19.4	14.1	11.3	51.1
	% Total	3.6%	6.0%	6.0%	4.8%	20.5%
IT support unit/Library system	Count	7	4	0	6	17
	% Library	18.4	6.9	0	18.8	44.1
	% Country	7.3	4.2	0	8.5	28
	% Total	4.2%	2.4%	0.0%	3.6%	10.2%
Cataloguing	Count	6	1	0	0	7
	% Library	15.8%	1.7	0	0	1.7
	% Country	6.3	1.2	0	0	7.5
	% Total	3.6%	0.6%	0.0%	0.0%	4.2%
Circulation	Count	0	9	0	0	9
	% Library	0	15.6	0	0	15.6
	% Country	0	9.8	0	0	9.8
	% Total	0.0%	5.4%	0.0%	0.0%	5.4%
Acquisition	Count	0	3	9	0	12
	% Library	0	5.2	23.1	0	28.3
	% Country	0	3.1	12.7	0	15.8
	% Total	0.0%	1.8%	5.4%	0.0%	7.2%
Digital Institutional Repository	Count	4	2	0	2	8
	% Library	10.5	3.4	0	6.25	20.15
	% Country	4.2	2.1	0	2.8	9.1
	Total	2.4%	1.2%	0.0%	1.2%	4.8%
Other	Count	2	12	0	9	23
	% Library	5.3	20.7	0	28.1	54.1
	% Country	2.1	12.5	0	12.7	27.3
	% Total	1.2%	7.2%	0.0%	5.4%	13.8%
No response	Count	0	1	0	0	1
	% Library	0	1.7	0	0	1.7
	% Country	0	1.0	0	0	1.0
	% Total	0.0%	0.6	0.0%	0.0%	.6
Total		38	58	39	32	167
		22.8%	34.7%	23.4%	19.2%	100.00 %

As shown in Table 5.4, most of the respondents 56 (33.7%) work in the reference services/information services section of the various academic libraries, followed by electronic resources with 34 (20.5%), then seventeen (10.2%) for IT support unit or library systems. The rest are as follows; acquisition had twelve (7.2%), circulation nine (5.4%), digital institutional repository eight (4.8%), and cataloguing seven (4.2%). One responded did not indicate a section, while 23 (13.8%) indicated “Other” sections. The latter was explained as students or academic computing units, information systems, and resources, discovery services, shared and support services, faculty/departmental heads or librarians, and library assistant directors.

5.3 Fourth Industrial Revolution (4IR) in the library

In the context of this study, the 4IR foster what has been called a “smart library” dealing with the fusion of Lib 4.0 technologies and applications such as Artificial Intelligence (AI), Internet of things (IoT), Big data, virtual and augmented reality, Makerspace, 3D printing, cloud computing, and blockchain technology to enhance the provision of library services to meet the current needs of patrons, stay relevant and not to be left behind.



5.3.1 4IR awareness and general knowledge

This section sought to find out respondents' awareness and general knowledge or idea about the 4IR in academic libraries. Soliciting such information enabled the researcher to fathom if the library staff were aware of the 4IR and have basic knowledge about it.

5.3.1.1 Awareness

Awareness plays a pivotal role in the use of information technology tools. As the world is preparing for the disruptive changes caused by the 4IR technologies, libraries will not be able to prepare adequately if they are not aware of relevant Lib 4.0 technologies that they need to embrace to avert the issue of their services becoming redundant. The kinds of Lib 4.0 incorporated into library services depend on whether library personnel are aware of the 4IR applicable in academic libraries. On account of this, respondents were asked to indicate if they were aware of the 4IR. Their responses are displayed in Figure 5.2.

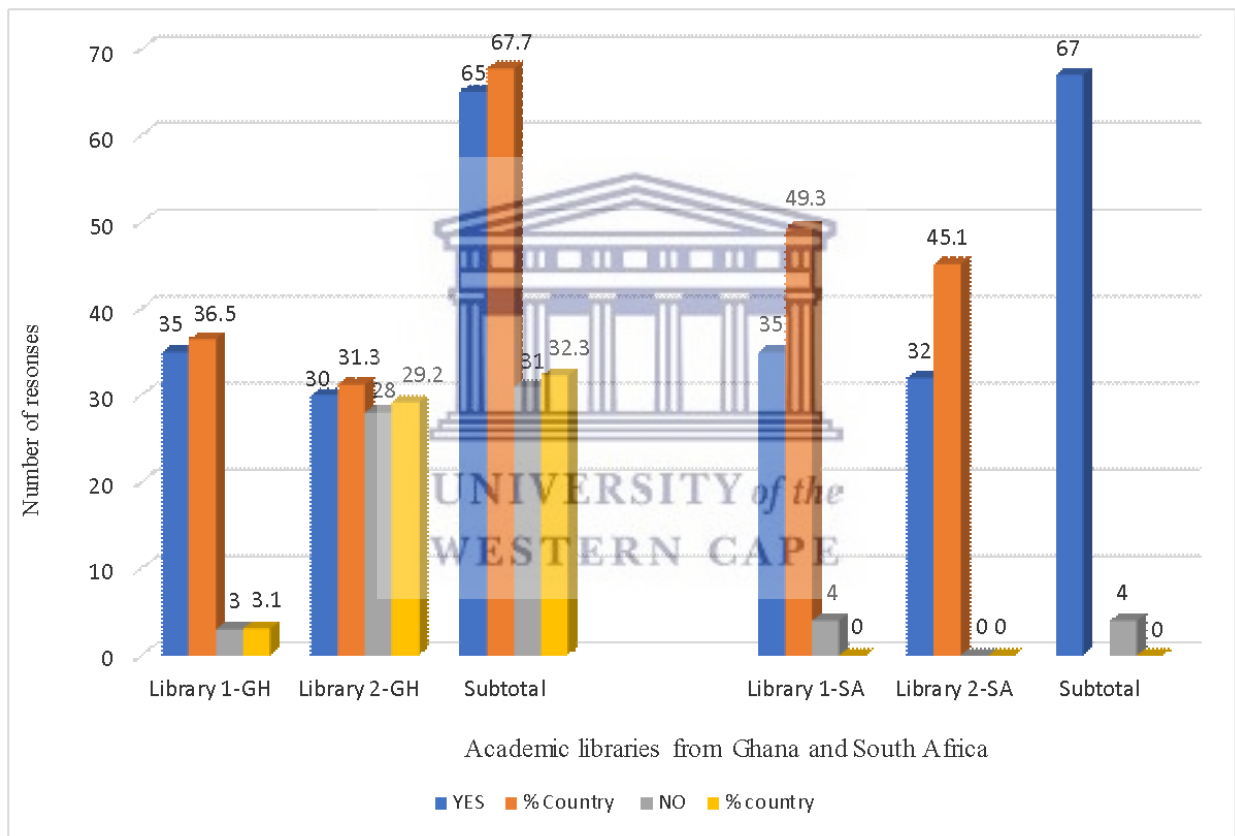


Figure 5.2 4IR Awareness (N=167)

From Figure 5.4, it can be observed that respondents aware of the 4IR were 65 (67.7%) from Ghana and 67 (94.4%) from South Africa resulting in a total of 132 (79%).

5.3.1.2 Channels of Awareness

Channels of awareness in the context of this study refer to the medium through which respondents became aware of the 4IR in academic libraries. Soliciting this data from respondents was considered germane by the researcher as it gave a picture of the medium through which they became aware of the 4IR for further discussion in the study. Given this, respondents were asked to indicate all the channels through which made them aware of the 4IR in academic libraries. The data retrieved is depicted in Table 5.5

Table 5.5 4IR channels of awareness (N=167)

Channel of Awareness of the 4IR in academic libraries		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Information literacy training	Count	15	16	31	9	16	25	56
	% Total	48.4	51.6	-	36	64	-	-
Research work	Count	19	26	45	10	18	28	73
	% Total	42.2	57.8	-	35.7	64.3	-	-
Internet	Count	23	24	47	39	21	60	107
	% Total	48.9	51.1	-	65	35	-	-
Social Media Platforms	Count	11	14	25	19	18	37	62
	% Total	44	56	-	51.4	48.6	-	-
News Items	Count	5	19	24	20	16	36	60
	% Total	20.8	79.2	-	55.6	44.4	-	-
Magazines	Count	3	8	11	10	8	18	29
	% Total	27.2	72.7	-	55.6	44.4	-	-
University website	Count	3	33	36	23	32	55	91
	% Total	8.3	91.7	-	41.8	58.2	-	-
Staff meeting	Count	3	13	16	9	23	32	48
	% Total	18.8	81.2	-	39.1	71.9	-	-
Conference/Seminar/webinar	Count	10	30	40	19	26	45	85
	% Total	25	75	-	42.2	57.8	-	-
Unit head	Count	2	1	3	0	11	11	14
	% Total	66.7	33.3	-	0	100	-	-

Table 5.5 exhibits that the majority of respondents, 107 (47 Ghana; 60 South Africa) became aware of 4IR via websites. This is followed by university websites (91), conferences (85), research work (73), social media platforms (62), news items (60), information literacy training (56), staff meetings (48), magazines (29), and their unit heads (14).

In summary, the study revealed that a greater number of respondents are aware of the 4IR and its potential impacts on the academic library. A greater number of them became aware of the 4IR through websites, then university websites, conferences, research work, social media platforms news items, information literacy training, staff meetings, magazines, and their unit heads in that order.

5.3.1.3 Smart library features

A smart library is characterized as a type of library where library services and resources can easily be accessed virtually and regulated by the use of information technology in an innovative way. The cardinal focus of the 4IR and Lib 4.0 is to make library services smart to enhance efficiency and effectiveness. In the same vein, considering 4IR in the academic library, the fundamental idea is to make the library look smart. Given this, respondents were asked to indicate their agreement or disagreement with ten (10) statements regarding smart library services.

5.3.1.3.1 Access

Respondents were first asked whether smart library services can be accessed at anytime, anywhere, everywhere, and by everyone. Results are revealed in Table 5.6

Table 5.6 Access (N=167)

Smart library services can be accessed at any time, anywhere, everywhere, and by everyone.		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Sub Total	Library 1-SA	Library 2-SA	Sub Total	
Strongly Disagree (SD)	Count	0	1	1	0	0	0	1
	% Country	0	1.0	1.0	0	0	0	1.0
	% Total	0.0%	0.6%	0.6%	0.0%	0.0%	0.0%	0.6%
Disagree (D)	Count	0	4	4	0	0	0	4
	% Country	0	4.2	4.2	0	0	0	4.2
	% Total	0.0%	2.4%	2.4%	0.0%	0.0%	0.0%	2.4%
Neutral (N)	Count	2	1	3	0	0	0	3
	% Country	2.1	1.0	3.1	0	0	0	3.1
	% Total	1.2%	0.6%	1.8%	0.0%	0.0%	0.0%	1.8%
Agree (A)	Count	13	28	41	20	14	34	75
	% Country	13.5	29.2	42.7	28.2	19.17	47.4	90.1
	% Total	7.8%	16.8%	24.6%	12.0%	8.4%	20.4%	44.9%
Strongly Agree (SA)	Count	23	24	47	19	18	37	84
	% Country	24.0	25.0	49	26.4	25.4	51.8	100.8
	% Total	13.8%	14.4%	28.2%	11.4%	10.8%	22.2%	50.3%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.5%	100.0%

Of the Ghanaian respondents, 41 (24.6%) agreed and 47 (28.2%) strongly agreed. On the other hand, 34 (20.4%) and 37 (22.2%) of the South African respondents agreed and strongly agreed respectively. In total, Ghana had a percentage score of 52.8% while South Africa had 42.6%. Even though responses from Ghana had a higher total number of positive responses than South Africa, the difference was insignificant. It can therefore be seen that the majority of the respondents had a positive response signifying their basic knowledge about the smart library.

5.3.1.3.2 Spaces

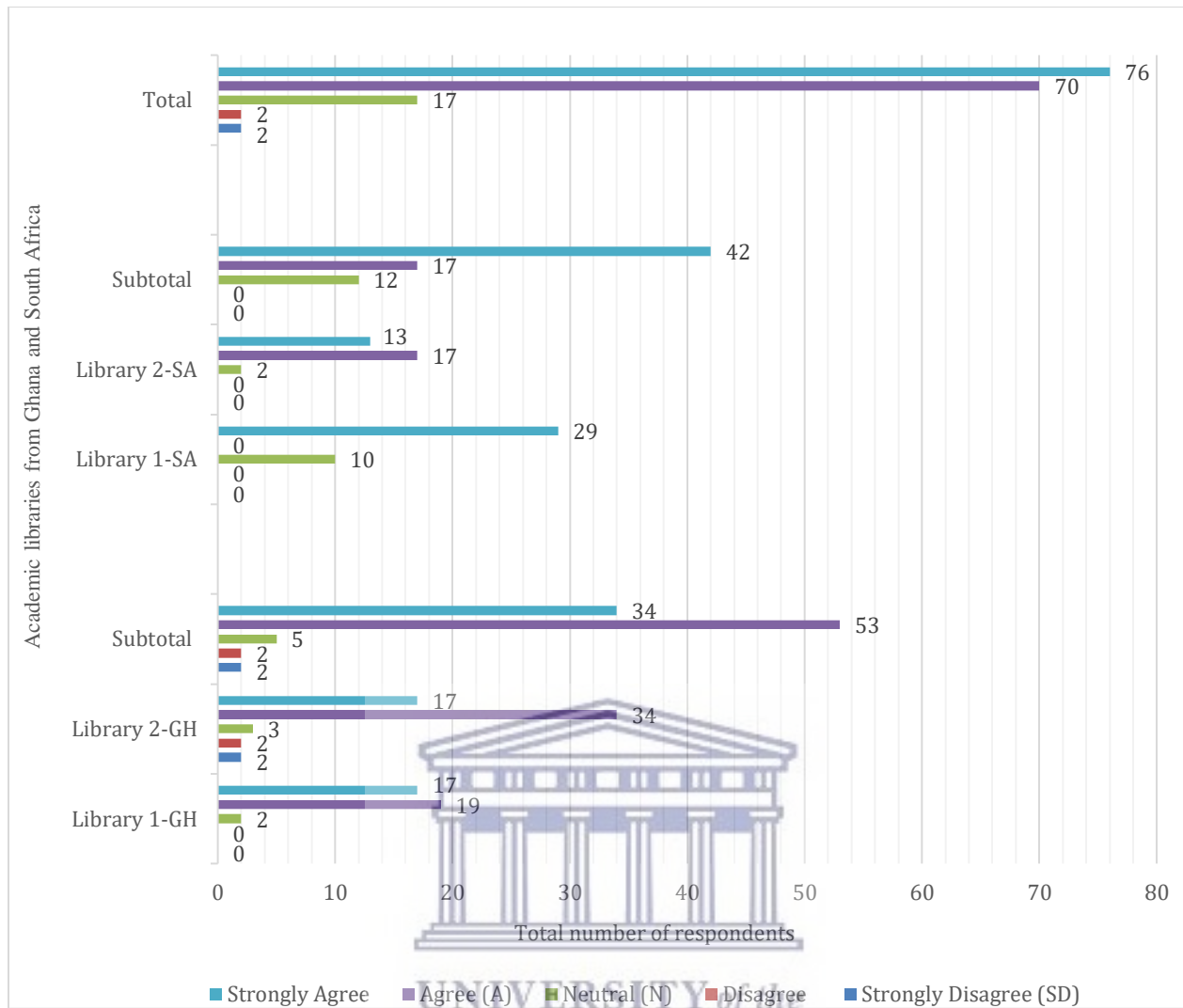
Table 5.7 reflects responses to the assertion “Smart library spaces are available at any time, for everyone and everywhere”. The majority (96, 57.5%) of Ghanaian respondents agreed and strongly agreed. In contrast, only 71 (42.6%) of South African librarians indicated strongly agreed and agreed.

Table 5.7 Spaces (N=167)

Smart library services can be accessed at any time, anywhere, everywhere, and by everyone.	Ghana			South Africa			Total	
	Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal		
Strongly Disagree (SD)	Count	0	1	1	0	0	0	1
	% Country	0	1.0	1.0	0	0	0	1.0
	% Total	0.0%	0.6%	0.6%	0.0%	0.0%	0.0%	0.6%
Disagree (D)	Count	0	4	4	0	0	0	4
	% Country	0	4.2	4.2	0	0	0	4.2
	% Total	0.0%	2.4%	2.4%	0.0%	0.0%	0.0%	2.4%
Neutral (N)	Count	2	1	3	0	0	0	3
	% Country	2.1	1.0	3.1	0	0	0	3.1
	% Total	1.2%	0.6%	1.8%	0.0%	0.0%	0.0%	1.8%
Agree (A)	Count	13	28	41	20	14	34	75
	% Country	13.5	29.2	42.7	28.2	19.17	47.4	90.1
	% Total	7.8%	16.8%	24.6%	12.0%	8.4%	20.4%	44.9%
Strongly Agree (SA)	Count	23	24	47	19	18	37	84
	% Country	24.0	25.0	49	26.4	25.4	51.8	100.8
	% Total	13.8%	14.4%	28.2%	11.4%	10.8%	22.2%	50.3%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.5%	100.0%

5.3.1.3.3 Staff

Figure 5.3 illustrates that the majority (57) of the respondents from Ghana concord with the assertion that “Smart library staff are qualified, competent, adaptive, creatively innovative, critical thinkers, complex problem solvers, self-learners, and ethically upright”. Likewise, the majority of responses from South Africa (59) reflected that they agreed or strongly agreed.



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Figure 5.3 Staff (N=167)

5.3.1.3.4 Technology and applications

Table 5.8 demonstrates that most of the respondents know that smart technology and applications are effective, efficient, and innovative. The majority (55.6%) of respondents from Ghana strongly agreed and agreed as compare compared to 42.6% of South Africans strongly agreeing and agreeing.

Table 5.8 Technology and applications

Smart technology and applications are effective, efficient, and innovative	Ghana			South Africa			Total
	Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Strongly Disagree (SD)	Count	-	-	-	-	-	-
	% Country	-	-	-	-	-	-
	% Total	-	-	-	-	-	-
Disagree	Count	-	-	-	-	-	-
	% Country	-	-	-	-	-	-
	% Total	-	-	-	-	-	-
Neutral (N)	Count	2	3	5	-	-	5
	% Country	2.8	3.1	5.9	-	-	-
	% Total	1.2%	1.8%	3%	-	-	3.0%
Agree (A)	Count	20	34	54	20	17	37
	% Country	20.8	35.4	56.2	28.2	23.9	52.1
	% Total	12.0%	20.4%	32.4%	12.0%	10.2%	22.2%
Strongly Agree (SA)	Count	16	21	37	19	15	34
	% Country	16.7	21.9	38.6	26.7	21.1	47.8
	% Total	9.6%	12.6%	23.2%	11.4%	9.0%	20.4%
Total		38	58	96	39	32	71
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%

5.3.1.3.5 Users

Smart users are defined as users who are “information and smart technology literate, well informed, adaptable, self-learners, and ethical”. As indicated in Table 5.9, Ghanaians agreed (33%) and strongly agreed (15%) while South Africans agreed (19.2%) and strongly agreed (21.6%) with the statement regarding smart uses.



Table 5.9 Users (N=167)

Smart users are information and smart technology literate, well-informed, adaptable, self-learners, and ethical	Ghana			South Africa			Total
	Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Strongly Disagree (SD)	Count	-	2	2	-	-	2
	% Country	-	2.1	2.1	-	-	-
	% Total	-	1.2%	1.2%	-	-	1.2%
Disagree (D)	Count	-	3	3	-	-	3
	% Country	-	3.1	3.1	-	-	-
	% Total	-	1.8%	1.8%	-	-	1.8%
Neutral (N)	Count	10	1	11	-	3	14
	% Country	10.4	1.00	11.4	-	4.2	15.6
	% Total	6.0%	0.6%	6.6%	-	1.8%	8.4%
Agree (A)	Count	16	39	55	19	13	87
	% Country	16.7	40.6	57.3	27.1	18.3	45.4
	% Total	9.6%	23.4%	33%	11.4%	7.8%	19.2%
Strongly Agree (SA)	Count	12	13	35	20	16	61
	% Country	12.5	1.0	13.5	28.2	22.5	50.7
	% Total	7.2%	7.8%	15%	12.0%	9.6%	21.6%
Total		38	58	96	39	32	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%



5.3.1.3.6 Leaders

Figure 5.4 indicates that respondents regarded “smart leaders” are visionary and innovative. The majority of the responses from both countries were skewed toward positive reactions. Ghanaians agreed (31.1%) and strongly agreed (19.2%) while ten (6.6%) felt ambivalent about the assertion. South Africans agreed (22.8%) and strongly agreed (16.8%).

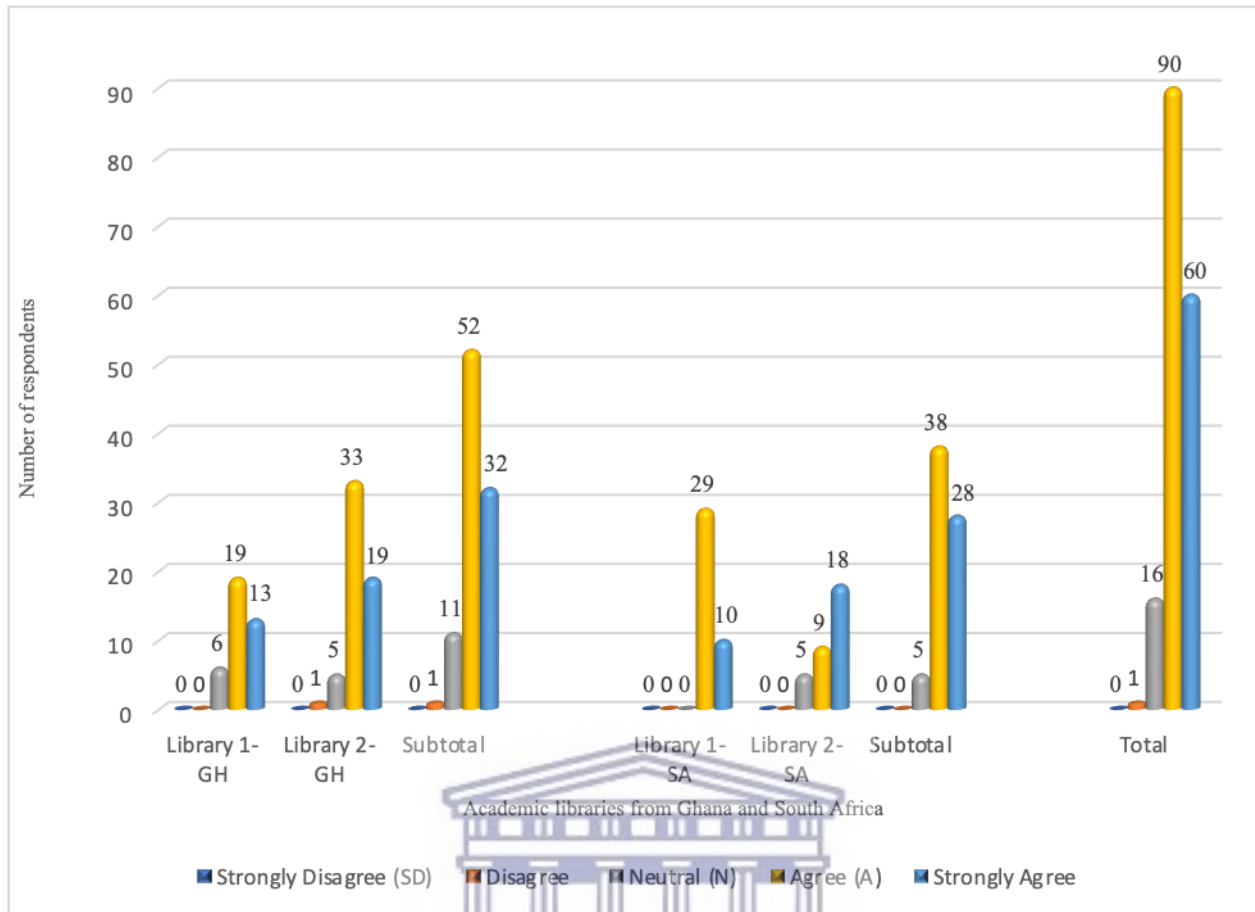


Figure 5.4 Leaders (N=167)

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5.3.1.3.7 Resources

Respondents regard smart library resources as “openly accessible at any time, anywhere and by everyone” as reflected by respondents from Ghana agreeing (29.4%) and strongly agreeing (19.8%) and from South Africa agreeing (11.4%) and strongly agreeing (24.0%). Only 5.4% of all the respondents were either neutral or disagreed. Details are recorded in Table 5.10.

Table 5.10 Resources (N=167)

Smart library resources are openly accessible at any time, anywhere, and by everyone.	Ghana			South Africa			Total
	Library 1-GH	Library 1-GH	Subtotal	Library 1-SA	Library 1-SA	Subtotal	
Strongly Disagree (SD)	Count	-	-	-	-	-	-
	% Country	-	-	-	-	-	-
	% Total	-	-	-	-	-	-
Disagree (D)	Count	-	5	5	-	-	5
	% Country	-	5.2	5.2	-	-	-
	% Total	-	3.0%	3.0%	-	-	3.0%
Neutral (N)	Count	3	6	9	9	3	12
	% Country	3.3	6.3	9.6	12.7	4.2	16.9
	Total	1.8%	3.6%	5.4%	5.4%	1.8%	7.2%
Agree (A)	Count	15	34	49	10	9	19
	% Country	15.6	35.4	51	14.1	12.7	26.8
	% Total	9.0%	20.4%	29.4%	6.0%	5.4%	11.4%
Strongly Agree (SA)	Count	20	13	33	20	20	40
	% Country	20.8%	13.5	34.3	28.2	28.2	56.4
	% Total	12.0%	7.8%	19.8%	12.0%	12.0%	24.0%
Total	% Total	38	58	96	39	32	71
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%



5.3.1.3.8 Policies

Smart library policies as adaptable, responsive, sensitive, and ethical/social justice-aligned policies. Table 5.11 defines that statistically, 56 (33.6%) from Ghana agreed with the assertion and 24 (14%) strongly agreed. In the same token, responses from South Africa depict a positive response as 56 (33.6%) strongly agreed with the definition, and eight (4.8%) agreed. It can therefore be seen that proportionally, the number of respondents who agreed with the assertion from Ghana was more than that of South Africa.

Table 5.11 Policies (N=167)

Smart policies are adaptable, responsive, sensitive, and ethical/social justice aligned.	Ghana			South Africa			Total
		Library 1-GH	Library 1-GH	Subtotal	Library 1-GH	Library 1-GH	
Strongly Disagree (SD)	Count	-	-	-	-	-	-
	% Country	-	-	-	-	-	-
	% Total	-	-	-	-	-	-
Disagree (D)	Count	-	5	5	-	3	8
	% Country	-	5.2	5.2	-	4.2	9.4
	% Total	-	3.0%	3.0	-	1.8%	4.8%
Neutral (N)	% Count	8	3	11	-	4	15
	% Country	8.3	3.1	11.4	-	5.6	17
	% Total	4.8%	1.8%	6.6%	-	2.4%	9.0%
Agree (A)	Count	18	38	56	-	8	64
	% Country	18.8	39.6	58.4	-	8	66
	% Total	10.8%	22.8%	33.6%	-	4.8%	38.3%
Strongly Agree (SA)	Count	12	12	24	39	17	80
	% Country	12.5	12.5	25	54.9	23.9	103
	% Total	7.2%	7.2%	14%	23.4%	10.2%	47.9%
Total		38	58	96	39	32	167
		22.8%	34.7%	57.5	23.4%	19.2%	42.6%
						71	100.0%



5.3.1.3.9 Management

From Figure 5.5 it can be seen that the majority of the respondents from Ghana 56 (33.6%) concord with the explication of smart library management is management that “deals with the increasing transparency of the administration and management system, user participation in decision-making processes, automatic and optimized administration procedures in real-time”. Similar positive reactions manifested in the responses from South Africa where 35 (21%) strongly agreed and 24 (24.4%) agreed. It can be inferred from the results that library staff from both countries understand what smart library management is and how critical it will be needed in the 4IR.

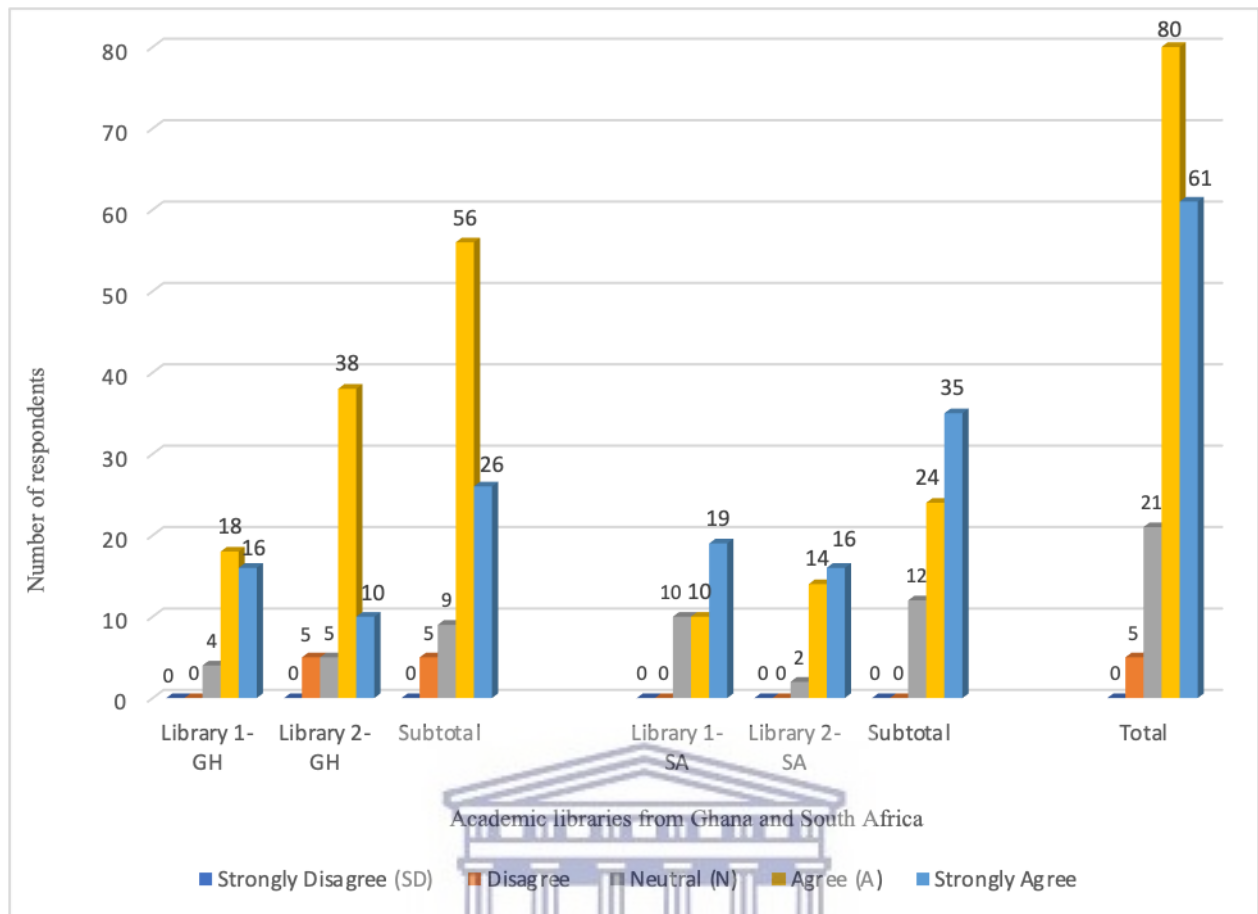


Figure 5.5 Management (N=167)

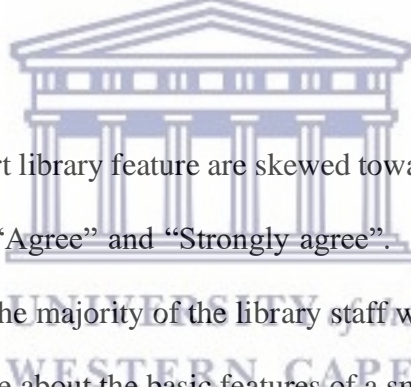
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5.3.1.3.10 Networking

Table 5.12 captures smart library networking as one of the features of a smart library. The results indicate that the majority of the respondents 60 (36%) from Ghana agreed with the assertion that “smart library networking is about library openness and embeddedness in its social and cultural environment” and 27 (16.2%) strongly agreed. South African librarians also agreed (42, 25.2%) and strongly agreed (26, 15.6%). Comparing the results, even though responses from Ghana indicated positive reactions more than those from South Africa, each result was skewed towards positive. It can therefore be inferred from these results that smart library networking is understood as postulated by the author.

Table 5.12 Networking (N=167)

Smart library networking is about library openness and embeddedness in its social and cultural environment	Ghana			South Africa			Total	
		Library 1-GH	Library 1-GH	Subtotal	Library 1-SA	Library 2-SA		Subtotal
Strongly Disagree (SD)	Count	-	1	1	-	-	-	1
	% Country	-	-	-	-	-	-	-
	% Total	-	0.6%	0.6%	-	-	-	0.6%
Disagree	Count	-	-	-	-	-	-	-
	% Country	-	-	-	-	-	-	-
	% Total	-	-	-	-	-	-	-
Neutral (N)	Count	2	6	8	0	3	3	11
	% Country	2.1	6.3	8.4	0	4.2	4.2	12.6
	% Total	1.2%	3.6%	4.8%	0.0%	1.8%	1.8%	6.6%
Agree (A)	Count	24	36	60	29	13	42	102
	% Country	25	37.5	62.5	40.8	18.3	59.1	121.6
	% Total	14.4%	21.6%	36%	17.4%	7.8%	25.2	61.1%
Strongly Agree (SA)	Count	12	15	27	10	16	26	53
	% Country	12.5	15.6	28.1	14.1	22.5	36.6	64.7
	% Total	7.2%	9.0%	16.2%	6.0%	9.6%	15.6%	31.7%
Total	% Total	38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%



All in all, the results of each smart library feature are skewed towards positive as the majority of a high percentage of scores were “Agree” and “Strongly agree”. Therefore, the results from this section gave a clear picture that the majority of the library staff were aware of the 4IR revolution and have basic general knowledge about the basic features of a smart library.

5.4 Lib 4.0 Technologies and Applications

The 4IR comes with disruptive changes coupled with Lib 4.0 technologies and applications that needed to be incorporated into the provision of smart library services with the intent to respond to the demand of the 4IR. Lib 4.0 technologies and applications are as follows: artificial intelligence, complex sensors, Internet of Things (IoT), cognitive computing, virtual reality, big data, 3D

printing, cloud computing advanced robotics that has taken center stage (Geotagging, & Sharif, 2020; Labangon & Manabat, 2018; Schwab, 2016).

5.4.1 Lib 4.0 technologies and applications utilized

In an attempt to find out the readiness of the academic library for the 4IR, respondents were asked to indicate which Lib 4.0 technologies and applications have been introduced to support the provision of library services in their library. The results are shown in Table 5.13.



Table 5.13. Lib 4.0 Technologies and applications utilized (N=167)

SN	New (LIB 4.0) Technologies and Applications Available due to 4IR	Library 1-GH	Library 2-GH	Library 1-SA	Library 2-SA
		YES	YES	Yes	Yes
1	Artificial intelligence	1	1	1	1
2	Big data tools (e.g. Batch analysis tools, interactive tools, stream analysis tools)	X	X	1	1
3	Virtual reality	X	X	1	1
4	Robot library assistant (e.g. Semi Humanoid robot for reference service)	X	X	X	X
5	Clouding computing	1	1	1	1
6	Blockchain technology	x	x	x	1
7	Makerspace	X	X	X	1
8	Chatbot	X	X	1	1
9	3D modelling software	X	X	X	1
10	Quick response (QR) code	X	X	1	1
11	Ask-a-librarian app	1	1	1	1
12	Library mobile apps	X	X	1	1
13	Library bookmark apps	X	X	X	1
14	Self-checkout machine	X	X	1	1
15	Scheduling and event management software	X	X	1	1
16	Biometric security sensor for check-in and check out	1	X	1	1
17	Internet of Things (IoT)	1	X	1	1
14	Virtual library research guide	1	1	1	1
15	Library tutorials (video) tool	1	1	1	1
16	Circulation module	1	1	1	1
18	Digital library repositories (Dspace, Fedora Commons)	1	1	1	1
20	Library social media platform	1	1	1	1
25	Electronic newspaper	1	X	1	1
26	Webinar digital library training service	1	1	1	1
27	Reference management tools (e.g. Mendeley, endnote, Zotero)	1	1	1	1

Table 5.13 gives an overview of the new 4IR and Lib 4.0 technologies and applications available in the various academic libraries in Ghana and South Africa. All the libraries have implemented artificial intelligence, cloud computing, ask-a-librarian application, library videos as tutorials, circulation, digital library repositories, social media platforms, webinars, and reference

management tools in the provision of library services. These tools have been in operation for some time already but are enhanced with new features that are pertinent in the 4IR epoch as far as a smart library is concerned.

Blockchain technology, Makerspace, 3D modeling, and bookmark applications have been implemented only by Library 2-SA. Both South African libraries have incorporated big data tools (e.g. Batch and steam analysis), virtual reality, chatbot, QR codes, library mobile applications, self-checkout machines, and event management software, while the Ghanaian libraries are still to do so. Scheduling and event management software, as well as a Self-checkout machine, were found as part of services in all two academic libraries in South Africa.

Only one academic library from South Africa has incorporated a Makerspace, a bookmark application is a space earmarked for creativity and innovation where users can use creative tools to solve problems, into their library services as well as 3D modeling software assisting patrons to think creatively by transferring ideas into a real object.

Library1-GH is utilizing, compared to the other Ghanaian library, biometric security sensors for circulation.

In comprehensive synthesis, the study revealed a unanimous affirmative response from the respondents, indicating the integration and utilization of various cutting-edge technologies and services within their library facilities. These include artificial intelligence, cloud computing, the Ask-a-librarian app, virtual library research guides, video-based library tutorials, circulation modules, digital library repositories (such as DSpace and Fedora commons), library social media

platforms, webinar-based digital library training services, and reference management tools (e.g. Mendeley, EndNote, Zotero).

Putting all together, the study found that the respondents unanimously responded in affirmative that their library services have applied, artificial intelligence, Clouding computing, Ask-a-librarian app, Virtual library research guide, Library tutorials (video) tool, Circulation module, Digital library repositories (Dspace, Fedora commons) Library social media platform, Webinar digital library training service, and Reference management tools (e.g. Mendeley, endnote, Zotero).

The study also found that two of the participating institutions use Big data tools (e.g. Batch analysis tools, interactive tools, stream analysis tools), virtual reality, Chatbots, Self-checkout machines, scheduling and event management software, biometric security sensor for check-in and check-out, Internet of Things (IoT). It was also revealed that at least one of the libraries uses Blockchain technology, Makerspace, 3D modelling software, Library bookmark apps, and Electronic newspaper to enhance library services. Also, none of the respondents indicated a robot library assistant (e.g. Semi Humanoid robot for reference service).

5.4.2 Reasons for using Lib 4.0 technologies and applications

Five questions were asked to investigate what propelled the various academic libraries to deploy some Lib 4.0 technologies and applications.

5.4.2.1 Easy access and usage

Respondents were asked whether they use Lib 4.0 technologies and applications to make library services easier to access and use. Results captured in Table 5.14 reflect that 99.4% of respondents acknowledged that it is used for easier access and use.

Table 5.14 Easy access and use (N=167)

Reasons for using Lib 4.0 technologies and applications in your library		Ghana		South Africa		Total	
		Library 1-GH	Library 2-GH	Library 1-SA	Library 2-SA		
To make library services easier to use and access	Yes	Count	38	57	39	32	166
		%Country	39.5	59.4	54.9	45.1	-
		Total	22.8%	34.1%	23.4%	19.2%	99.4%
	No	Count	0	1	0	0	1
		%Country	0	1.0	0	0	-
		Total	0.0%	0.6%	0.0%	0.0%	0.6%
Total		38	58	39	32	167	
		22.8%	34.7%	23.4%	19.2%	100.0%	

5.4.2.2 Incite interest

Most patrons are becoming technologically literate and are interested to use new technologies and applications. As indicated in Figure 5.6 the majority of the respondents (84.4%) responded favorably to the assertion. The low number (15.6%) of responses is an indication that libraries employ technology.

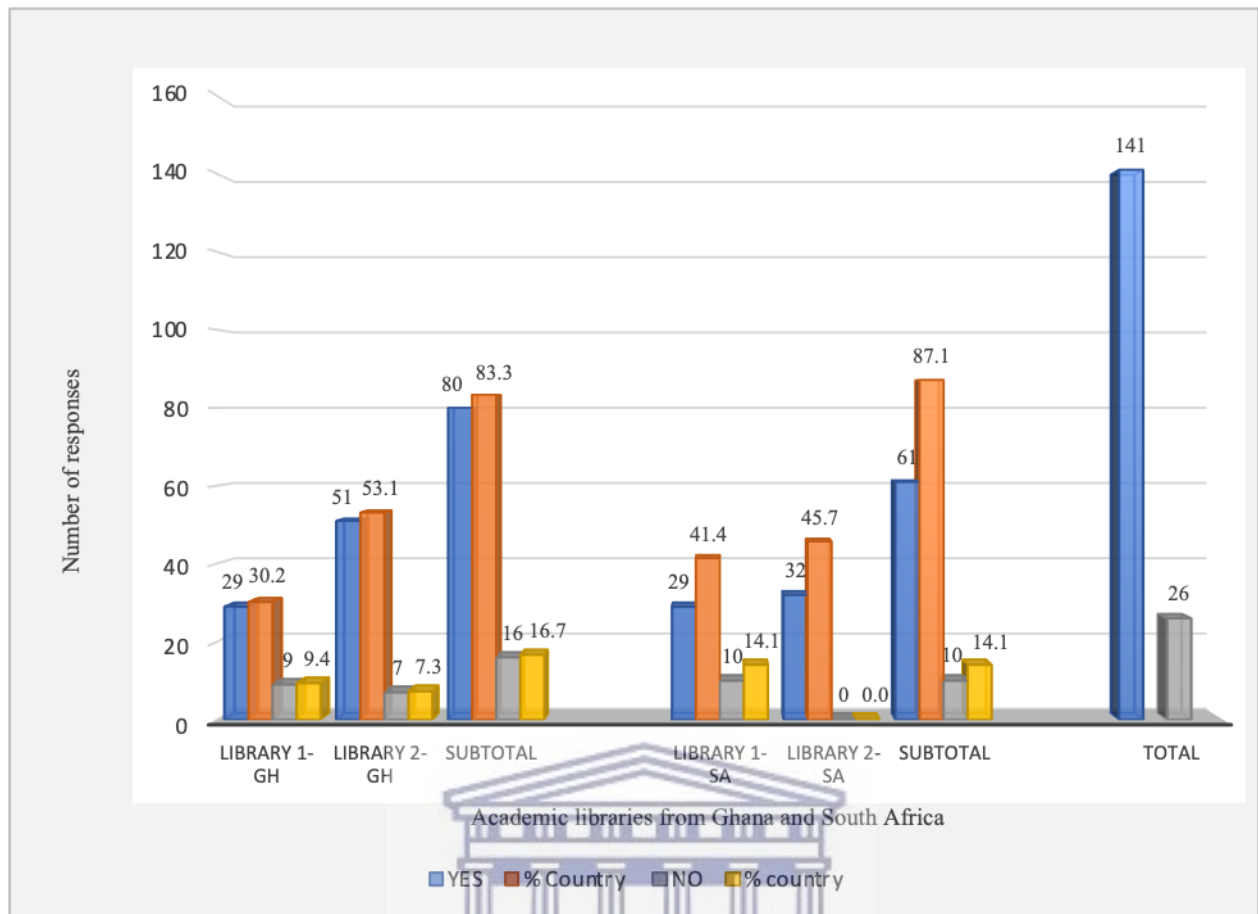


Figure 5.6 Incite interest (N=167)

5.4.2.3 Learn new skills

Newly implemented Lib 4.0 technologies compel both library staff and patrons to learn new skills since this will require them to go through training to be in a better position to utilize them. As shown in Figure 5.7, 77.8% (130) of librarians agreed that new technology implies learning new skills.

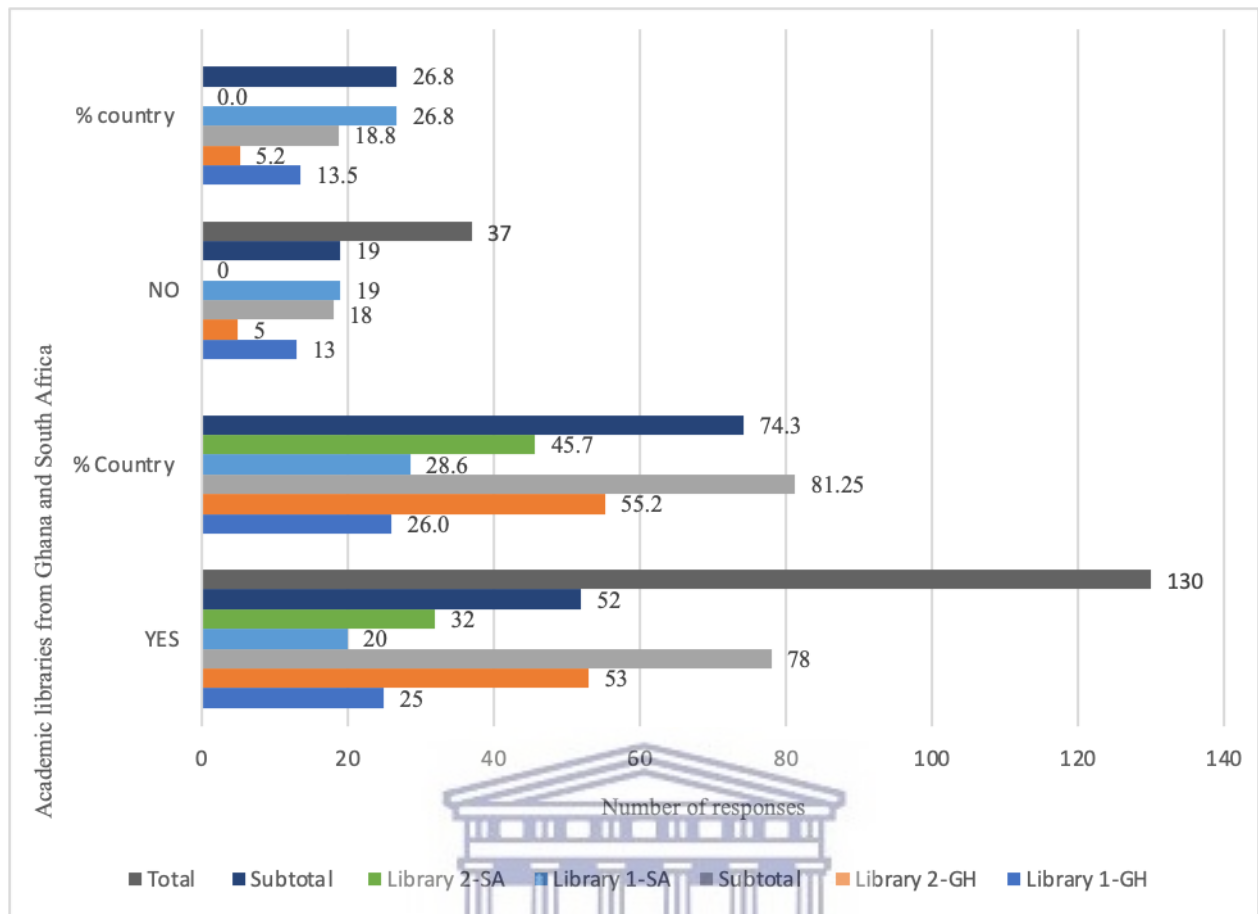


Figure 5.7 New skills (N=167)

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5.4.2.4 Staying relevant

One of the compelling reasons for incorporating Lib 4.0 technologies and applications is for academic libraries to stay relevant and to provide innovative library services. This is evident in the responses captured in Table 5.15 as almost all respondents (97.6%) from both Ghana and South Africa agreed that technology enhances staying relevant and that if they are not proactive enough to employ new Lib 4.0 technologies and applications, their services will eventually become redundant.

Table 5.15 Staying relevant (N=167)

Reasons for using Lib 4.0 technologies and applications in your library		Ghana		South Africa		Total	
		Library 1-GH	Library 2-GH	Library 1-SA	Library 2-SA		
To stay relevant in providing library services	Yes	Count	36	56	39	32	163
		%Country	37.5	58.3	54.9	45.1	-
		Total	21.6%	33.5%	23.4%	19.2%	97.6%
	No	Count	2	2	0	0	4
		%Country	2.1	2.1	0	0	-
		Total	1.2%	1.2%	0.0%	0.0%	2.4%
Total		38	58	39	32	167	
		22.8%	34.7%	23.4%	19.2%	100.0%	

5.4.2.5 Attracting new and maintaining the interest of existing customers

As depicted in Figure 5.8, 30 of the respondents representing Library 1-GH and 49 from Library 2-GH concur with the assertion that Lib 4.0 technology and application help “to attract new and maintain existing clients”. From South Africa, 32 respondents from Library 1-SA and 20 from Library 2-SA confirmed the statement. These results show that the majority (131, 78%) of librarians believe that Lib 4.0 technologies and applications attract new and maintain existing library clients as agreed by the majority of the respondents.

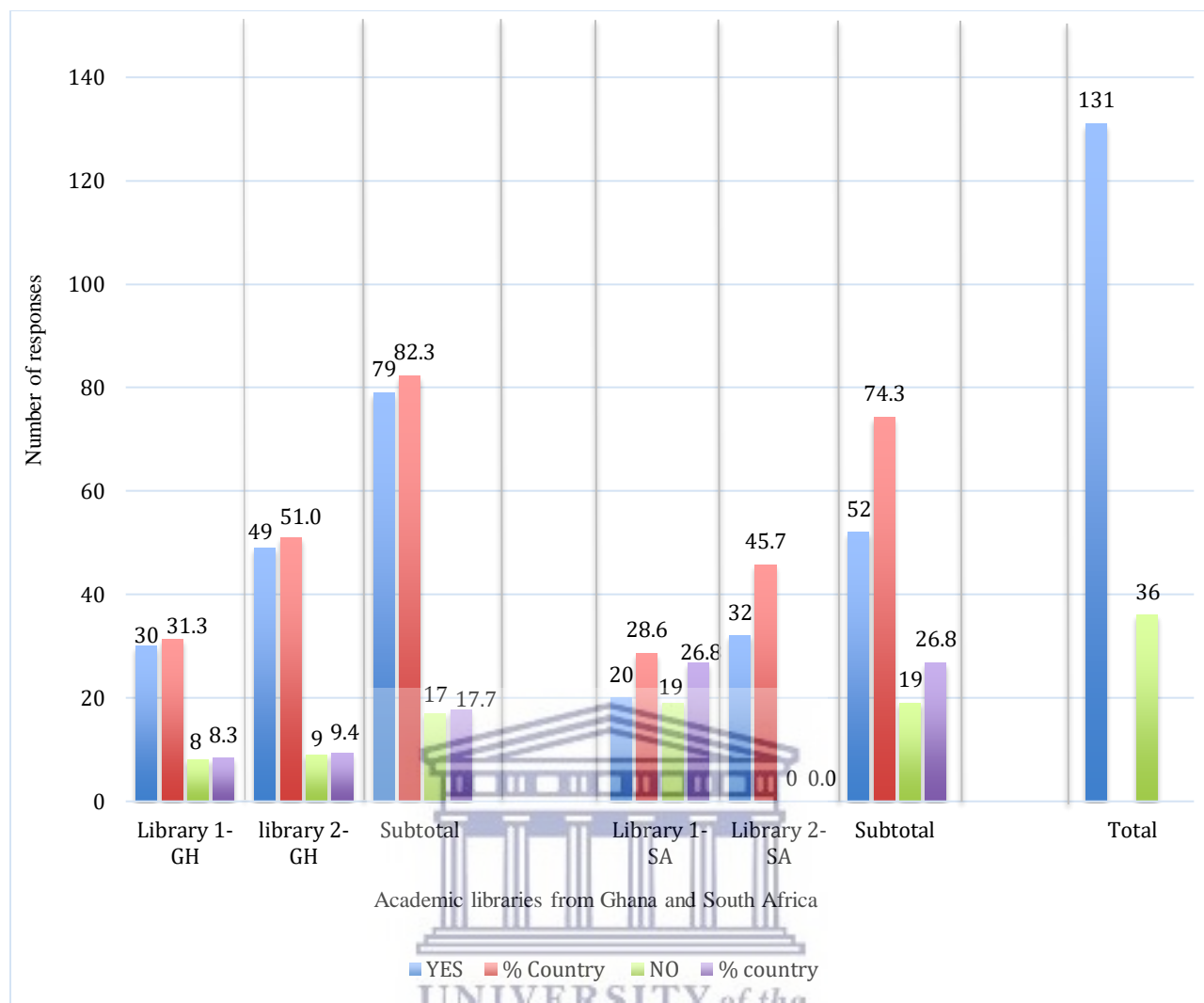


Figure 5.8: Attract new and maintain existing customers (N=167)

In summary, the findings suggest that a greater percentage of the respondents confirmed that their reasons for using Lib 4.0 include easy access and usage, inciting interest, learning new skills, staying relevant, and attracting new and maintaining the interest of existing library customers.

5.5 Librarian Knowledge, skills, and abilities needed

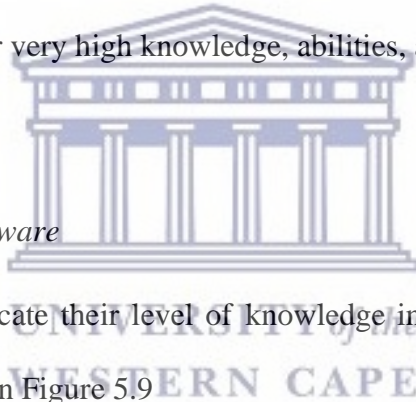
The disruptive changes of the 4IR in libraries have initiated the demand for new knowledge, skillsets, and competencies necessary for the academic library to embrace new technology and function effectively to counter anxiety about technology replacing humans.

5.5.1 Knowledge abilities

This section of the questionnaire assessed the knowledge abilities of librarians to apply Lib 4.0 technologies and applications in library services. Respondents had to rate themselves as having very low, low, moderate, high, or very high knowledge, abilities, and skills.

5.5.1.1 Library management software

Respondents were asked to indicate their level of knowledge in selected 4IR applications and activities. Responses are shown in Figure 5.9



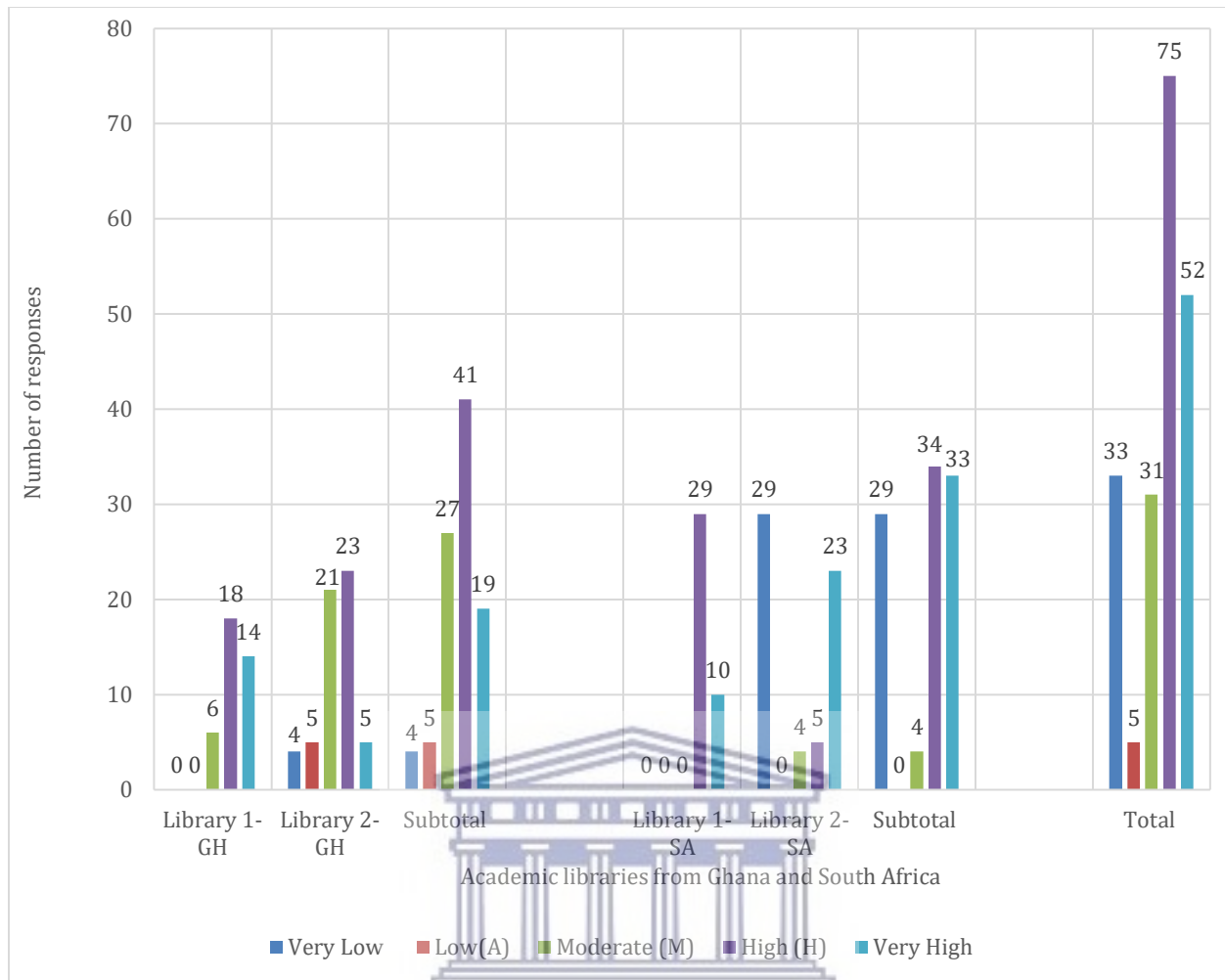


Figure 5.9 Library management software (N=167)

Figure 5.6 reflects that 41 representing the majority of respondents from Ghana rated their ability as High, 27 as Moderate, and nineteen as Very High. The majority of the responses are skewed towards positive even then the number of respondents who rated moderate was more than those who selected Very High. In South Africa, librarians rate their knowledge as High (34) and Very High (33), thus also reflecting a positive response. Even though the responses from both countries skew towards positive, respondents from South Africa reflect being more knowledgeable in library management software than those in Ghana.

5.5.1.2 Programming

In the library and information science discipline, students are introduced to basic programming to enable them to understand certain basic coding and programming fundamentals. Knowledge of programming is relevant in the era of 4IR. As shown in Figure 5.10, responses from Ghana reflect that nine (5.4 %) rated their knowledge abilities in programming as very low, eight (4.8%) as Low, 24 (14.4%) as Moderate, 24 (14.4%) as High, and nine (5.4%) as Very High. South African librarians rated their programming knowledge as Very low (6, 3.6%), Low (25, 15%), Moderate (11,6.6%), High (16, 9.6%), and Very high (13, 7.8%). It can be inferred from these results that while the majority of respondents from Ghana skew towards Moderate, responses from South Africa tip towards Low.

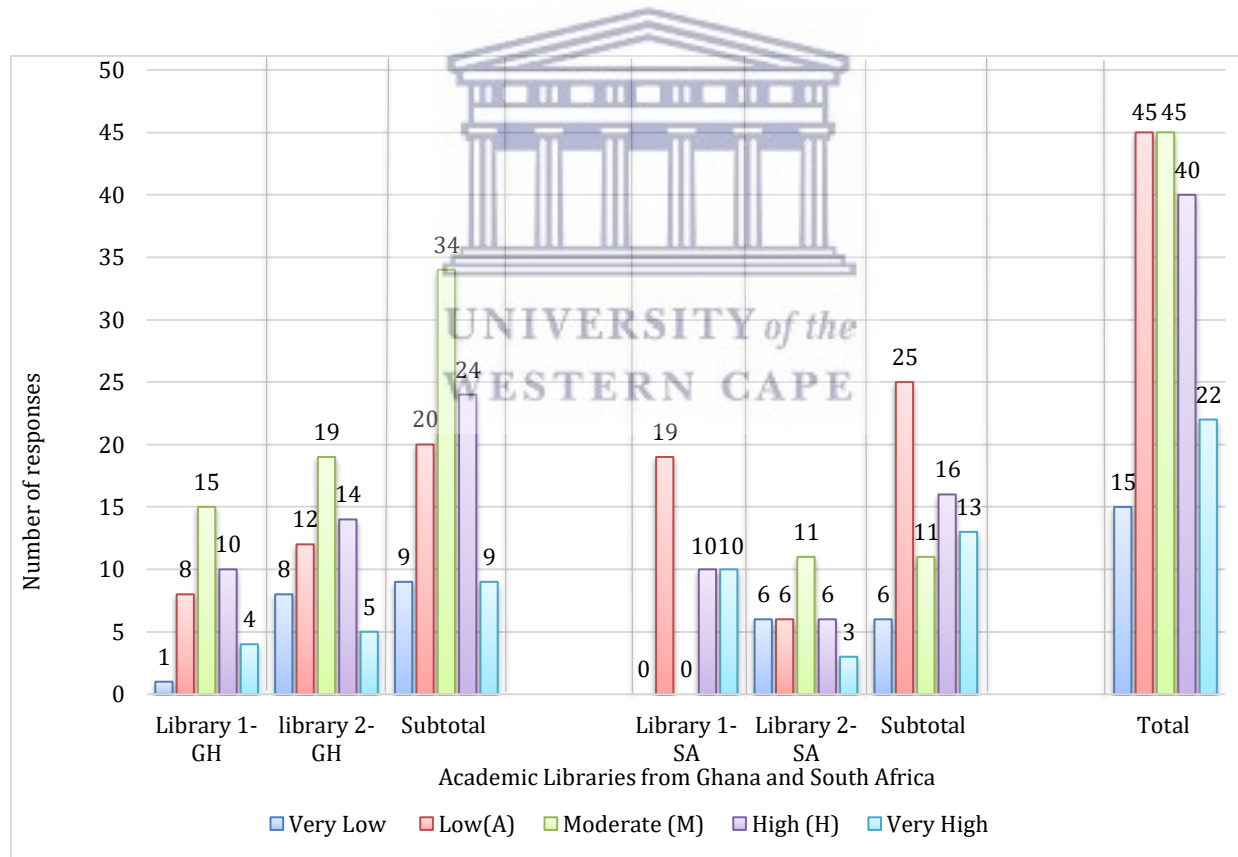


Figure 5.10 Programming (N=167)

5.5.1.3 Automation

Table 5.16 shows respondents' knowledge of library automation. Responses from Ghana show that 39 (23.4%) representing the majority rated their knowledge as High. Other ratings are 27 (16.2%) Very High, 23 (13.8%) Moderate, and four (2.4%) Very Low. Similarly, from South Africa, the majority of the respondents 27 (22.2%) rate their knowledge as High followed by sixteen (9.6%) as Moderate and five (3.0%) as Low. It can be inferred from these results that responses from each country skew toward a positive High.

Table 5.16 Automation (N=167)

Knowledge Abilities			Library Staff of Ghana			Library Staff of South Africa			Total
			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Library automation	Very Low (VL)	Count	0	4	4	0	0	-	4
		%Country	0	4.2	4.2	0	0	0	-
		%Total	0.0%	2.4%	2.4%	0.0%	0.0%	-	2.4%
	Low (A)	Count	2	1	3	0	5	5	8
		%Country	2.1	1.0	4.2	0	7.0	7.0	-
		%Total	1.2%	0.6%	1.8%	0.0%	3.0%	3.0%	4.8%
	Moderate (M)	Count	6	17	23	10	6	16	39
		%Country	2.1	17.7	19.8	14.1	8.5	22.6	-
		%Total	3.6%	10.2%	13.8%	6.0%	3.6%	9.6%	23.4%
	High (H)	Count	10	29	39	29	8	37	76
		%Country	10.4	30.2	40.6	40.8	11.3	52.1	-
		%Total	6.0%	17.4%	23.4%	17.4%	4.8%	22.2%	45.5%
	Very High (VH)	Count	20	7	27	0	13	13	40
		%Country	20.8	7.3	28.1	0	18.3	18.3	-
		%Total	12.0%	4.2%	16.2%	0.0%	7.8%	7.8%	24.0%
Total			38	58	96	39	32	71	167
			22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.5.1.4 Knowledge taxonomy

Knowledge taxonomy “focuses on enabling the efficient retrieval and sharing of knowledge, information, and data across an organization by building the taxonomy around workflows and knowledge needs in an intuitive structure” (Lambe, 2007). Knowledge taxonomy is relevant in the era of 4IR as varying patrons may need assistance with advanced search techniques. Given this, respondents were asked to rate their knowledge in that regard. Figure 5.11 shows that the majority of respondents (21%) from Ghana rate their knowledge as Moderate, followed by (19.8%) who indicated High. Library staff in Ghana have a fair knowledge of knowledge taxonomy. South Africa librarians rate their knowledge as Very High (21.6%), High (6%), and Moderate (8.4%).

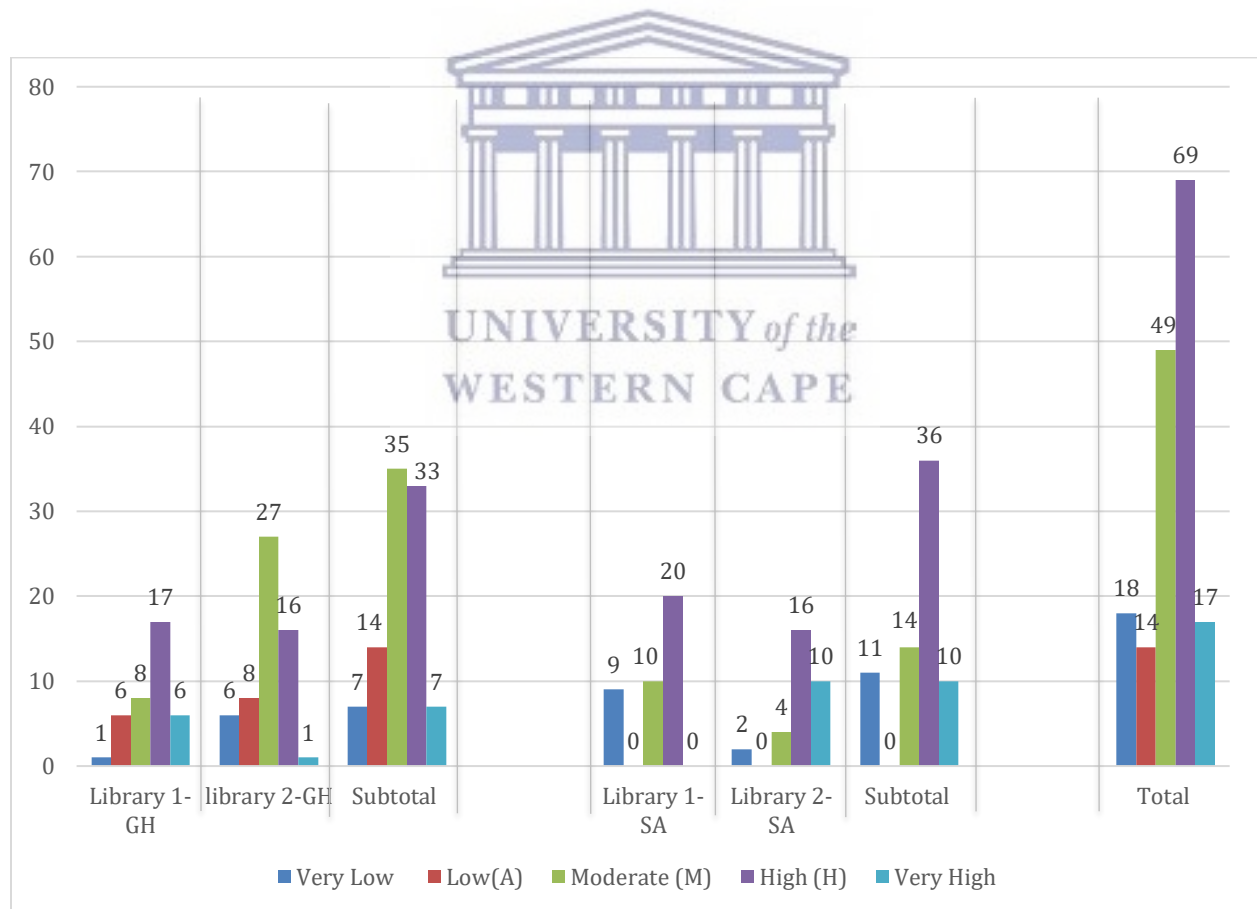


Figure 5.11 Knowledge taxonomy (N=167)

5.5.1.5 Information search strategy

Table 5.17 shows the results on the knowledge abilities of respondents in the information search strategy. Ghanaian librarians marked their abilities as Very High (7.8%), High (28.2%), and Moderate (7.8%). This signifies positive results. By the same token, a positive result was observed in the responses in South Africa as (27.6%) and (13.8%) evaluated their abilities for information search strategy as Very High and High respectively. Responses from each country skew towards positive, and differences are infinitesimal.

Table 5.17 Information search strategy (N=167)

Knowledge Abilities		Ghana			South Africa			Total	
		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal		
Information search strategy	Very Low (VL)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		Total	0.0%	1.2%	1.2%	0.0%	0.0%	0%	1.2%
	Low (A)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		Total	0.0%	1.2%	1.2%	0.0%	0.0%	0%	1.2%
	Moderate (M)	Count	4	9	13	0	2	2	15
		Country	4.2	9.4	13.6	0	2.8	2.8	-
		Total	2.4%	5.4%	7.8%	0.0%	1.2%	1.2%	9.0%
	High (H)	Count	12	35	47	19	4	23	70
		%Country	12.5	36.5	49	26.8	5.6	32.4	-
		Total	7.2%	21.0%	28.2%	11.4%	2.4%	13.8%	41.9%
	Very High (VH)	Count	22	10	32	20	26	46	78
		%Country	22.9	10.4	33.3	28.2	36.6	64.8	-
		Total	13.2%	6.0%	19.2%	12.0%	15.6%	27.6%	46.7%
Total		38	58	96	39	32	71	167	
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%	

5.5.1.6 Online registration of patrons

Online registration of patrons is one of the common features of the 4IR academic library. Patrons should be able to register for library services remotely and library staff should be able to assist patrons in that regard. The results from Figure 5.12 shows that 43.8% of respondents from Ghana rated their abilities positively as High and Very High, while 44 (13.2%) and 2 (1.2%) rated their knowledge as Moderate or Low respectively. From South Africa, the ratings are High and Very High (35.4%) and depict positive results as only ten librarians (7.2%) rated their knowledge Moderate.

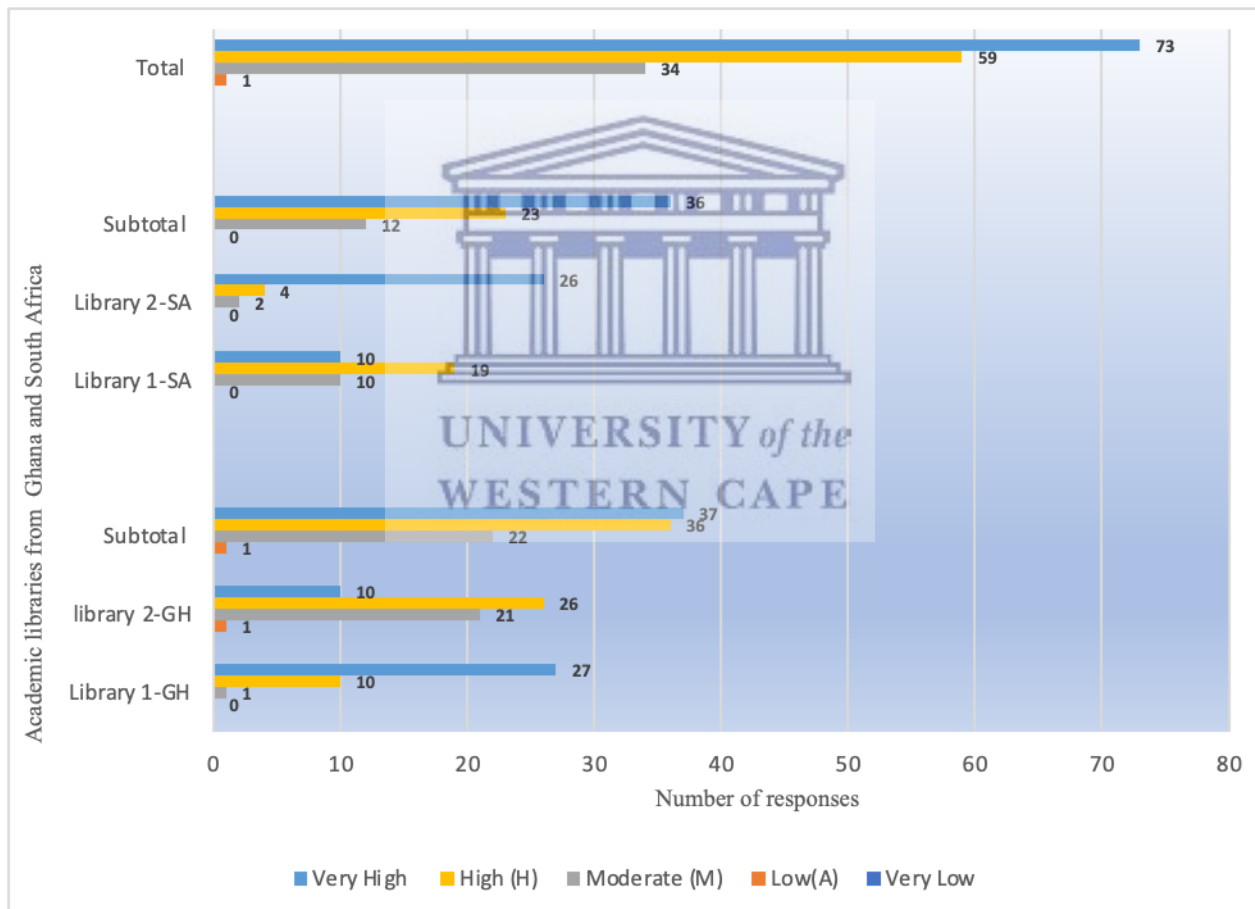


Figure 5.12 Online registration of patrons (N=167)

5.5.1.7 User interface of library webpages

As shown in Table 5.18, 39, 31, and 19 Ghanaian respondents rated their knowledge abilities in the user interface of library webpages as High, Very High, and Moderate. More positive results were evident in the ratings from South Africa where knowledge was rated as Very High (48), High (21), and Moderate (2).

Table 5.18 Users' interfaces of library webpages (N=167)

Knowledge Abilities:		Ghana			South Africa			Total	
		Library 1-GH	Library 1-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal		
Users' interfaces of library webpages	Very Low (VL)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		Total	0.0%	1.2%	1.2	0.0%	0.0%	0	1.2%
	Low (A)	Count	0	5	5	0	0	0	5
		%Country	0	5.2	5.2	0	0	0	-
		Total	0.0%	3.0%	3%	0.0%	0.0%	0	3.0%
	Moderate (M)	Count	1	18	19	0	2	2	21
		%Country	1.0	18.8	19.8	0	2.8	2.8	-
		Total	0.6%	10.8%	11.4%	0.0%	1.2%	1.2%	12.6%
	High (H)	Count	14	25	39	10	11	21	60
		%Country	14.6	26.0	40.6	14.1	15.5	29.6	-
		Total	8.4%	15.0%	23.4%	6.0%	6.6%	12.6%	35.9%
Very High (VH)	Count	23	8	31	29	19	48	79	
	%Country	24.0	8.3	32.3	40.8	26.8	67.6	-	
	Total	13.8%	4.8%	18.6%	17.4%	11.4%	28.8%	47.3%	
Total		38	58	96	39	32	71	167	
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6	100.0%	

5.5.1.8 Virtual help desk

In terms of virtual help desk abilities, as seen in Table 5.19, responses from Ghana are as follows; High (26.4%), Very High (11.4%), and Moderate (13.8%). In South Africa, (21.6%), (15.6%), and (5.4%) indicated Very High, High, and Moderate respectively. For both countries, the majority of librarians rated their abilities as High.

Table 5.19 Virtual help desk (N=167)

Knowledge Abilities:			Ghana			South Africa			Total
			Library 1-GH	Library 1-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Virtual help desk	Very Low (VL)	Count	0	5	5	0	0	0	5
		%Country	0	5.2	5.2	0	0	0	-
		%Total	0.0%	3.0%	3%	0.0%	0.0%	0	3.0%
	Low (A)	Count	2	3	5	0	0	0	5
		%Country	2.0	3.1	5.1	0	0	0	-
		%Total	1.2%	1.8%	2	0.0%	0.0%	0	3.0%
	Moderate (M)	Count	10	13	23	9	0	9	32
		%Country	10.4	13.5	23.9	12.7	0	0	-
		%Total	6.0%	7.8%	13.8%	5.4%	0.0%	5.4%	19.2%
	High (H)	Count	14	30	44	10	16	26	70
		%Country	14.6	31.2	45.8	14.1	22.5	36.6	-
		%Total	8.4%	18.0%	26.4%	6.0%	9.6%	15.6%	41.9%
	Very High (VH)	Count	12	7	19	20	16	46	55
		%Country	12.5	7.3	19.8	28.2	22.5	50.7	-
		%Total	7.2%	4.2%	11.4%	12.0%	9.6%	21.6%	32.9%
Total			38	58	96	39	32	71	167
			22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.5.1.9 Web-based tutorial (YouTube, webinar)

A Web-based tutorial (YouTube, webinar) is the cheapest and faster way of introducing patrons to new services. Respondents were asked to indicate their knowledge and abilities to produce such tutorials. Ratings are recorded in Figure 5.13. Librarians from Ghana rated their abilities as Moderate (22.8%), High (15.6%), and Very high (12.6%). Results from South Africa show that the majority of the respondents appraised their abilities as Very High (19.8%), High (20.4%), and Moderate (2.4%). Comparably, the majority of responses from Ghana rated their abilities as Moderate and that of South Africa as High.

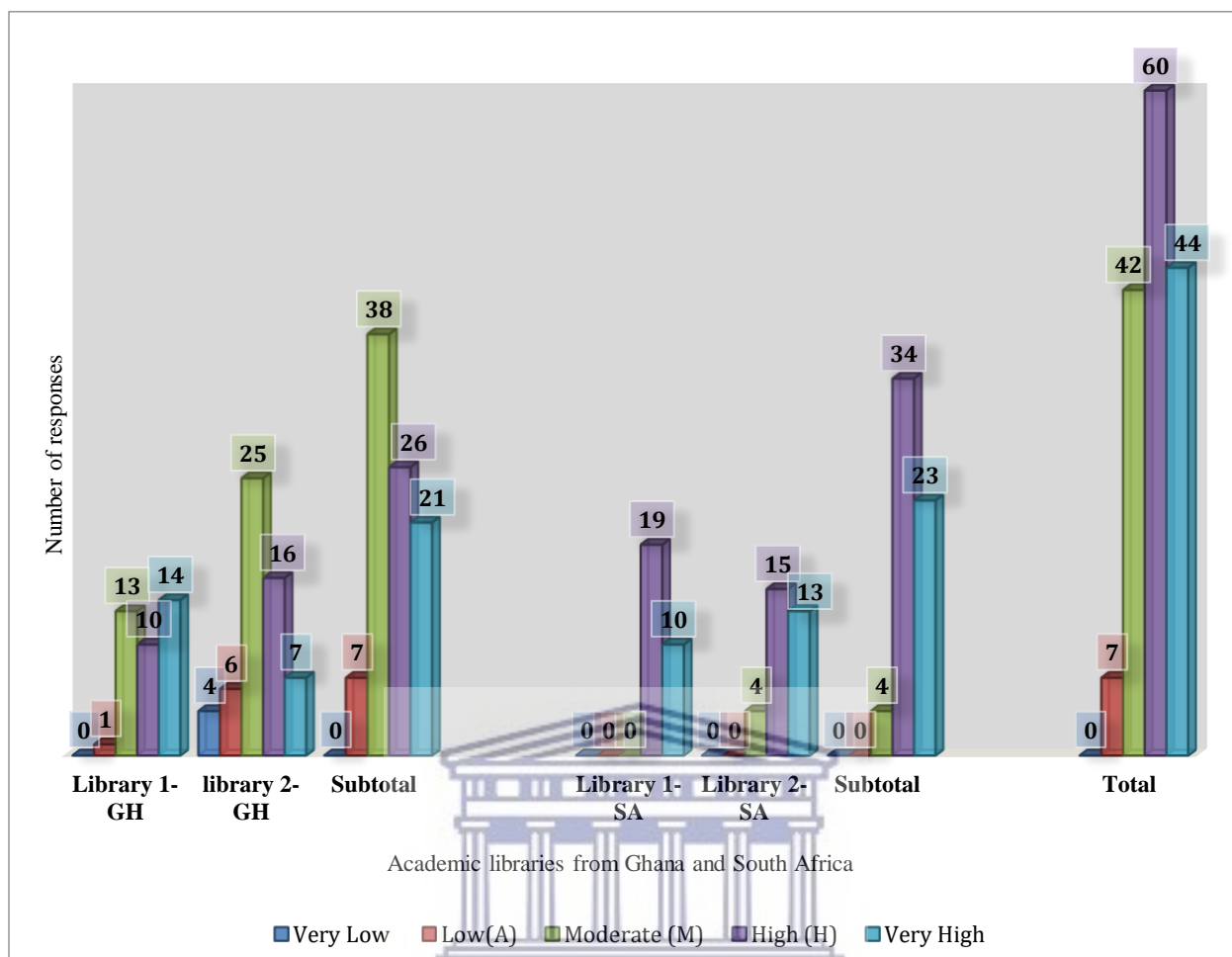


Figure 5.13 Web-based tutorial (YouTube, webinar) (N=167)

5.5.1.10 The overall level of knowledge in Lib 4.0 applications

This section puts all the responses together under knowledge in Lib 4.0 applications to ascertain the overall level of respondents' level of knowledge by ranking with low, moderate, and high.

The assessment was based on the 9 items under librarians' knowledge in Lib 4.0 applications.

The 5 Likert scale was used which comprises; Very High = 5, High= 4, Moderate= 3, Low = 2, Very low = 1

If an individual respondent should score 5 throughout the total score will be the number of items multiply by 5.

Therefore, = Very High= $9 \times 5 = 45$, High = $9 \times 4 = 36$, Moderates = $9 \times 3 = 27$, Low = $9 \times 2 = 18$.

All individual responses were computed, and the results are depicted in Tables 5.20 and 5.21

Table 5.20 Overall knowledge - Ghana (N=96)

Ranking of responses	Score ranges	Frequency	Percepts (100%)
Low level of knowledge	22 and below	6	6.3
Moderate level of knowledge	23-31	46	47.9
High level of knowledge	32-45	44	45.8
Total		96	100

Table 5.20 reflects that the most (46) librarians (47.9%) from Ghana had a total range score ranging from 23 to 31 presenting a moderate level of knowledge. Forty-four librarians (45.8%) with a range score of 32 to 45 presenting a high level of knowledge. Six librarians (6.3%) obtained a range below 22 indicating a low level of knowledge. It can be inferred from these results that library staff from Ghana have moderate knowledge of Lib 4.0 applications and activities needed for 4IR.



Table 5.21 Overall knowledge - South Africa (N=71)

Ranking of responses	Score ranges	Frequency	Percepts (100%)
Low level of knowledge	22 and below	0	0
Moderate level of knowledge	23-31	25	35.2
High level of knowledge	32-45	46	64.8
Total		71	100

Table 5.21 reflects that the most (46) South African librarians (64.8%) had a score range from 32 to 45 representing a high level of knowledge. Twenty-five (35.2%) obtained a score range from 23 to 31 indicating a moderate level of knowledge. There was no score for the range below 22. It

can be inferred from these results that library staff from South Africa have high levels of knowledge of Lib 4.0 applications and activities needed for 4IR.

Comparing the range scores between Ghana and South Africa, it can be inferred that library staff from South Africa possesses a higher level of knowledge of Lib 4.0 applications and activities and are better prepared for 4IR changes.

5.5.2 IT skills

As projected by the Future of Jobs Report during the World Economic Forum 2018 (Schwab, 2018), the disruptive change of the 4IR requires library staff to acquire new skill-sets needed to stay ahead of changes in technological innovation, to stay relevant, and to provide library services demanded by library users. The following encapsulates selected IT skills and competencies needed by library staff to thrive in the 4IR.



5.5.2.1 Technical IT skills

The need for technical IT skills in the era of 4IR is essential as library staff must possess certain technical skill-sets concerning digital library services. To investigate these skills, various sub-sections were used.

5.5.2.1.1 Fault and error recovery skills

Respondents were first asked to rate their fault and error recovery skills. Figure 5.14 shows that Ghanaian respondents acknowledged their skills in fault and error recovery as High (37) or Very high (7), while 43 rated their skills as Moderate. From South Africa, 55 librarians rated their skills

as High (33) and Very high (22) with nobody rating their skills as Moderate. Responses from the two countries show that the majority (59.3%) had high or very high skills in fault and recovery.

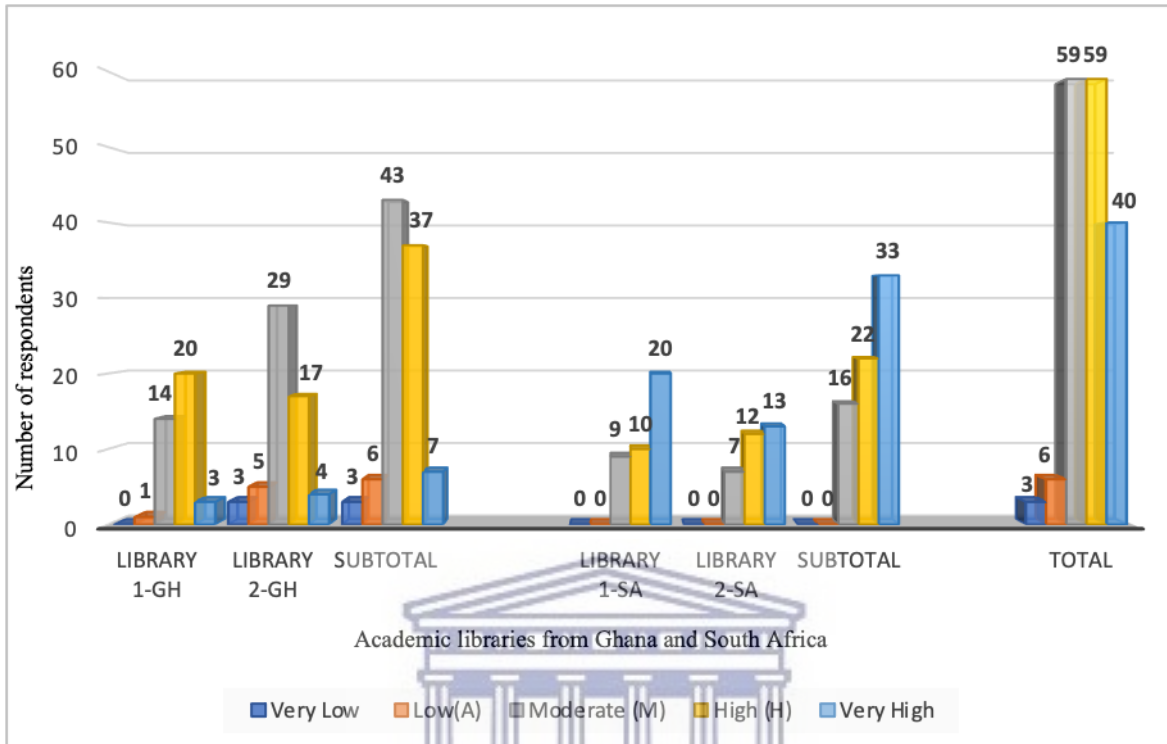


Figure 5.14 Fault and error recovery skills (N=167)

5.5.2.1.2 Understand digitization processing

On the assertion of understanding digitization processing, the majority of the respondents (26.3%) from Ghana appraised their skills as High (42) and Very high (13) followed by 33 (19.8%) who rated themselves as Moderate. Comparably, 39.6% of the respondents from South Africa rated themselves as High (41) and Very High (25). It can be seen that both countries are skilled, but South African librarians are more positive about their skills. Details of responses are presented in

Figure 5.15.

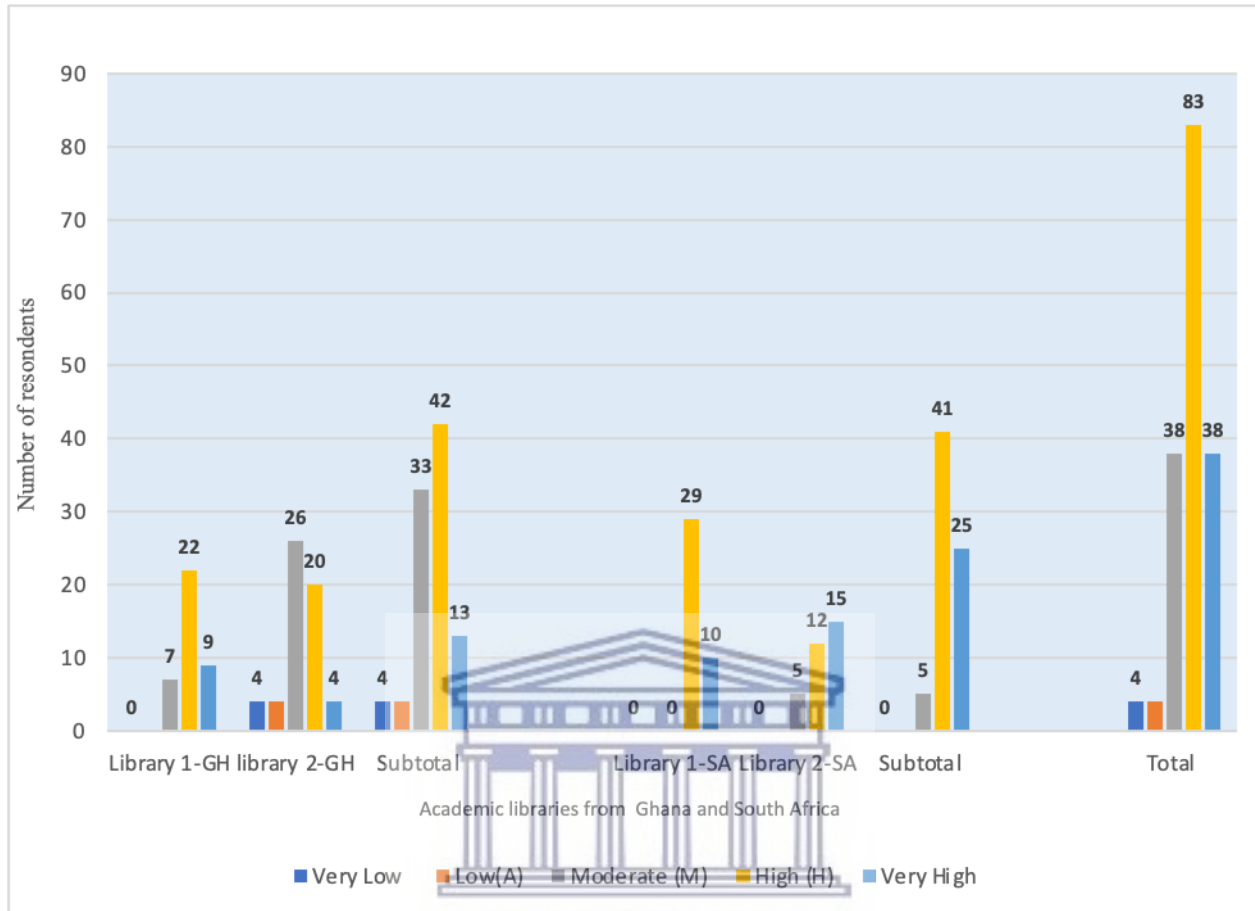


Figure 5.15 Understand digitization Processing (N=167).

5.5.2.1.3 Advanced technologies

Responses on advanced skills in technologies are presented in Figure 5.16. A greater portion of the respondents (27.6%) from Ghana rated their skills as Moderate (46), High (22), and Very high (8). South Africans rated their skills as Moderate (35), High (24), and Very high (8). For both countries, the majority of librarians (81) rated their skills as Moderate.

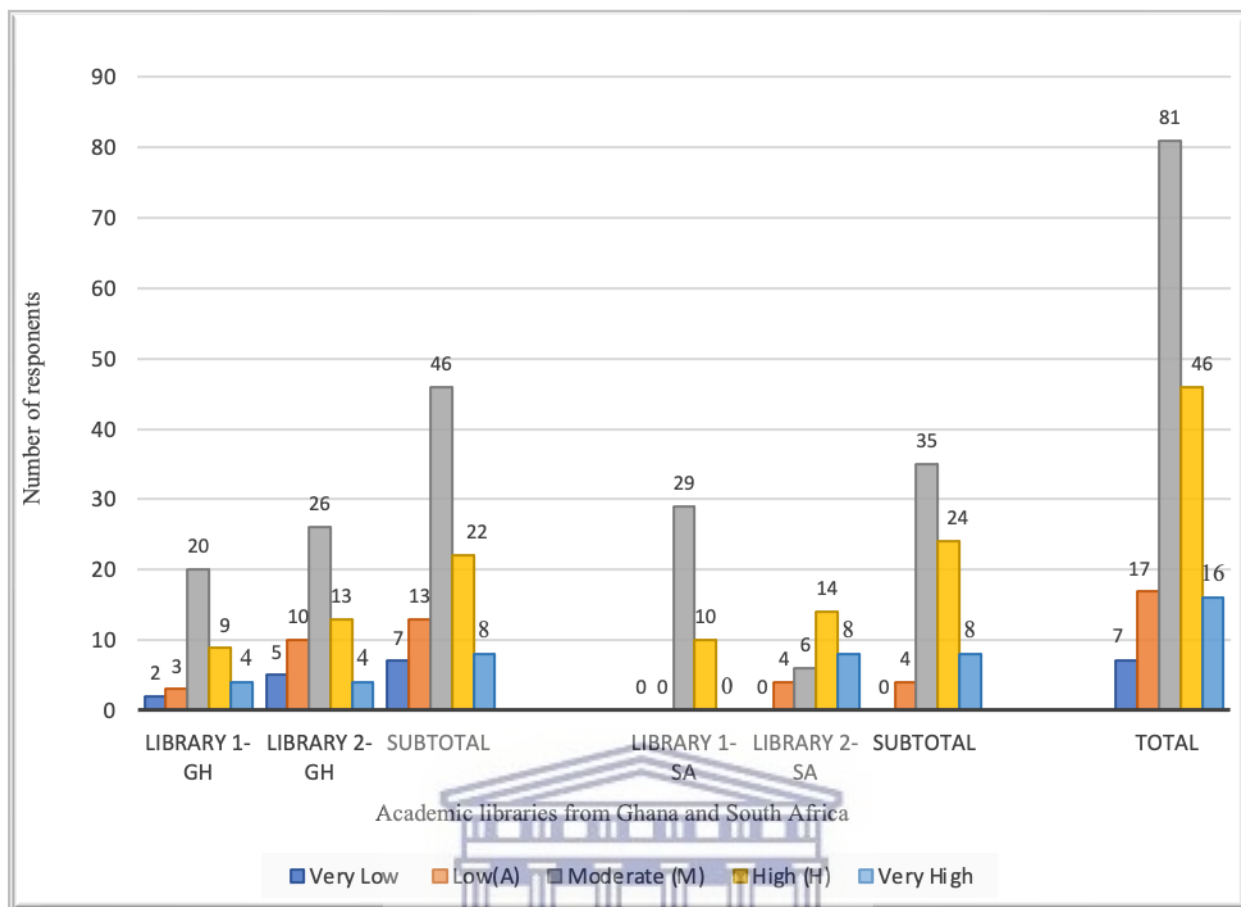


Figure 5.16 Advanced technologies (N=167)

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5.5.2.2 Digital IT skills

This section investigated the digital IT skills needed for providing digital library services. To investigate these skills, various sub-sections were used.

5.5.2.2.1 Cloud computing skills

Table 5.22 reflects that the majority of Ghanaian respondents (54) rated their cloud computing skills as Very low (30) or Low (24). Moderate skills were recorded by 30 librarians. High (23) and (40), and the next greater percentage were skewed towards negative with a percentage of

22.2% (14.4% Low; Very Low 7.8%) unlike South Africa where a majority of responses were skewed towards positive with a percentage of 34.8 % (10.8% High; 24% Very High).

Table 5.22: Cloud computing skills (N=167)

Digital IT skills		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
Cloud computing skill	Very Low (VL)	Count	3	10	30	0	2	15	
		%Country	3.1	10.4	16.5	0	2.8	2.8	-
		% Total	1.8%	6.0%	7.8	0.0%	1.2%	1.2	9.0%
	Low (A)	Count	12	12	24	9	2	11	35
		%Country	12.5	12.5	25	12.7	2.8	15.5	-
		%Total	7.2%	7.2%	14.4	5.4%	1.2%	6.6	21.0%
	Moderate (M)	Count	10	20	30	10	0	10	40
		%Country	10.4	20.8	23.9	19.4	0	19.4	-
		%Total	6.0%	12.0%	18	6.0%	0.0%	6.0	24.0%
	High (H)	Count	10	13	23	0	18	18	41
		%Country	10.4	13.5	33.9	0	25.4	25.4	-
		% Total	6.0%	7.8%	13.8	0.0%	10.8%	10.8	24.6%
Very High (VH)	Count	3	3	6	20	10	30	36	
	%Country	3.1	3.1	6.2	28.2	14.8	43	-	
	% Total	1.8%	1.8%	5.1	12.0%	12.0%	24%	21.6%	
Total		Count	38	38	58	96	39	167	
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	100.0%	

5.5.2.2.2 Data analytics/data processing

From Table 5.23 it can be seen that whiles the majority of respondents from Ghana indicated moderate (19.2%) and that from South Africa was (5.4%) out of 167. In terms of positive responses, 23.4% of Ghanaians indicated (18.0% High and 5.4% Very High) and the same percentage of respondents from South Africa indicated (12.0% High and 12.4% Very High). It can therefore be inferred from these statistics that the responses from both countries were positively skewed.

Table 5.23 Data analytics/data processing (N=167)

Digital IT skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Data analytics/data processing	Very Low (VL)	Count	0	5	5	0	2	2	7
		%Country	0	5.2	5.2	0	2.8	2.8	-
		% Total	0.0%	3.0%	3.0	0.0%	1.2%	1.2	4.2%
	Low (A)	Count	8	12	20	19	2	21	41
		%Country	8.3	12.5	20.8	26.8	2.9	29.7	-
		Total	4.8%	7.2%	9	11.4%	1.2%	12.6	24.6%
	Moderate (M)	Count	10	22	32	0	9	9	41
		%Country	10.4	22.9	33.3	0	9.4	9.4	-
		% Total	6.0%	13.2%	19.2	0.0%	5.4%	5.4	24.6%
	High (H)	Count	14	16	30	10	10	20	50
		%Country	14.6	16.7	31.3	14.1	14.1	28.2	-
		% Total	8.4%	9.6%	18	6.0%	6.0%	12.0	29.9%
	Very High (VH)	Count	6	3	9	10	9	19	28
		%Country	6.3	3.1	9.4	14.1	12.7	12.7	-
		% Total	3.6%	1.8%	5.4	6.0%	5.4%	11.4	16.8%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.2.3 Digital content creation skills

Digital content creation skills in the context of this study is a range of skills needed by librarians to access and manage information through networks, communication applications, and digital devices. As indicated in Figure 5.17, the majority of the respondents 53% (34% Very High; 19% High) from South Africa acknowledged that they have digital content creation skills. A high number of Ghanaian librarians (42%) also rated themselves as High (35%) and Very High (97%). It can be inferred from these results that positive responses from South Africa were more skewed towards positive than those from Ghana.

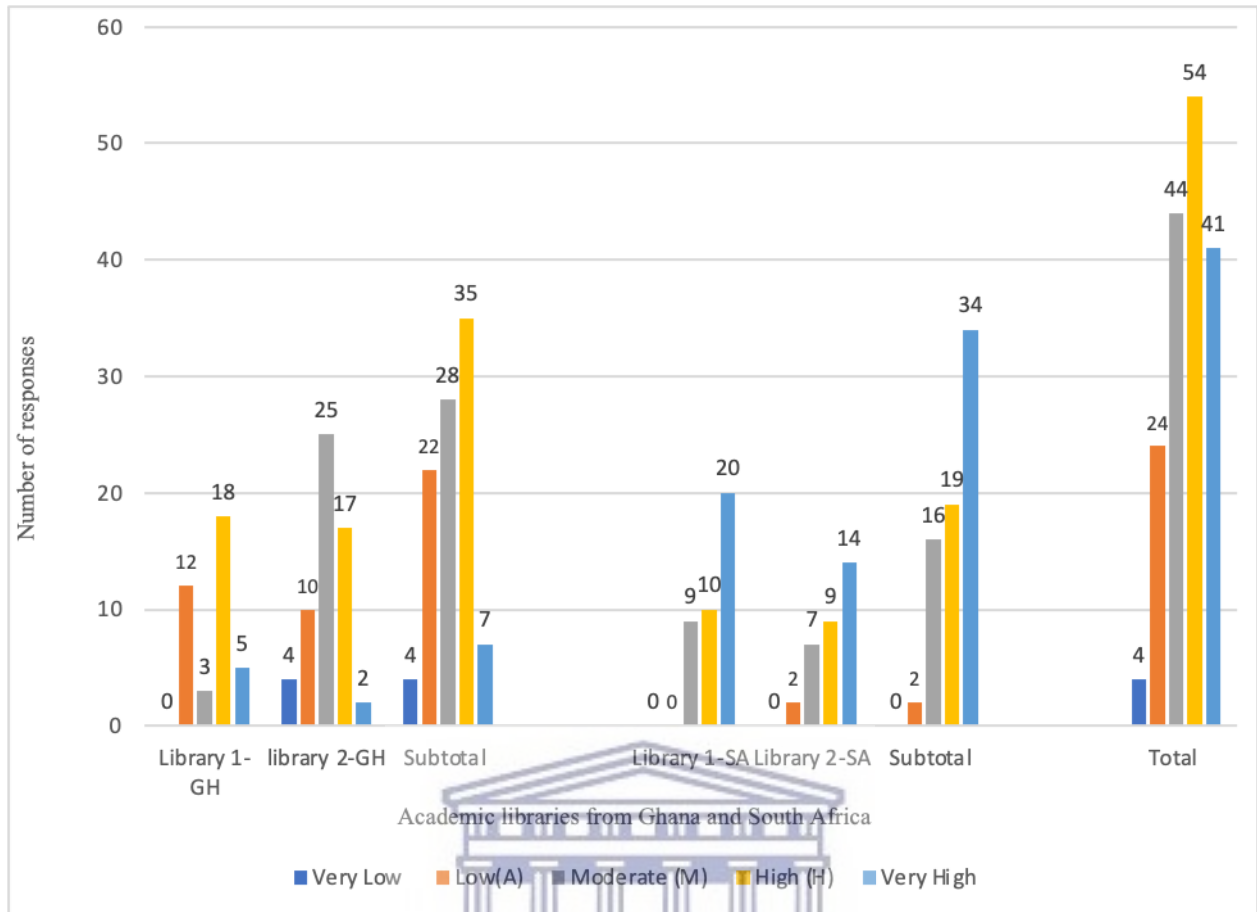


Figure 5.17 Digital content creation skills (N=167).

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5.5.2.3 Thinking skills

Thinking skills reflect the cognitive abilities of individuals to think critically to solve issues in line with providing services to patrons. The 4IR requires workers who can think critically and innovatively to find a solution to a myriad of problems. Given this, respondents were asked to rate their thinking skills by responding to four related questions.

5.5.2.3.1 Critical and logical thinking

As shown in Figure 5.24, most respondents from Ghana (61) rated their critical and logical thinking as High, while fourteen rated their skills as Very High. Likewise, most South African librarians (69) rated their skills as High (46.8%) or Very High (15%). In comparison, South Africa had a larger percentage of librarians (82%) than Ghana (67.7%) rating their critical and logical thinking positively.

Table 5.24 Critical and logical thinking (N=167)

Thinking skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Critical and logical thinking	Very Low (VL)	Count	0	6	6	0	0	0	6
		%Country	0	6.3	6.3	0	0	0	
		% of Total	0.0%	3.6%	3.6	0.0%	0.0%	0.0%	3.6%
	Low (A)	Count	2	4	6	0	2	2	8
		%Country	2.1	9.4	11.5	0	33.3	33.3	-
		% of Total	1.2%	2.4%	3.6	0.0%	1.2%	1.2	4.8%
	Moderate (M)	Count	6	13	19	0	0	0	19
		%Country	6.3	13.5	19.8	0	0	0	-
		% of Total	3.6%	7.8%	11.4	0.0%	0.0%	0.0	11.4%
	High (H)	Count	22	29	61	29	15	44	95
		%Country	22.9	30.2	53.1	31.2	15.6	46.8	-
		% of Total	13.2%	17.4%	30.4	17.4%	9.0%	26	56.9%
Very High (VH)	Count	8	6	14	10	15	25	39	
	%Country	8.3	6.3	14.6	14.1	21.1	35.2	-	
	% of Total	4.8%	3.6%	8.4	6.0%	9.0%	15	23.4%	
Total		Count	38	58	96	39	32	71	167
		% of Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.3.2 Complex problem solving and troubleshooting

Table 5.25 gives an account of the complex problem-solving and troubleshooting abilities of respondents. More respondents from South Africa (35.4%) rated their abilities as High (12.6%) and Very High (22.8%) compared to 28.2% of respondents from Ghana rating themselves as High (21.6%) or Very High (6.6%).

Table 5.25 Complex problem-solving and troubleshooting (N=167)

Thinking skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Complex problem-solving and troubleshooting	Very Low (VL)	Count	2	5	7	0	0	0	7
		Country	2.1	5.2	7.3	0	0	0	
		% Total	1.2%	3.0%	4.2	0.0%	0.0%	0.0%	4.2%
	Low (A)	Count	2	5	7	0	2	2	9
		Country	2.1	5.2	7.3	0	1.4	1.4	
		% of Total	1.2%	3.0%	6.4	0.0%	1.2%	1.2	5.4%
	Moderate (M)	Count	13	22	35	10	0	10	45
		Country	13.5	11.9	25.4	14.1	0	14.1	
		% Total	7.8%	13.2%	21	6.0%	0.0%	6.0	26.9%
	High (H)	Count	14	22	36	9	12	21	57
		Country	14.6	22.9	37.5	12.7	16.9	29.6	-
		% Total	8.4%	13.2%	21.6	5.4%	7.2%	12.6	34.1%
	Very High (VH)	Count	7	4	11	20	18	38	49
		Country	7.3	4.2	11.5	28.2	25.4	53.6	
		% Total	4.2%	2.4%	6.6	12.0%	10.8%	22.8	29.3%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.3.3 Analytical thinking skills

Table 5.26 reflects that the majority of all respondents (120) rated their analytical thinking skills as High (82) and Very High (38). The percentage of South African librarians rating themselves as High or Very High was 97.2%, compared to Ghanaian librarians' 52.6%. This is an indication that respondents from South Africa possessed more analytical thinking skills than those from Ghana.

Table 5.26 Analytical thinking skills (N=167)

Thinking skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Analytical thinking skills	Very Low (VL)	Count	0	4	4	0	0	0	4
		%Country	0	4.2	4.2	0	0	0	-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0	2.4%
	Low (A)	Count	3	7	10	0	0	0	10
		%Country	3.1	7.3	10.4	0	0	0	-
		%Total	1.8%	4.2%	6	0.0%	0.0%	0.0	6.0%
	Moderate (M)	Count	9	22	31	0	2	2	33
		%Country	9.4	22.9	32.3	0	2.1	2.1	-
		%Total	5.4%	13.2%	18.6	0.0%	1.2%	1.2	19.8%
	High (H)	Count	20	22	42	29	11	40	82
		%Country	20.8	22.9	43.7	40.8	15.5	56.3	-
		%Total	12.0%	13.2%	25.2	17.4%	6.6%	23.4	49.1%
	Very High (VH)	Count	6	3	9	10	19	29	38
		%Country	6.3	3.1	9.4	14.1	26.8	40.9	-
		%Total	3.6%	1.8%	5.4	6.0%	11.4%	17.4	22.8%
Total		Count	38	58	96	39	32	71	167
		%Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%



5.5.2.3.4 Creativity /innovation

As shown in Table 5.27, a greater portion of the respondents 34 (20.4%) from Ghana rated them as High, followed by 31 (18.6%) who remarked their abilities as Moderate, 20 (12%) as Low and six (3.6%) as Very low. Only five (3%) rated themselves as Very high. Unlike Ghana, a greater percentage of the South African respondents rated themselves as Very High (18%), High (7.8%), Moderate (10.2%), or Low (1%). Nobody rated their creativity or innovative skills as Very low.

Table 5.27 Creativity /innovation (N=167)

Thinking skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Creativity /innovation	Very Low (VL)	Count	2	4	8	9	0	9	15
		%Country	2.1	4.2	6.3	12.7	0	12.7	-
		% Total	1.2%	2.4%	3.6	5.4%	0.0%	0.0	9.0%
	Low (A)	Count	10	10	20	0	2	0.0	22
		%Country	10.4	10.4	20.8	0	2.8	2.8	-
		% Total	6.0%	6.0%	12.0	0.0%	1.2%	1	13.2%
	Moderate (M)	Count	8	23	31	10	7	17	48
		%Country	8.3	24	32.3	14.1	9.9	24	-
		% Total	4.8%	13.8%	18.6	6.0%	4.2%	8.4	28.7%
	High (H)	Count	14	20	34	0	13	13	47
		%Country	14.6	20.8	35.4	0	18.3	18.3	-
		%Total	8.4%	12.0%	20.4	0.0%	7.8%	7.8	28.1%
	Very High (VH)	Count	4	1	5	20	10	30	35
		%Country	4.2	1.0	5.2	28.2	14.1	42.3	-
		% Total	2.4%	0.6%	3	12.0%	6.0%	18	21.0%
Total		Count	38	58	96	39	32	71	167
		%Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6%	100.0%

5.5.2.4 Personal skills

Personal skills also called soft or people skills in the context of this study are attributes needed by library staff to thrive in the 4IR era. Some of these skills include lifelong learning, communicating technologically, leadership, people management, emotional intelligence, negotiation, embracing and adaptability, active listening with a growth mindset, judgment, and decision-making skills.

The following shows the personal skills of respondents.

5.5.2.4.1 Lifelong learning skills

Lifelong learning is one of the compelling personal skills that library staff need to sustain the unprecedented demand caused by the 4IR. “In the 4IR, lifelong learning will be the rule, not the exception” (Gladstone, 2018). Table 5.28 reflects positive results from both academic libraries. However, in comparison, responses from South Africa show more positive 69 (35 High; 34 Very

High) out of 71 representing 97.2%. From Ghana, 61 (38 High; 23 Very High) out of 96 respondents representing 63% show positive responses. Even though responses from both countries signify positive, that of South Africa are more skewed to positive than those from Ghana.

Table 5.28 Lifelong learning skills (N=167)

Personal Skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Lifelong learning skills	Very Low (VL)	Count	0	2	2	0	0	0	2
		% Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.1	0.0%	0.0%	0.0	1.2%
	Low (A)	Count	0	3	3	0	0	0	3
		% Country	0	3.1	3.1	0	0	0	-
		% Total	0.0%	1.8%	1.8	0.0%	0.0%	0.0	1.8%
	Moderate (M)	Count	8	22	30	0	2	2	32
		% Country	8.3	22.9	31.2	0	2.8	2.8	-
		% Total	4.8%	13.2%	18	0.0%	1.2%	1.2	19.2%
	High (H)	Count	11	27	38	20	15	35	73
		% Country	11.5	28.1	39.6	28.2	21.1	49.3	-
		% Total	6.6%	16.2%	22.8	12.0%	9.0%	21	43.7%
Very High (VH)	Count	19	4	23	19	15	34	57	
	% Country	19.8	4.2	24	26.8	21.1	47.9	-	
	% Total	11.4%	2.4%	13.8	11.4%	9.0%	20.4	34.1%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

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5.5.2.4.2 Communicating technologically

Another skill needed for the 4IR is the ability to communicate technologically as it is the gateway to exchanging and receiving information, as well as executing tasks. Table 5.29 shows that 49 Ghanaian librarians, rated their abilities as High, followed by 26 with Moderate skills. South African librarians rated their skills as Very High (22.8%), High (18.6%), and Moderate (1.2%) indicating that they regarded their skills to communicate technologically better than the Ghanaians.

Table 5.29 Communicate technologically (N=167)

Personal Skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Communicate technologically	Very Low (VL)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0.0	1.2%
	Low (A)	Count	0	5	0.5	0	0	0.0	5
		%Country	0	5.2	5.2	0	0	0	-
		% Total	0.0%	3.0%	3.0	0.0%	0.0%	0.0	3.0%
	Moderate (M)	Count	7	19	26	0	2	2	28
		%Country	7.3	19.8	27.1	0	2.8	2.8	-
		% Total	4.2%	11.4%	15.6	0.0%	1.2%	1.2	16.8%
	High (H)	Count	24	25	49	19	12	31	80
		%Country	25	26	51	26.8	12.5	39.3	-
		% Total	14.4%	15.0%	29.4	11.4%	7.2%	18.6	47.9%
	Very High (VH)	Count	7	7	14	20	18	38	52
		%Country	7.3	7.3	14.6	28.2	25.4	53.6	-
		% Total	4.2%	4.2%	8.4	12.0%	10.8%	22.8	31.1%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.4.3 Leadership or people management skills

Leadership or people management skills are vital for library staff in the 4IR as these skills are needed to act as a team leader and inspire others to work assiduously to generate new ideas to solve emerging problems. As expressed in Table 5.30, 48.5% of librarians from both Ghana and South Africa rated their leadership or people management skills as High and 29.3% as Very High. This shows that most respondents are positive about leading and managing others.

Table 5.30 Leadership skills/people management (N=167)

Personal Skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Leadership skills/people management	Very Low (VL)	Count	0	4	4	0	0	0	4
		%Country	0	4.2	4.2	0	0		-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0	2.4%
	Low (A)	Count	0	4	4	0	0	0	4
		%Country	0	4.2	4.2	0	0	0	-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0%	2.4%
	Moderate (M)	Count	6	13	19	10	0	10	29
		%Country	6	6.25	12.25	14.1	0	14.1	-
		% Total	3.6%	7.8%	11.4	6.0%	0.0%	6.0	17.4%
	High (H)	Count	14	31	45	20	16	36	81
		%Country	14.6	32.3	46.0	28.2	22.5	50.7	-
		% Total	8.4%	18.6%	27	12.0%	9.6%	21.6	48.5%
Very High (VH)	Count	18	6	24	9	16	25	49	
	%Country	18.8	6.25	25.1	12.7	22.5	35.2	-	
	% Total	10.8%	3.6%	14.4	5.4%	9.6%	15	29.3%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.4.4 Emotional intelligence

Another imperative skill needed by library staff for the 4IR is emotional intelligence as it implies having empathy, integrity, and the ability to work with others. As indicated in Table 5.31, all the respondents (71) rated their emotional intelligence as High (45) or Very High (26), while 54 from Ghana rated themselves as High (54) or Very High (12).

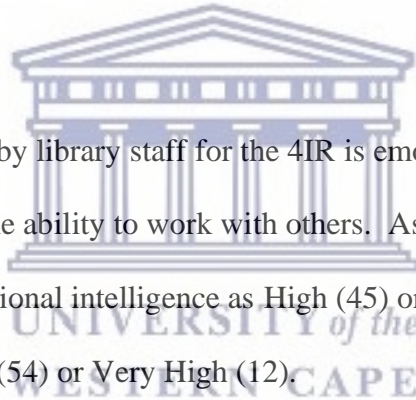


Table 5.31 Emotional intelligence (N=167)

Personal Skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Emotional intelligence	Very Low (VL)	Count	0	1	1	0	0	0	1
		%Country	0	1.0	1.0	0	0	0	-
		% Total	0.0%	0.6%	0.6	0.0%	0.0%	0.0	0.6%
	Low (A)	Count	1	6	7	0	0	0	7
		%Country	1.0	6.3	7.3	0	0	0	-
		% Total	0.6%	3.6%	4.2	0.0%	0.0%	0.0	4.2%
	Moderate (M)	Count	8	14	22	0	0	0	22
		%Country	8.3	14.6	22.9	0	0	0	-
		% Total	4.8%	8.4%	13.2	0.0%	0.0%	0.0	13.2%
	High (H)	Count	22	32	54	20	25	45	99
		%Country	22.9	33.3	56.2	28.1	35.2	63.3	
		% Total	13.2%	19.2%	32.4	12.0%	15.0%	27	59.3%
	Very High (VH)	Count	7	5	12	19	7	26	38
		%Country	7.3	5.2	12.5	26.8	9.9	36.7	
		% Total	4.2%	3.0%	7.2	11.4%	4.2%	15.6	22.8%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.4.5 Negotiation skills

Negotiation skills are needed in the 4IR to gain, in particular, better funding deals for the working force to thrive and to effectively apply limited funds for 4IR technologies and applications to enhance library services. Against this background, most (41.4%) South African respondents rated themselves as High (31.8%) or Very high (9.6%) while 37.8% of respondents from Ghana rated themselves as High (26.4%) or Very High (11.4%). Details are summarized in Table 5.32.

Table 5.32 Negotiation skills (N=167)

			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Negotiation skills	Very Low (VL)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0.0	1.2%
	Low (A)	Count	4	3	7	0	0	0	7
		%Country	4.2	3.1	7.3	0	0	0	-
		% Total	2.4%	1.8%	4.2	0.0%	0.0%	0.0%	4.2%
	Moderate (M)	Count	6	18	21	0	2	2	26
		%Country	6.3	18.8	25.1	0	2.8	2.8	-
		% Total	3.6%	10.8%	14.4	0.0%	1.2%	1.2	15.6%
	High (H)	Count	15	29	44	30	23	53	97
		%Country	15.6	30.2	45.8	42.3	32.4	74.7	-
		% Total	9.0%	17.4%	26.4	18.0%	13.8%	31.8	58.1%
Very High (VH)	Count	13	6	19	9	7	17	35	
	%Country	13.5	6.3	19.8	12.7	9.9	35.3	-	
	% Total	7.8%	3.6%	11.4	5.4%	4.2%	9.6	21.0%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.4.6 Embracing and adaptability skills

Embracing and adaptability skills are core skills needed by library staff to survive due to the disruptive changes caused by the 4IR. Individuals who see change not as a burden but as a golden opportunity to grow, are needed. The rating of these skills are expressed in Table 5.33. From Ghana, eighteen (10.8%) of the respondents rated themselves as Very high, 51 (30.6%) as High, twenty (12%) as Moderate, six (3.6%) as Low, and one (0.6%) as Very low. The majority of respondents 55 (33%) from South Africa rated their skills as High, followed by ten (6%) who indicated Moderate and six (3.3%) as Very high.

Table 5.33 Embracing and adaptability skills (N=167)

Personal Skills			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Embracing and adaptability skills	Very Low (VL)	Count	0	1	1	0	0	0	1
		%Country	0	1.0	1.0	0	0	0	-
		% Total	0.0%	0.6%	0.6	0.0%	0.0%	0.0	0.6%
	Low (A)	Count	2	4	6	0	0	0	6
		%Country	2.1	4.2	6.3	0	0	0	-
		% Total	1.2%	2.4%	3.6	0.0%	0.0%	0.0	3.6%
	Moderate (M)	Count	5	15	20	10	0	10	30
		%Country	5.2	15.6	20.8	14.1	0	14.1	--
		% Total	3.0%	9.0%	12	6.0%	0.0%	6.0	18.0%
	High (H)	Count	15	36	51	29	26	55	106
		%Country	15.6	37.5	52.5	40.8	36.6	77.4	-
		% Total	9.0%	21.6%	30.6	17.4%	15.6%	33	63.5%
	Very High (VH)	Count	16	2	18	0	6	6	24
		%Country	16.7	2.1	18.8	0	6.3	6.3	-
		% Total	9.6%	1.2%	10.8	0.0%	3.6%	3.6	14.4%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.4.7 Active listening with a growth mindset

Another compelling skill for the 4IR is active listening with a growth mindset. Individuals with a growth mindset appreciate the fact that their abilities need to be developed from time to time to obtain higher achievement. From Ghana, 37 (38.5%) librarians rated their skills in active listening with a growth mindset as Moderate, 32 (33.3%) as High, and 27 (28.1%) as Very high. Similar positive responses were recorded from respondents from South Africa with the majority 30 (18%) rating themselves as High, twenty-one (12.6%) as Very high, fifteen (8.0%) as Moderate, and five (3%) as Very low. Details are reflected in Figure 5.18.

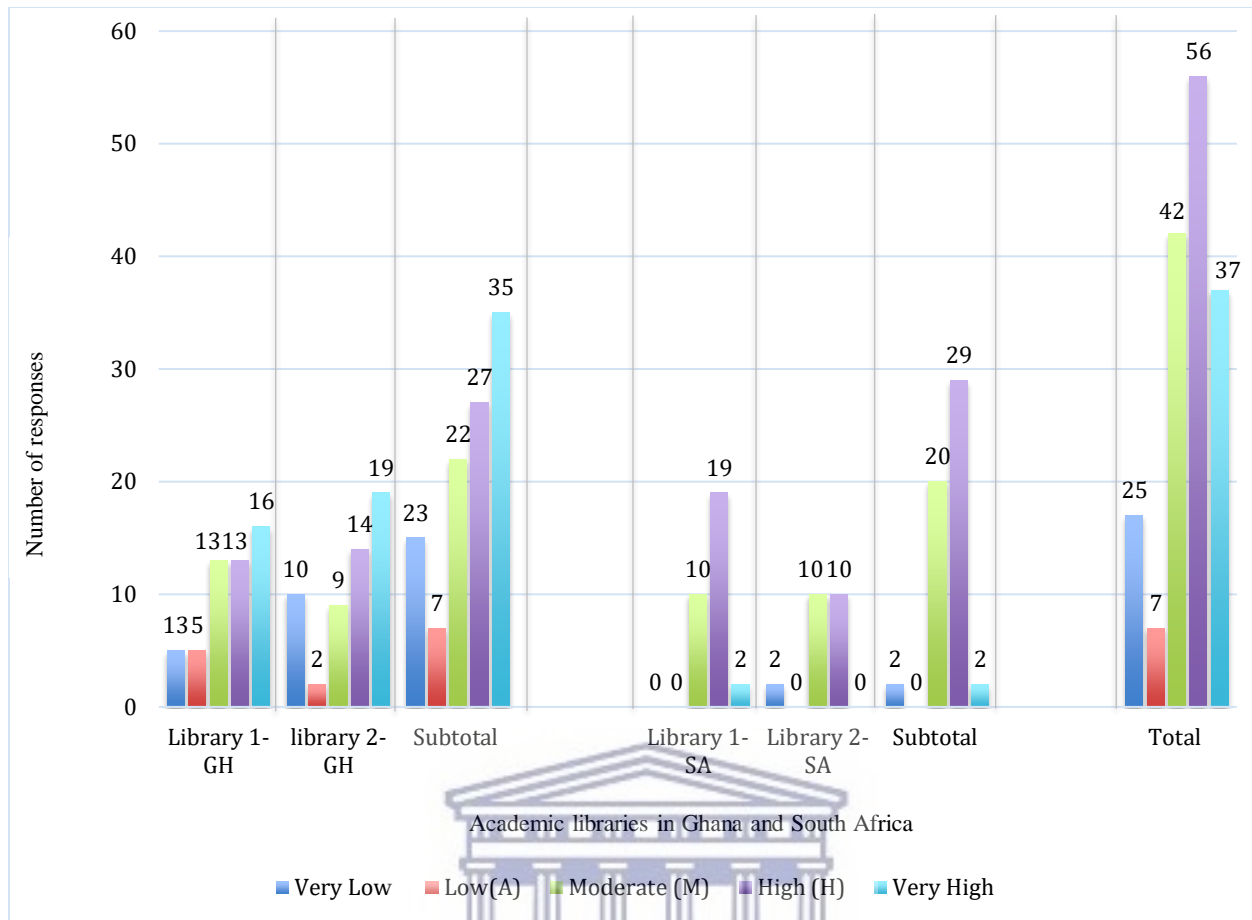


Figure 5.18 Active listening with a growth mindset (N=167)

5.5.2.4.8 Judgmental decision making

Good judgmental decisions are cardinal for library staff during the 4IR. For instance, the library would have to decide on what best Lib 4.0 technology to invest their limited resource in and to determine employees with the right skillset. Librarians from Ghana rated their judgmental decision-making skills as Very high (36.5%) and High (28.1%), Moderate (23%), Low (7.3%), and Very low (15.6%). From South Africa, as follows; 43.7% (29 High; 2 Very High) represents the majority and follow by 28.2% (20 Moderate) out of the 71 total respondents. This result is an indication that library staff from Ghana have good judgment and decision makings skills than

South Africa even though both results were positively skewed. Details of responses are indicated in Figure 5.19.

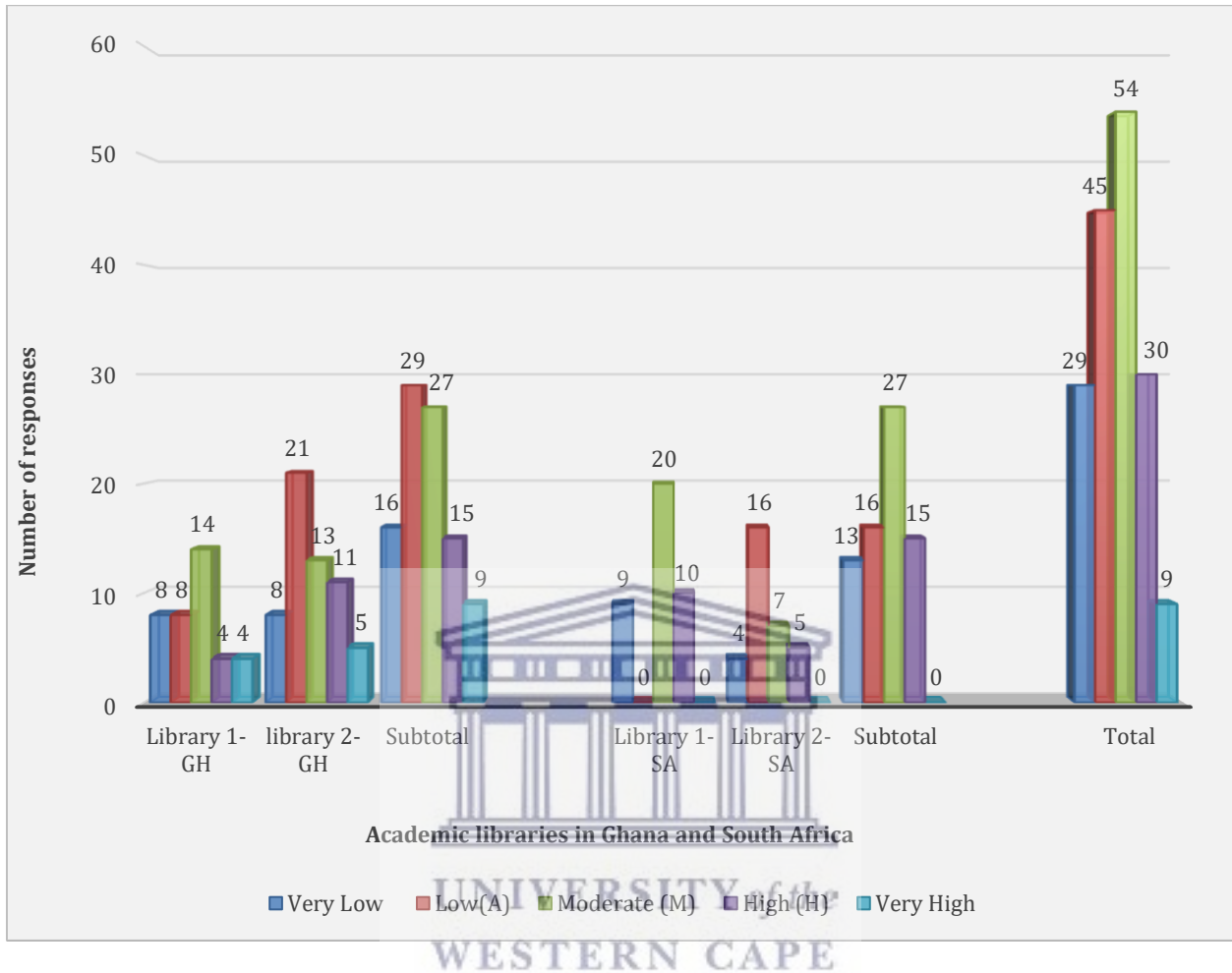


Figure 5.19 Judgmental and decision making (N=167)

5.5.2.5 Data analysis

The disruptive changes caused by the 4IR require working staff to possess the ability to analyze complex data. “Not everyone needs to be a data scientist, but everyone needs to be data literate” as asserted by Jordan Morrow the head of data literacy at analytics firm Qlik (Herbert, 2020). To stay needed, library staff must have the necessary skill-sets to analyze and interpret data in a

meaningful way as well as the ability to assist patrons to do so. Eight questions were used to determine the data scientist's talent capabilities and are reflected below.

5.5.2.5.1 Ability to identify patterns of data

Library staff in one way or another other is required to analyze data in diverse forms, therefore, respondents were asked to rate their ability to identify patterns of data. As depicted in Table 5.34, 44 (26.4%) representing the majority of the Ghanaian respondents rated their ability to identify patterns of data as High, followed by 32 (19.2%) as Moderate. South Africans rated their ability as High (25.8%) and Very High (10.2%). Only eleven (6.6%) rated their skills as Moderate.

Table 5.34: Ability to identify patterns of data (N=167)

Data analysis		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
The ability to identify patterns of data	Very Low (VL)	Count	2	3	6	0	0	5	
		%Country	2.1	3.1	5.1	0	0	-	
		% Total	1.2%	1.8%	3	0.0%	0.0%	0.0	3.0%
	Low (A)	Count	4	7	11	0	0	0	11
		%Country	4.1	7.3	11.4	0	0	0	-
		% Total	2.4%	4.2%	6.6	0.0%	0.0%	0.0	6.6%
	Moderate (M)	Count	10	22	32	0	11	11	43
		%Country	10.4	22.9	33.3	0	15.5	15.5	-
		% Total	6.0%	13.2%	19.2	0.0%	6.6%	6.6	25.7%
	High (H)	Count	18	26	44	29	14	43	87
		%Country	18.8	27.1	26.8	30.2	14.6	44.8	-
		% Total	10.8%	15.6%	26.4	17.4%	8.4%	25.8	52.1%
Very High (VH)	Count	4	0	4	10	7	17	21	
	%Country	4.2	0	4.2	14.1	7.3	21.4	-	
	% Total	2.4%	0.0%	2.4	6.0%	4.2%	10.2	12.6%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.5.2 Context and intelligence

Table 5.35 shows in detail the respondents' ability to apply context and intelligence. The majority (50.4%) of librarians from both countries rated their abilities as High (Ghana 21%; South Africa 29.4%).

Table 5.35: Context and intelligence (N=167)

Data analysis			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Context and intelligence	Very Low (VL)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0.0	1.2%
	Low (A)	Count	5	13	18	0	2	2	20
		%Country	5.2	13.5	18.7	0	2.8	2.8	-
		% Total	3.0%	7.8%	10.8	0.0%	1.2%	1.2	12.0%
	Moderate (M)	Count	9	20	29	9	3	12	41
		%Country	9.4	20.8	30.2	12.7	4.2	16.9	-
		% Total	5.4%	12.0%	17.4	5.4%	1.8%	7.2	24.6%
	High (H)	Count	14	21	35	30	19	49	84
		%Country	14.6	21.9	36.5	42.3	26.8	69.1	-
		% Total	8.4%	12.6%	21	18.0%	11.4%	29.4	50.4%
Very High (VH)	Count	10	2	12	0	8	8	20	
	%Country	10.4	2.1	12.5	0	11.3	11.3	-	
	% Total	6.0%	1.2%	7.1	0.0%	4.8%	4.8	12.0%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%



5.5.2.5.3 Complex data and retrieval skills

Librarians need to be able to evaluate complex data and possess retrieval skills to locate relevant information from a large volume of data, draw conclusions and take appropriate actions. Analyzing big data will be a common task to be presented to librarians. As shown in Table 5.36, 36 (21.6%) of respondents from Ghana regarded their ability as High, 30 (18%) as Moderate, sixteen (9.6%) as Low, and four (2.4%) as Very low. A considerable number of South African respondents rated their ability as Moderate (27) as Moderate, but still, many as High (12) or Very high (30). It can be seen that while the result from Ghana and South Africa were skewing positive.

Table 5.36 Complex data and document findings (N=167)

Data scientist's talent capabilities		Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total	
Evaluate complex data, retrieve complex data, draw conclusions, and take appropriate actions	Very Low (VL)	Count	0	4	4	0	0	4	
		%Country	0	4.2	4.2	0	0	0	-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0	2.4%
	Low (A)	Count	4	12	16	0	2	2	18
		%Country	4.2	12.5	16.7	0	2.8	2.8	-
		% Total	2.4%	7.2%	9.6	0.0%	1.2%	1.2	10.8%
	Moderate (M)	Count	10	20	30	19	8	27	57
		%Country	10.4	20.8	31.2	26.7	11.3	38	-
		% Total	6.0%	12.0%	18	11.4%	4.8%	16.2	34.1%
	High (H)	Count	16	20	36	0	12	12	48
		%Country	16.7	20.8	37.5	0	12.5	12.5	-
		% Total	9.6%	12.0%	21.6	0.0%	7.2%	7.2	28.7%
	Very High (VH)	Count	8	2	10	20	10	30	40
		%Country	8.3	2.1	10.4	28.2	14.1	42.3	-
		% Total	4.8%	1.2%	6	12.0%	6.0%	18	24.0%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.5.2.5.4 Extract relevant information hidden in large volumes of data

The ability to extract relevant information hidden in large volumes of data was assessed and the results are expressed in Table 5.37. From Ghana, a total of 46 librarians rated themselves as High (21.6%) and Very high (10.4%). Similarly, from South Africa, a greater portion of respondents (57) were rated as High (28.2%) and Very High (15.5%). A considerable number of librarians from Ghana (24) and South Africa (14) regarded their ability as Moderate.

Table 5.37 Extract relevant information hidden in large volumes of data (N=167)

Data scientist's talent capabilities		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
The ability to extract relevant information hidden in large volumes of data	Very Low (VL)	Count	0	5	5	0	0	5	
		%Country	0	5.2	5.2	0	0	0	-
		% Total	0.0%	3.0%	3.0	0.0%	0.0%	0	3.0%
	Low (A)	Count	3	9	12	0	0	0	12
		%Country	3.1	9.3	12.4	0	0	0	
		% Total	1.8%	5.4%	7.2	0.0%	0.0%	0.0	7.2%
	Moderate (M)	Count	6	18	24	10	4	14	38
		%Country	6.3	18.8	25.1	14.1	4.2	18.3	-
		% Total	3.6%	10.8%	14.4	6.0%	2.4%	26.7	22.8%
	High (H)	Count	17	24	41	9	18	27	68
		%Country	17.7	25	42.7	9.4	18.8	28.2	-
		% Total	10.2%	14.4%	24.6	5.4%	10.8%	16.2	40.7%
	Very High (VH)	Count	12	2	14	20	10	30	44
		%Country	12.5	2.1	27.1	1.4	14.1	15.5	-
		% Total	7.2%	1.2%	8.4	12.0%	6.0%	18	26.3%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42	100.0%

5.5.2.5.5 Design and implement data models and statistical methods

Librarians need the ability to design and implement data models and statistical methods. This is because the 4IR will require librarians to possess the skills to create sample/complex data and make predictions about the real world. As shown in Table 5.38, a greater number of respondents 42 (25.2%) from Ghana, rated their ability as Moderate, while 24 (14.4%) rated themselves as High. The number of respondents from South Africa who rated their ability as Moderate also drew large numbers 31 (18.6%) followed by 22 (13.2%) who rated their abilities as High. These results suggest that respondents from both countries rated their ability to design and implement data models and statistical methods as average.

Table 5.38 Design and implement data models and statistical methods (N=167)

Data scientist's talent capabilities			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
The ability to design and implement data models and statistical methods	Very Low (VL)	Count	4	7	12	0	2	2	13
		%Country	4.2	7.3	11.5	0	1.4	1.4	-
		% Total	2.4%	4.2%	6.6	0.0%	1.2%	1.2	7.8%
	Low (A)	Count	4	9	13	0	2	2	15
		%Country	4.2	9.4	13.6	0	1.4	1.4	-
		% Total	2.4%	5.4%	7.8	0.0%	1.2%	1.2	9.0%
	Moderate (M)	Count	10	32	42	19	12	31	73
		%Country	10.4	33.3	43.7	26.8	16.9	43.7	-
		% Total	6.0%	19.2%	25	11.4%	7.2%	18.6	43.7%
	High (H)	Count	14	10	39	0	14	19.7	38
		%Country	14.6	10.4	25	0	1.4	1.4	-
		% Total	8.4%	6.0%	14.4	0.0%	8.4%	8.4	22.8%
	Very High (VH)	Count	6	0	6	20	2	22	28
		%Country	6.3	0	6.3	28.2	2.8	31	-
		% Total	3.6%	0.0%	3.6	12.0%	1.2%	13.2	16.8%
Total	Count	38	58	96	39	32	71	167	
	% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%	

5.5.2.5.6 Integrate research and best practices

The ability to integrate research and best practices into problem avoidance and continuous improvement was evaluated. Research is one of the incredible functions of the library and their need for them will increase to apply findings to solve real-life problems, especially pertaining to information. Responses are captured in Figure 5.20. Responses indicate that the majority (48%) of Ghanaian librarians considered their skills as Moderate, while 31.0% (23.0% High; 8.3% Very high) rated their abilities as above average. In contrast, the majority of respondents from South Africa (81.2%) rated their abilities as High (38.0%) and Very High (43.7%).

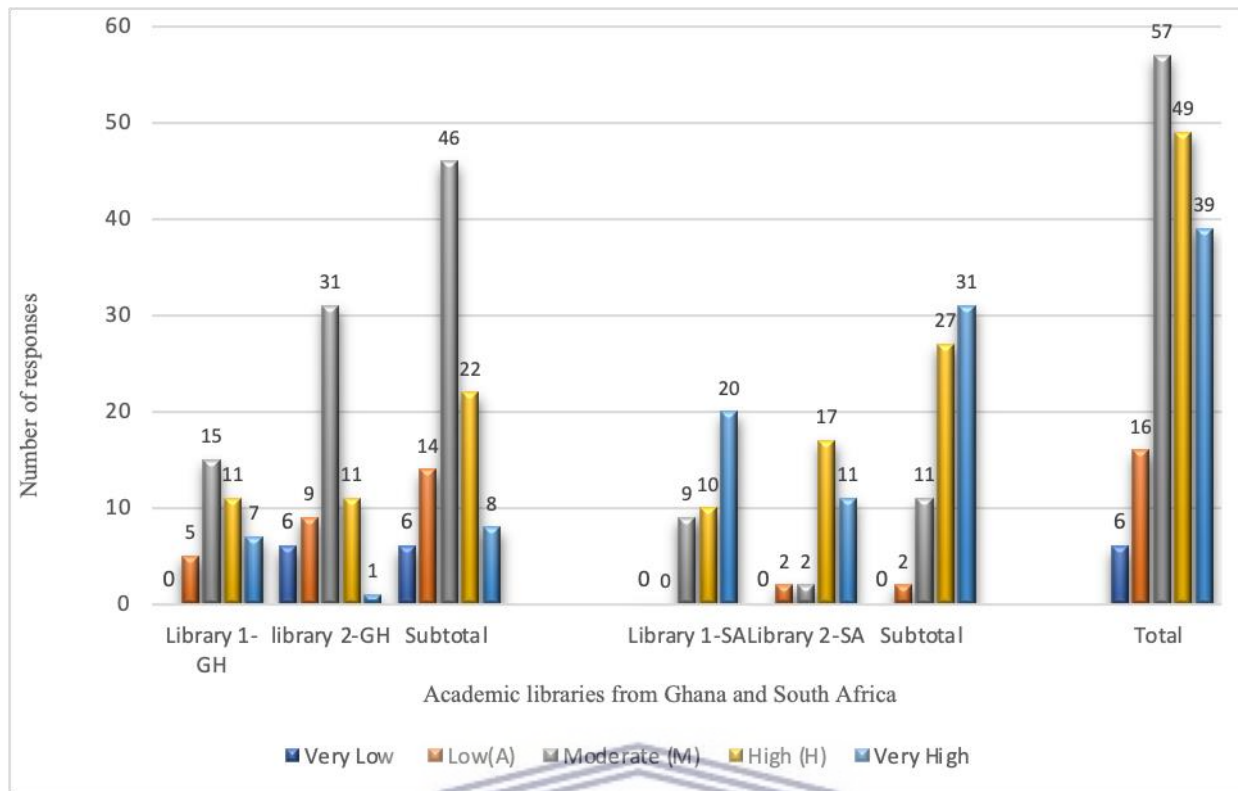


Figure 5.20 Integrate research and best practices (N=167)

5.5.2.5.7 Trend analysis

Trend analysis can be used to improve library services and usage using trend data to make informed decision-making. Figure 5.21 reveals the abilities of respondents to apply trend analysis. Responses reflect that more than half of the Ghanaian librarians (53.1%) rated their skills as moderate, followed by 25 (26.0%) rating themselves as High. Only seventeen (23.9%) South African librarians, however, rated their skills as Moderate, while 39.4% rated their skills as High and 21.15 as Very high.

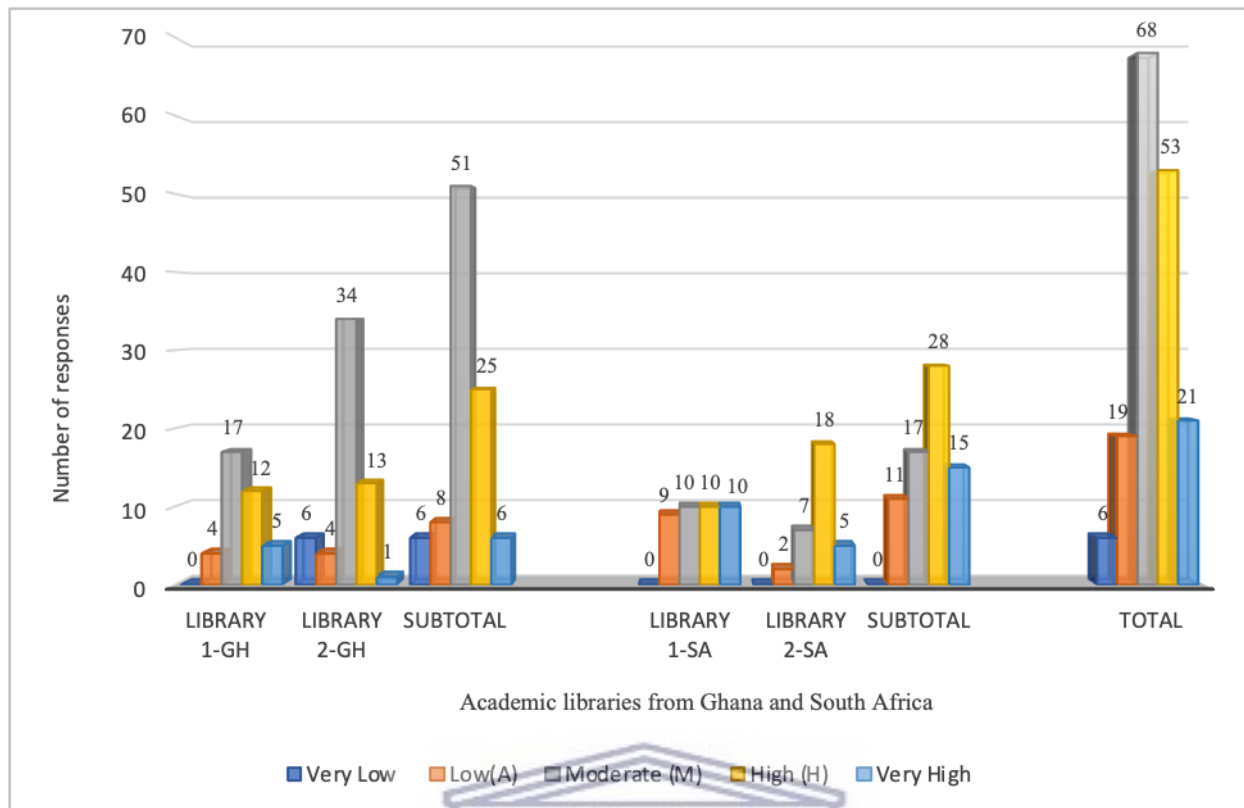


Figure 5.21 Trend analysis (N=167)

5.5.2.5.8 Digital content user interaction

As demonstrated in Figure 5.22, in response to rating their expertise to interact with values of digital content user interaction, 32 (19.2%) of respondents from Ghana rated their level of ability as High, while 30 (18.0%) considered their ability as Moderate. In comparison, 28 (16.7%) South Africans rated their abilities as Very High, and 21 (12.5%) as Moderate.

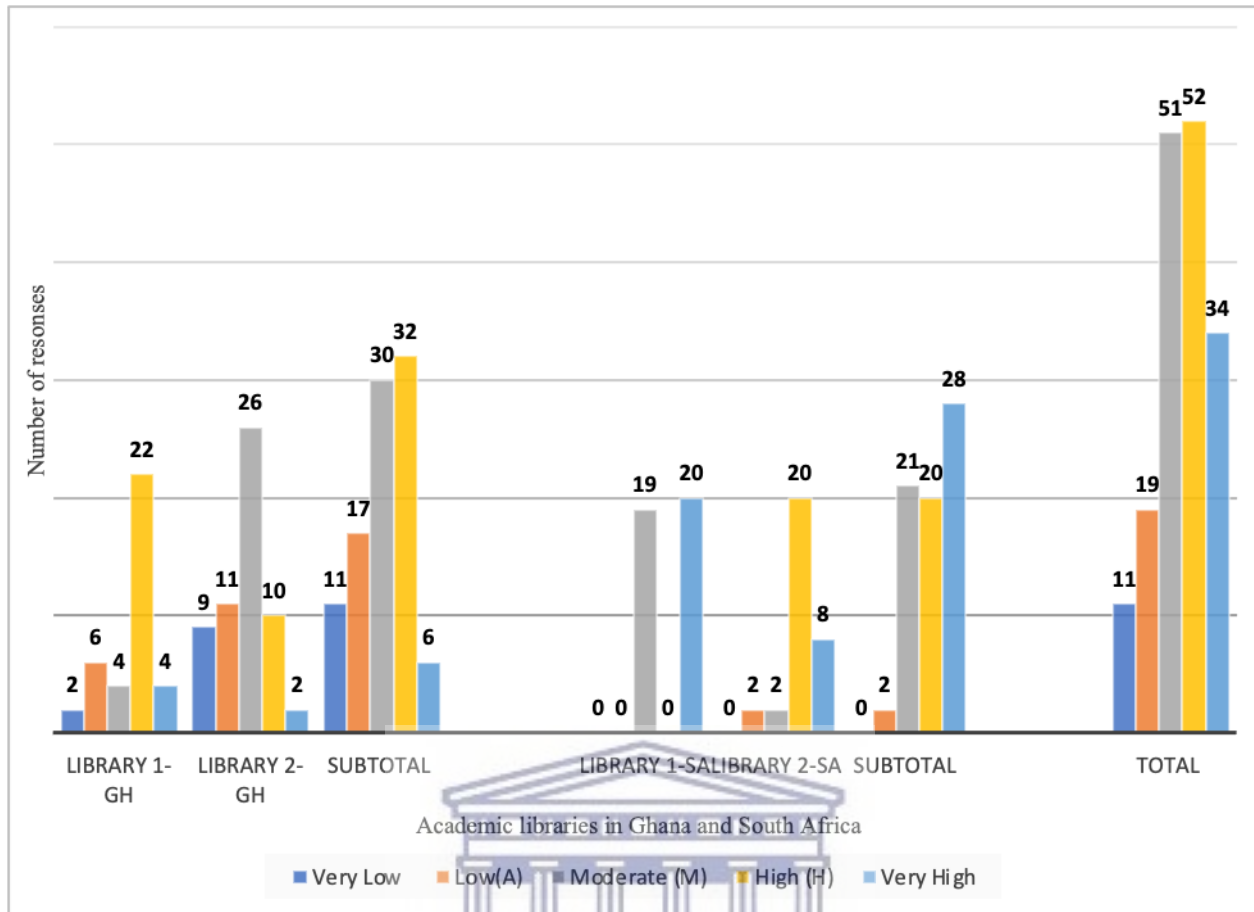


Figure 5.22 Digital content user interaction (N=167)

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5.5.3 The overall librarian's knowledge, skills, and competencies

The overall librarian's knowledge, skills, and competencies for each country were put together to obtain a general result. This was done by summing up the number of items.

The breakdown is shown below.

Number of items = 27

Likert scale used were; Very High = 5, High= 4, Moderate= 3, Low = 2, Very low = 1

If an individual respondent should score 5 throughout, the total score will be the number of items x 5

Therefore, = Very High= 27 X 5 = 135, High = 27 X 4= 108, Moderate =27 X 3= 81, Low= X
2=54 and Very Low = 27 X 1= 27

All individual results based on the Likert scale were computed and the results are shown in Tables 5.39 and 5.40

Table 5.39: Overall IT Skills of librarians- Ghana (N=96)

Ranking of responses	Score ranges	Freq	Percepts (100%)
Low level of IT skills and competencies	65 and below	60	62.5
Moderate level of IT skills and competencies	66-93	36	37.5
High level of IT skills and competencies	94- 135	-	-
Total		96	100

Table 5.40: Overall IT Skills of librarians- South Africa (N=71)

Ranking of responses	Score ranges	Freq	Percepts (100%)
Low level of IT skills and competencies	65 and below	23	32.4
Moderate level of IT skills and competencies	66-93	48	67.6
High level of IT skills and competencies	94- 135	-	-
Total		71	100

To sum up, Table 5.39 shows the overall responses from Ghana on the level of IT skills and competencies needed in the 4IR. The results show that 60 (62.5%) out of the total respondents from Ghana have a low level of knowledge of IT skills and competencies needed for the 4IR and 36 (37.5%) indicated a moderate level of knowledge. As depicted in Table 5.40, 48 (67.6%) out of the total respondents from South Africa have a moderate level of IT skills and competencies needed for the 4IR, and 23 (32.4%) have a low level of competency. It can be inferred from these results that, there is a need for library staff to go through education and training, and retraining to acquire the necessary new skillset needed for them to utilize Lib 4.0 technologies and applications.

5.5.4 Computer proficiency skills

Several researchers such as Darko-Adjei (2018), Emily (2016), and Ankrah (2015) have confirmed that the computer proficiency skills of individuals are a determinant of their willingness to embrace and use any new IT application and tools. The level of computer literacy skills of librarians will affect the willingness to embrace the incorporation of 4IR technologies and their applications in the provision of library services. The reason is that without good computer proficiency skills, library staff will find it difficult learning new skill-sets required of them to bridge the skill gap consequently, this will slow down the implementation of 4IR technologies and applications. Given this, respondents were asked to indicate their level of computer proficiency skills. The results are depicted in Table 5.41.

Table 5.41: Level of Computer Proficiency skills of respondents (N=167)

Level of Computer Proficiency		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Beginner	Count	0	3	3	0	0	0	3
	%Country	0	3.1	3.1	0	0	0	-
	%Total	0.0%	1.8%	1.8%	0.0%	0.0%	0.0%	1.8
Intermediate	Count	12	30	42	20	4	24	66
	%Country	12.5	31.3	43.8	28.2	5.6	33.8	-
	%Total	7.2%	18.0%	25.2%	12.0%	2.4%	14.4%	39.5
Advanced	Count	26	12	38	19	12	31	69
	%Country	27.1	12.5	39.6	26.8	16.9	43.7	-
	%Total	15.6%	7.2%	22.8%	11.4%	7.2%	18.6%	41.3
Expert	Count	0	1	1	0	16	16	17
	%Country	0	1.0	1.0	0	22.5	22.5	-
	%Total	0.0%	0.6%	0.6%	0.0%	9.6%	9.6%	10.2
NR	Count	0	12	12	0	0	0	12
	%Country	0	12.5	12.5	0	0	0	-
	%Total	0.0%	7.2%	7.2%	0.0%	0.0%	0.0%	7.2
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

Table 5.41 reflects that the majority of the respondents 42(25.2%) from Ghana rated themselves as Intermediate, while 38 (22.8%), and three (1.8%) respectively rated themselves as Advanced and Beginner. Only one (0.6%) respondent rated her/himself as an Expert. Twelve (7.2%) did not

respond to the question. Responses from South Africa show that the majority of the responses rated their computer proficiency skills as Advanced. The rest of the ratings were 24 (14.4%) for Intermediate and sixteen (9.6%) for Expert. It can be inferred from the responses that South Africa library staff have higher computer proficiency than those in Ghana.

5.6 Challenges to incorporating 4IR in academic libraries

There are myriads of challenges that mitigate the incorporation of new IT applications and technologies, and this phenomenon is also evident in the quest to incorporate 4IR technologies and applications in academic libraries. This section sought to determine challenges experienced by library staff to incorporate 4IR technologies and applications.

5.6.1 Insufficient budget

Respondents were first asked about the insufficient budget for ICT infrastructure and network facilities. Table 5.42 shows that a total of 37.8% of Ghanaian respondents agree (23.4% Agree; 14.4 Strongly agree). The majority (21.6%) of South Africans disagreed, while 10.2% and 8.4% agreed and strongly agreed. From these results, it can be inferred that academic libraries in Ghana are more encumbered with the issue of inadequate ICT infrastructure and network faculties than those in South Africa.

Table 5.42 Insufficient budget (N=167)

Challenges:			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Insufficient budget for new ICT tools and equipment	Strongly Disagree (SD)	Count	1	3	3	0	0	0	4
		%Country	1.0	33.3	34.3	0	0	0	-
		% of Total	0.6	1.8	2.4	0.0	0.0	0.0	2.4%
	Disagree (D)	Count	3	13	16	20	16	36	52
		%Country	3.1	13.5	16.6	28.2	22.5	50.7	-
		% of Total	1.8%	7.8%	9.6	12.0%	9.6%	21.6	31.1%
	Neutral (N)	Count	5	8	13	0	4	4	17
		%Country	5.2	8.3	13.5	0	5.6	5.6	-
		% of Total	3.0%	4.8%	7.8	0.0%	2.4%	2.4	10.2%
	Agree (A)	Count	19	20	39	9	8	17	56
		%Country	19.8	20.8	40.6	12.7	11.3	24	-
		% of Total	11.4%	12.0%	23.4	5.4%	4.8%	10.2	33.5%
Strongly Agree (SA)	Count	10	14	24	10	4	14	38	
	%Country	10.4	14.6	25	14.1	5.7	19.8	-	
	% of Total	6.0%	8.4%	14.4	6.0%	2.4%	8.4	22.8%	
Total		Count	38	58	96	39	32	71	167
		% of Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.2 Inadequate ICT infrastructure & network facilities

Regarding inadequate ICT infrastructure and network facilities, the majority (39.6%) of the respondents from Ghana either agreed or strongly agreed. Unlike Ghana, responses from South Africa show that the majority (40.9%) disagreed. It can therefore be deduced that budgets for ICT infrastructure and network facilities are inadequate in all libraries, but that it is a bigger issue in academic libraries in Ghana.

Table 5.43 Inadequate infrastructure & network facility (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Inadequate infrastructure & network facility	Strongly Disagree (SD)	Count	1	6	7	0	0	0	7
		%Country	1.0	6.3	7.3	0	0	0	-
		% Total	0.6%	3.6%	4.2	0.0%	0.0%	0.0	4.2%
	Disagree (D)	Count	1	11	12	10	19	29	41
		%Country	1.0	11.5	12.5	14.1	26.8	40.9	-
		% Total	0.6%	6.6%	7.2	6.0%	11.4%	17.4	24.6%
	Neutral (N)	Count	5	6	11	10	6	16	27
		%Country	5.2	6.3	11.5	14.1	8.5	22.6	-
		% Total	3.0%	3.6%	6.6	6.0%	3.6%	9.6	16.2%
	Agree (A)	Count	16	26	42	19	5	24	66
		%Country	16.7	27.1	43.8	26.8	7.0	33.8	-
		% Total	9.6%	15.6%	25.2	11.4%	3.0%	14.4	39.5%
	Strongly Agree (SA)	Count	15	9	24	0	2	2	26
		%Country	15.6	9.4	25	0	2.8	2.8	-
		% Total	9.0%	5.4%	14.4	0.0%	1.2%	1.2	15.6%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%



5.6.3 Inadequate training

Inadequate training in ICT applications and emerging technology is a big issue facing academic libraries. Respondents were asked to respond to the statement about inadequate training. The results are reflected in Table 5.44. The majority of the Ghanaian respondents (39%) were in agreement. Likewise, 31.2% of respondents from South Africa agreed and strongly agreed. These results are indications that all libraries in both countries need more training on new ICT applications and technologies.

Table 5.44 Inadequate training (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-GH	Library 2-GH	Subtotal	Total
Inadequate training in ICT applications	Strongly Disagree (SD)	Count	0	0	0	0	2	2	2
		% Country	0	0	0	0	2.8	2.8	
		% of Total	0.0%	0.0%	0.0	0.0%	1.2%	1.2%	1.2%
	Disagree (D)	Count	2	13	14	19	23	42	57
		% Country	2.1	13.5	15.6	26.8	32.4	85.2	
		% of Total	1.2%	7.8%	9	11.4%	13.8%	25.2	34.1%
	Neutral (N)	Count	8	8	16	10	4	14	30
		% Country	8.3	8.3	16.6	14.1	5.6	19.7	
		% of Total	4.8%	4.8%	9.6	6.0%	2.4%	8.4	18.0%
	Agree (A)	Count	17	27	44	0	3	3	47
		% Country	17.7	28.1	45.8	0	4.2	4.2	
		% of Total	10.2%	16.2%	26.4	0.0%	1.8%	1.8	28.1%
Strongly Agree (SA)	Count	11	10	21	10	0	10	31	
	% Country	11.5	10.4	21.9	14.1	0	14.1	14.1	
	% of Total	6.6%	6.0%	12.6	6.0%	0.0%	6	18.6%	
Total		Count	38	58	96	39	32	71	167
		% of Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.4 Lack of ICT skill-set

Data was solicited on the issue of the lack of an ICT skillset to utilize Lib 4.0 technologies. Figure 5.23 shows that the majority (38.3%) of respondents from Ghana agreed and strongly agreed. In contrast, only 22.5% of respondents from South Africa agreed, while nobody agreed strongly. This depicts that there is more room for improvement in ICT skills needed by academic librarians in Ghana to utilize Lib 4.0 technologies as compared to their counterparts from South Africa.

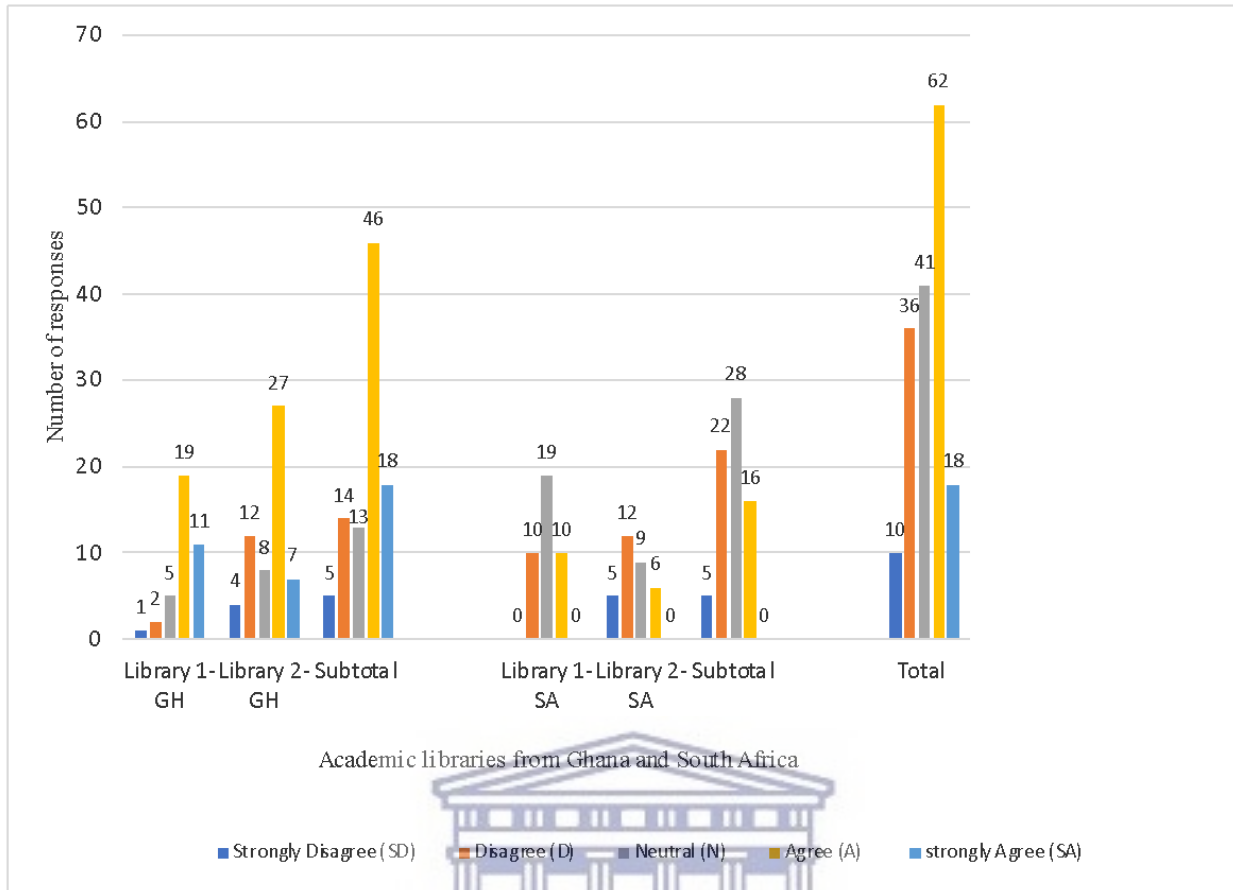


Figure 5.23 Lack of ICT skillset (N=167)

5.6.5 Lack of support from authorities

Figure 5.24 shows the results gathered regarding the lack of support from authorities for implementing ICT applications in the library. The majority of the respondents from Ghana (66) agreed and strongly agreed, while only twenty from South Africa agreed and strongly agreed.

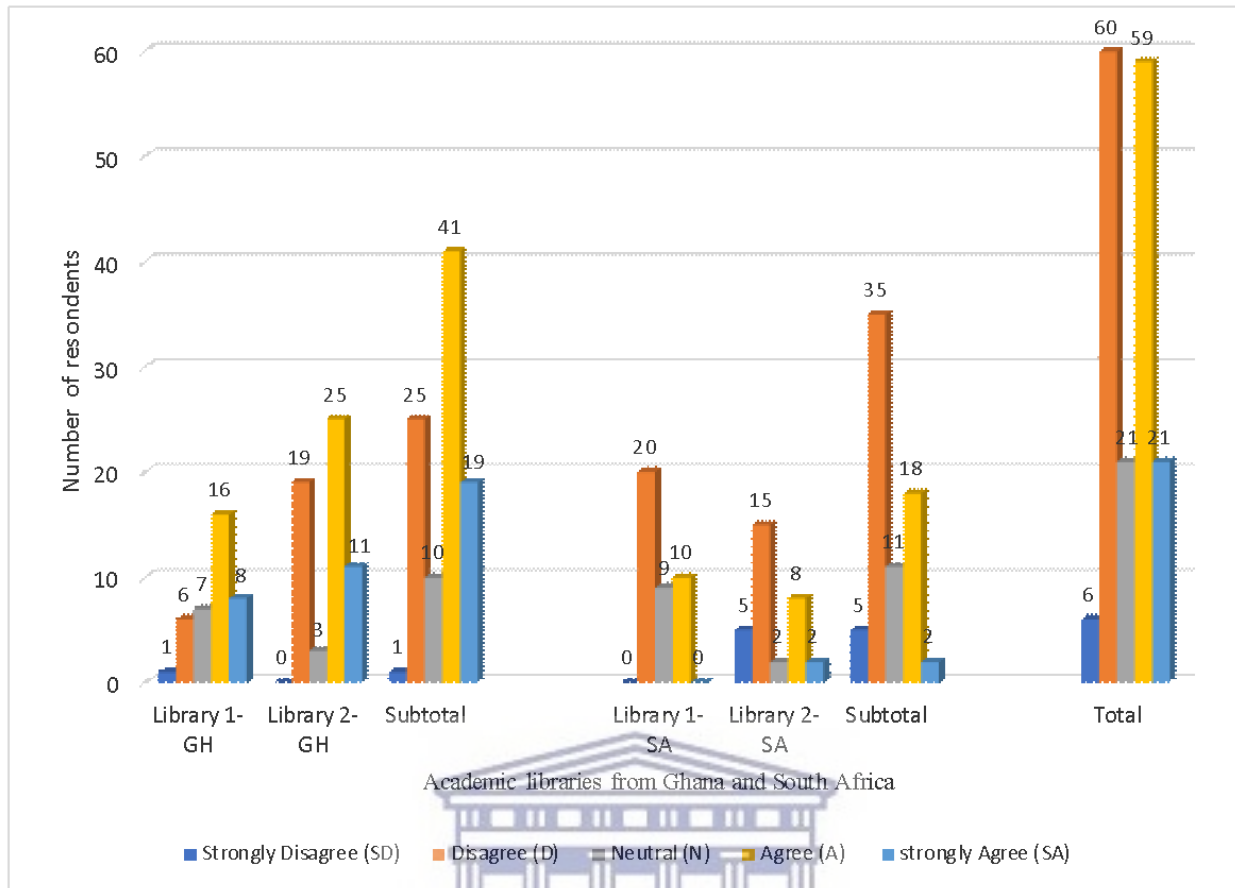


Figure 5.24 Lack of support (N=167)

5.6.6 Lack of staff motivation

Results on whether a lack of staff motivation was experienced are summarized in Table 5.45. Most participants from Ghana agreed (25.8%) or strongly agreed (12.6%). The majority (37.3%) of South Africans felt indifferent, while only 7% agreed and 3% strongly agreed. These responses are an indication that library staff in Ghana need more motivation to be able to excel in the era of 4IR than those in South Africa.

Table 5.45 Lack of staff motivation (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Challenges: Lack of staff motivation	Strongly Disagree (SD)	Count	1	4	5	0	13	13	18
		%Country	1.0	4.0	5.0	0	18.0	18.0	-
		% Total	0.6%	2.4%	3.0	0.0%	7.8%	7.8	10.8%
	Disagree (D)	Count	2	3	5	20	4	24	29
		%Country	2.1	3.1	5.2	28.2	6.0	34.2	-
		% Total	1.2%	1.8%	3.0	12.0%	2.4%	14.4	17.4%
	Neutral (N)	Count	12	10	22	19	8	27	49
		%Country	13.0	10.4	23.4	26.0	11.3	37.3	--
		% Total	7.2%	6.0%	13.2	11.4%	4.8%	16.2	29.3%
	Agree (A)	Count	18	25	43	0	5	5	48
		%Country	19.0	26.0	45.0	0	7.0	7.0	-
		% Total	10.8%	15.0%	25.8	0.0%	3.0%	3.0	28.7%
	Strongly Agree (SA)	Count	5	16	21	0	2	2	23
		%Country	5.2	17.0	22.5	0	3.0	3.0	-
		% Total	3.0%	9.6%	12.6	0.0%	1.2%	1.2	13.8%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.7 Fear of losing jobs

The statement “fear of losing my job due to emerging technologies” appeared not to be an issue among all the academic libraries in both countries. As indicated in Table 5.46, the majority of the respondents (53%) and (31.2%) from Ghana and South Africa respectively disagreed or agreed.

Table 5.46 Fear of losing a job (167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Fear of losing my job as new technology emerges	Strongly Disagree (SD)	Count	5	8	13	0	2	2	15
		%Country	5.2	8.3	13.5	0.0	3.0	3.0	-
		% Total	3.0%	4.8%	7.8	0.0%	1.2%	1.2	9.0%
	Disagree (D)	Count	13	25	38	20	14	34	72
		%Country	13.5	26.0	39.5	28.2	20.0	48.2	-
		% Total	7.8%	15.0%	22.8	12.0%	8.4%	20.4	43.1%
	Neutral (N)	Count	8	10	18	0	13	13	31
		%Country	8.3	10.4	18.7	0	18.0	18.0	-
		% Total	4.8%	6.0%	10.8	0.0%	7.8%	7.8	18.6%
	Agree (A)	Count	11	11	22	10	3	13	35
		%Country	11.5	11.5	23.0	14.1	4.2	18.3	-
		% Total	6.6%	6.6%	13.2	6.0%	1.8%	7.8	21.0%
	Strongly Agree (SA)	Count	1	4	5	9	0	9	14
		%Country	1.0	4.2	5.2	13.0	0	13.0	-
		% Total	0.6%	2.4%	3.0	5.4%	0.0%	5.4	8.4%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.8 Data infrastructure and incompatibility

Responses to the question regarding data infrastructure and incompatibility are summarized in Table 5.47. The majority (52.3%) of librarians from Ghana agreed or strongly agreed with the statement indicating that they have experienced data infrastructure and incapability. In contrast, 18.2% of South African librarians either agreed or strongly agreed.

Table 5.47 Data infrastructure and incompatibility (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Data infrastructure and incompatibility	Strongly Disagree (SD)	Count	1	1	2	0	0	0	2
		%Country	1.0	1.0	2.0	0	0	0	-
		% Total	0.6%	0.6%	1.2	0.0%	0.0%	0.0	1.2%
	Disagree (D)	Count	2	13	15	10	15	25	40
		%Country	2.1	14.0	16.1	14.0	20.3	24.3	-
		% Total	1.2%	7.8%	9.0	6.0%	9.0%	15.0	24.0%
	Neutral (N)	Count	12	17	29	19	13	32	61
		%Country	13.0	18.0	31.0	26.0	18.0	44.0	-
		% Total	7.2%	10.2%	17.4	11.4%	7.8%	19.2	36.5%
	Agree (A)	Count	20	23	43	10	2	12	55
		%Country	21.0	24.0	45.0	14.0	3.0	17.0	-
		% Total	12.0%	13.8%	25.8	6.0%	1.2%	7.2	32.9%
	Strongly Agree (SA)	Count	3	4	7	0	2	2	9
		%Country	3.1	4.2	7.3	0	3.0	3.0	-
		% Total	1.8%	2.4%	4.2	0.0%	1.2%	1.2	5.4%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	58.0	23.4%	19.2%	42.6	100.0%

5.6.9 Lack of co-ordination among library staff

As seen in Table 5.48, the majority of respondents (41.6%) from Ghana disagreed or strongly disagreed with the assertion of “lack of co-ordination among library staff”. Similarly, the majority of the respondents from South Africa (58.4%) also disagreed and strongly disagreed. It can be inferred from these results that the lack of coordination among staff is not a major issue among the various libraries in both countries.

Table 5.48 Lack of co-ordination among library staff (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Lack of coordination among library staff	Strongly Disagree (SD)	Count	3	4	7	10	8	18	25
		%Country	3.1	4.2	7.3	14.1	11.3	25.4	-
		% Total	1.8%	2.4%	4.2	6.0%	4.8%	10.8	15.0%
	Disagree (D)	Count	8	25	33	9	14	23	56
		%Country	8.3	26.0	34.3	13.0	20.0	33.0	-
		% Total	4.8%	15.0%	19.8	5.4%	8.4%	13.8	33.5%
	Neutral (N)	Count	11	10	21	10	10	20	41
		%Country	11.5	10.4	21.9	14.1	14.1	28.2	-
		% Total	6.6%	6.0%	12.6	6.0%	6.0%	12.0	24.6%
	Agree (A)	Count	13	14	17	10	0	10	37
		%Country	13.5	15.0	28.5	14.1	14.1	28.2	-
		% Total	7.8%	8.4%	16.2	6.0%	0.0%	6.0	22.2%
	Strongly Agree (SA)	Count	3	5	8	0	0	0	8
		%Country	3.1	5.2	8.3	0	0	0	-
		% Total	1.8%	3.0%	4.8	0.0%	0.0%	0	4.8%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.8 Non-availability of consultation services

The non-availability of consultation services on IT technical issues was explored and the results are captured in Table 5.49. Most respondents (34.1%) felt neutral. Still, 24% of respondents agreed with the statement suggesting the non-availability of consultation services on IT technical issues needs attention.

Table 5.49 Non-availability of consultation services (N=167)

Challenges		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
Non-availability of consultation services on IT technical issues	Strongly Disagree (SD)	Count	2	3	5	10	3	13	18
		% Country	2.1	3.1	5.2	14.1	4.2	18.3	-
		% Total	1.2%	1.8%	3.0	6.0%	1.8%	7.8	10.8%
	Disagree (D)	Count	3	17	20	0	15	15	35
		% Country	3.1	18.0	21.1	0	20.3	20.3	-
		% Total	1.8%	10.2%	12.0	0.0%	9.0%	9.0	21.0%
	Neutral (N)	Count	10	16	26	19	12	31	57
		% Country	10.4	17.0	27.4	26.0	17.0	43.0	-
		% Total	6.0%	9.6%	15.6	11.4%	7.2%	18.6	34.1%
	Agree (A)	Count	20	18	38	0	2	2	40
		% Country	21.0	19.0	40	0	3.0	3.0	-
		% Total	12.0%	10.8%	22.8	0.0%	1.2%	1.2	24.0%
Strongly Agree (SA)	Count	3	4	7	10	0	10	17	
	% Country	3.1	4.2	7.3	14.1	0	14.1	-	
	% Total	1.8%	2.4%	4.2	6.0%	0.0%	6.0	10.2%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.9 Lack of interest

Participants were asked to indicate their agreement with the lack of interest in newly adopted technologies. From Table 5.50 it can be seen that the majority of respondents from Ghana 24.6% (19.8% disagree; 4.8% strongly disagree) were not in favour of the assertion whiles 19.2% (15.6% agree; 3.6% strongly agree) reacted affirmatively. Also, the majority of South Africa librarians 22.2% (20.4% disagree; 1.8% strongly disagree) South Africa librarians objected to the assertion. These results signify that both countries are enthused with newly adopted technologies.

Table 5.50 Lack of interest (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Lack of interest in newly adopted technologies	Strongly Disagree (SD)	Count	4	4	8	0	3	3	11
		% Country	4.2	4.2	8.4	0	4.2	4.2	-
		% Total	2.4%	2.4%	4.8	0.0%	1.8%	1.8	6.6%
	Disagree (D)	Count	11	22	33	20	14	34	67
		% Country	11.5	23.0	34.5	28.2	20.0	48.2	-
		% Total	6.6%	13.2%	19.8	12.0%	8.4%	20.4	40.1%
	Neutral (N)	Count	15	8	23	19	10	29	52
		% Country	16.0	8.3	24.3	26.0	14.1	40.1	-
		% Total	9.0%	4.8%	13.8	11.4%	6.0%	17.4	31.1%
	Agree (A)	Count	7	19	26	0	5	5	31
		% Country	7.3	19.8	27.1	0	7.0	7.0	-
		% Total	4.2%	11.4%	15.6	0.0%	3.0%	3.0	18.6%
Strongly Agree (SA)	Count	1	5	6	0	0	0	6	
	% Country	1.0	5.2	6.2	0	0	0	-	
	% Total	0.6%	3.0%	3.6	0.0%	0.0%	0.0	3.6%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.6.10 Low priority in modern ICT

Responses to the assertion “low priority in modern ICT application and technologies” are captured in Table 5.51. The majority of Ghanaian librarians (22.8%) agreed and strongly agreed, while the majority of South African librarians (23.4%) disagreed and strongly disagreed. It can therefore be deduced that academic library staff from Ghana have more issues with prioritizing modern ICT applications and technologies than those in South Africa.

Table 5.51 Low priority in modern ICT (N=167)

Challenges			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Low priority in modern ICT applications and technologies	Strongly Disagree (SD)	Count	4	3	7	0	3	3	10
		%Country	4.2	3.1	7.3	0	4.2	4.2	-
		% Total	2.4%	1.8%	4.2	0.0%	1.8%	1.8	6.0%
	Disagree (D)	Count	9	18	27	20	16	36	63
		%Country	9.4	19.0	28.4	28.2	23.0	51.0	-
		% Total	5.4%	10.8%	16.2	12.0%	9.6%	21.6	37.7%
	Neutral (N)	Count	13	11	24	19	2	21	45
		%Country	13.5	11.5	25.0	14.1	3.0	17.1	-
		% Total	7.8%	6.6%	14.4	11.4%	1.2%	12.6	26.9%
	Agree (A)	Count	9	21	30	0	11	11	41
		%Country	9.4	22.0	31.4	0	15.5	15.5	-
		% Total	5.4%	12.6%	18.0	0.0%	6.6%	6.6	24.6%
	Strongly Agree (SA)	Count	3	5	8	0	0	0	8
		%Country	3.1	5.2	8.3	0	0	0	-
		% Total	1.8%	3.0%	4.8	0.0%	0.0%	0.0	4.8%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

To recapitulate, the findings revealed that libraries in both countries face common challenges, including limited budgets, inadequate ICT infrastructure, insufficient training, and a lack of ICT skillsets. However, certain distinctions between the two countries were observed.

Firstly, Ghanaian libraries exhibited a more pronounced issue with infrastructure and network facilities compared to those in South Africa, despite inadequate supply being a shared concern. Additionally, Ghanaian libraries reported a higher degree of challenges stemming from a lack of support from authorities in contrast to South African libraries.

Furthermore, in terms of staff motivation, a smaller proportion of respondents from Ghana indicated dissatisfaction, while the majority of respondents from South Africa expressed indifference. Moreover, respondents from Ghana tended to identify concerns related to fear of job loss, low prioritization of modern ICT, and a lack of interest as prominent challenges, whereas their South African counterparts differed in their responses.

Both countries, however, concurred on the lack of coordination among library staff, rating it as low, and shared neutral views on the availability of consultation services.

These findings provide valuable insights into the specific issues faced by libraries in Ghana and South Africa and underscore the importance of tailored strategies to address the challenges unique to each country's context.

5.7 Responsive structures needed and Policies

For the academic library which is the hub of every higher institution to stay active, abreast, and relevant to provide vital library services amidst the disruptive changes caused by the 4IR, it is important to have in place a responsive structure and policies (Schwab, 2016; Ahmat & Hanipah, 2017). This section assesses the responsive strategies and policies that academic libraries have in place for the 4IR.



5.7.1 Responsive structures needed

This section accentuates the propositions that emanated from socio-technical perspectives which state that to successfully incorporate any new technology, it is cardinal to consider both *social sub-systems* which encapsulate the behavioral individualities (people or actors and structure of the organization) and the *technical factors* (technology and tasks). This means to ascertain the level of preparedness of academic libraries for the 4IR, it is, therefore, imperative to evaluate these four critical variables in the library settings. Given this background, respondents were to indicate their level of agreement on the following sub-questions.

5.7.1.1 People

The human factor plays a pivotal role in determining the acceptance and use of 4IR technologies and applications. If academic libraries fail to prepare their staff adequately, there is a high propensity that utilizing and leveraging the opportunities brought by the 4IR will prove futile and consequently lead to failure to provide relevant library services in the digital epoch. The following analyses the human factor and in this case the library staff.

5.7.1.1.1 Well-skilled and experienced staff

As depicted in Figure 5.25, the majority (75) of the respondents from Ghana (30.5% Agree; 14.4% Strongly agreed) agreed with the statement “recruiting well-skilled and experienced staff”. More South African respondents (53) supported the statement (21.6% Agree; 14.4% Strongly agree). There is therefore a trend in both countries to employ highly skilled and experienced staff.



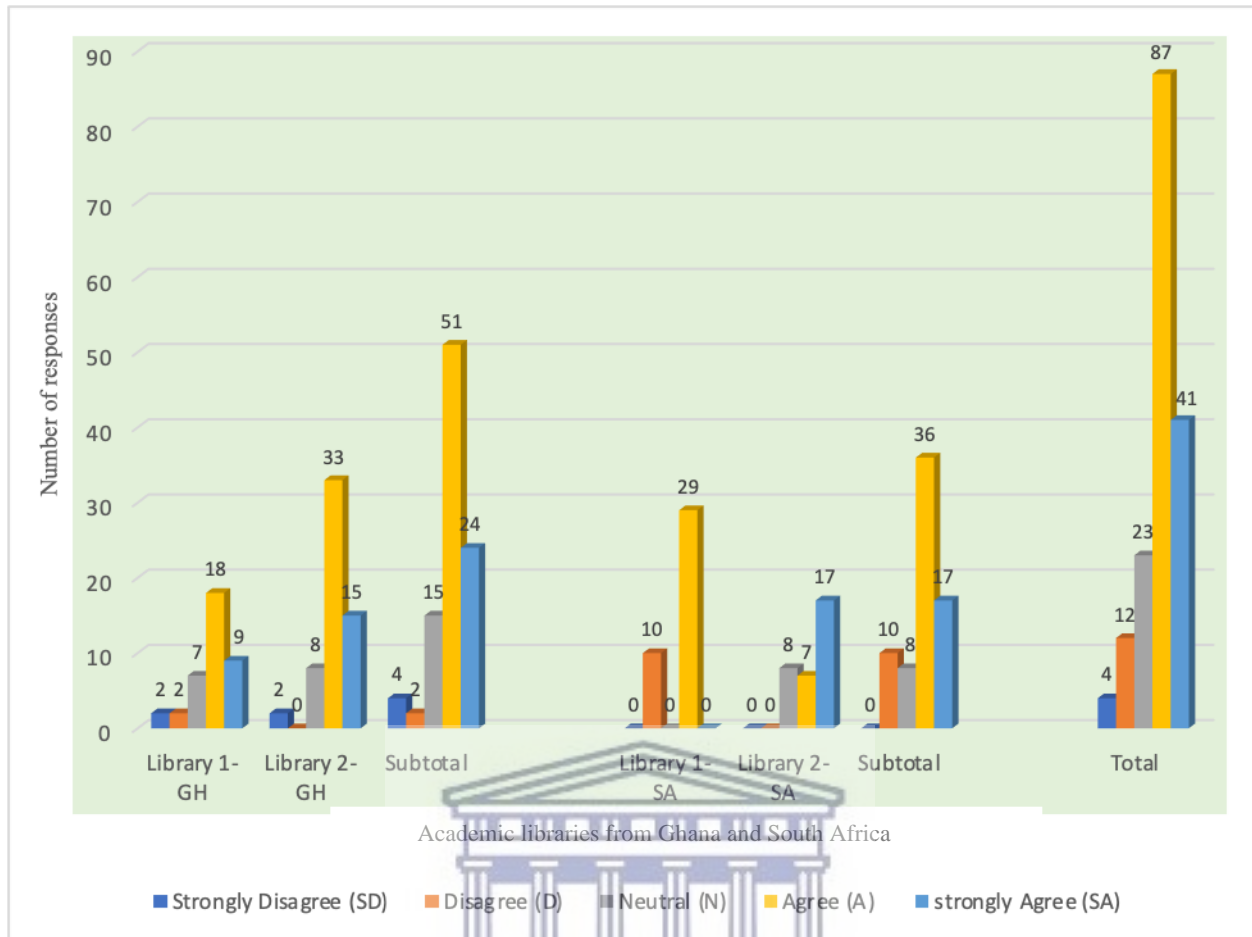


Figure 5.25 Well-skilled and experienced staff (N=167)

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5.7.1.1.2 Constant training

In response to the statement “constant training in newly adopted and emerging technologies to re-skill staff”, 88 Ghanaian respondents agreed and strongly agreed. Similarly, the majority of respondents (67) from South Africa agreed and strongly agreed. There is therefore a trend in both countries to constantly train academic library staff in newly adopted and emerging technologies.

Figure 5.26 reflects the details.

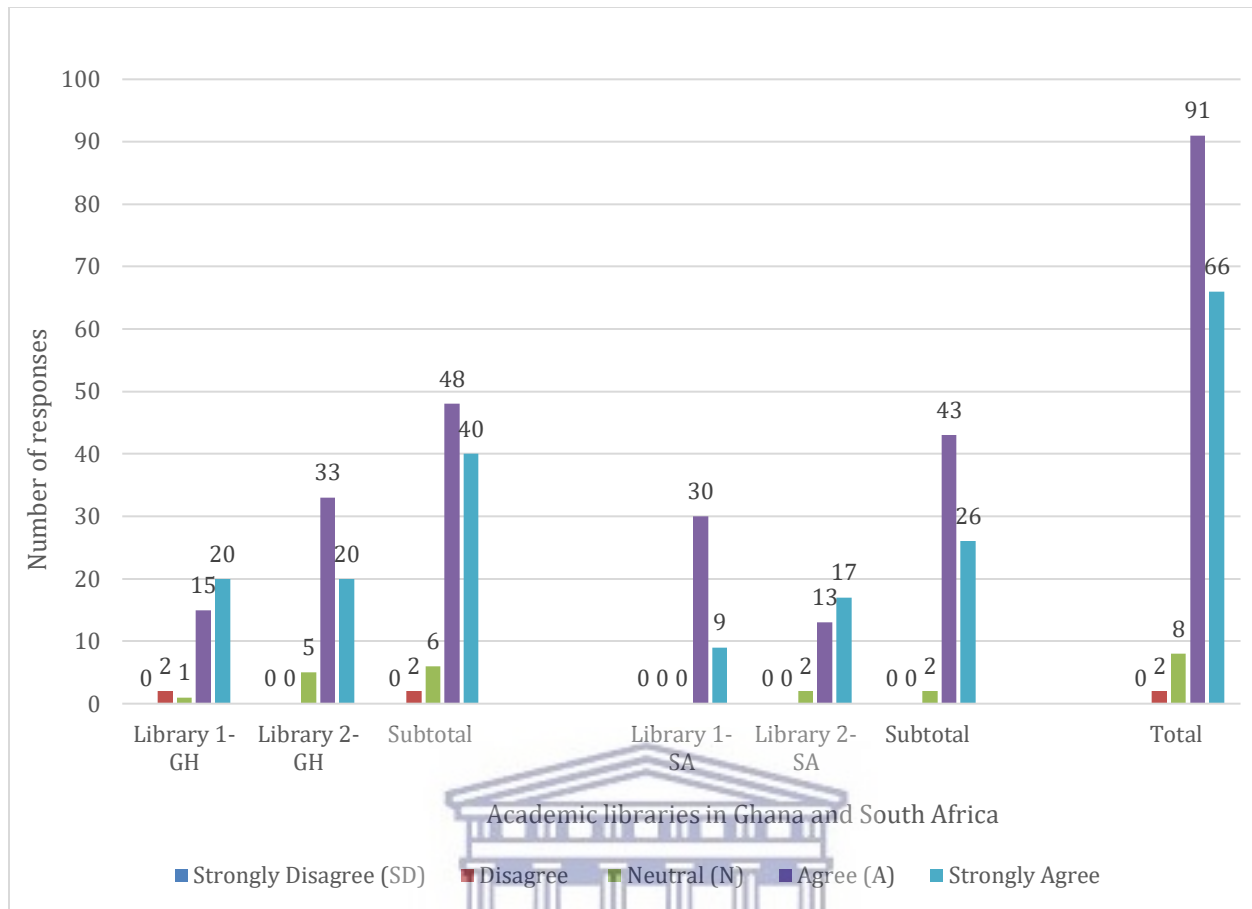


Figure 5.26 Constant training (N=167)

5.7.1.1.3 Good incentives

Figure 5.27 shows the responses to the assertion “good incentives to motivate staff to embrace new technologies and applications”. From Ghana 44.4% of librarians agreed and strongly agreed. Comparably, 46.5% of respondents from South Africa agreed and strongly agreed. Of concern is that 19.8% of South African librarians disagreed and strongly disagreed indicating problematic incentives.

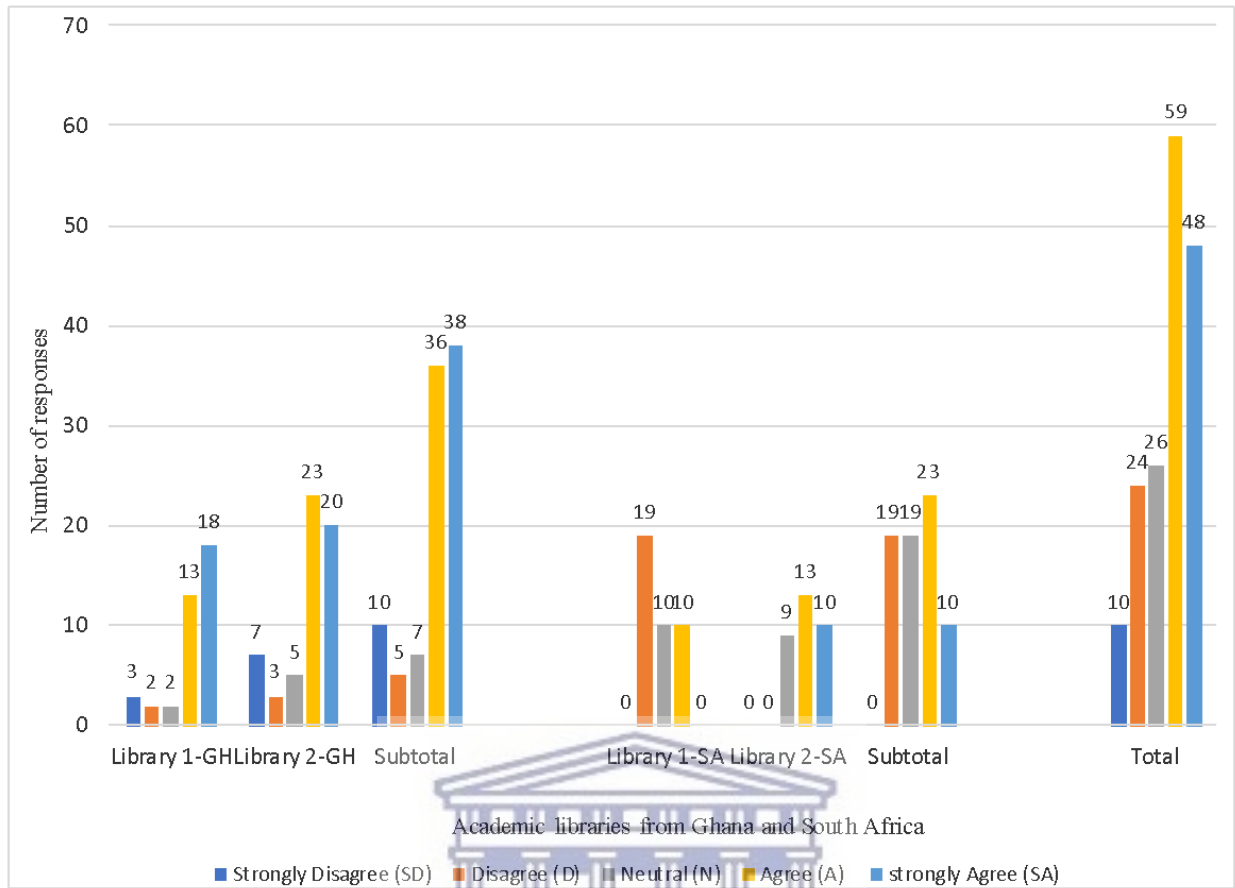


Figure 5.27 Good incentives (N=167)

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5.7.1.1.4 Periodic evaluation of staff attitude

Figure 5.28 reflects that 44.4% of Ghanaian respondents agreed and strongly agreed with the statement “periodic evaluation of staff attitude towards the usage of new technologies and applications”. Only 7.8% of respondents from South Africa strongly agreed indicating a need for periodically evaluating staff attitudes.

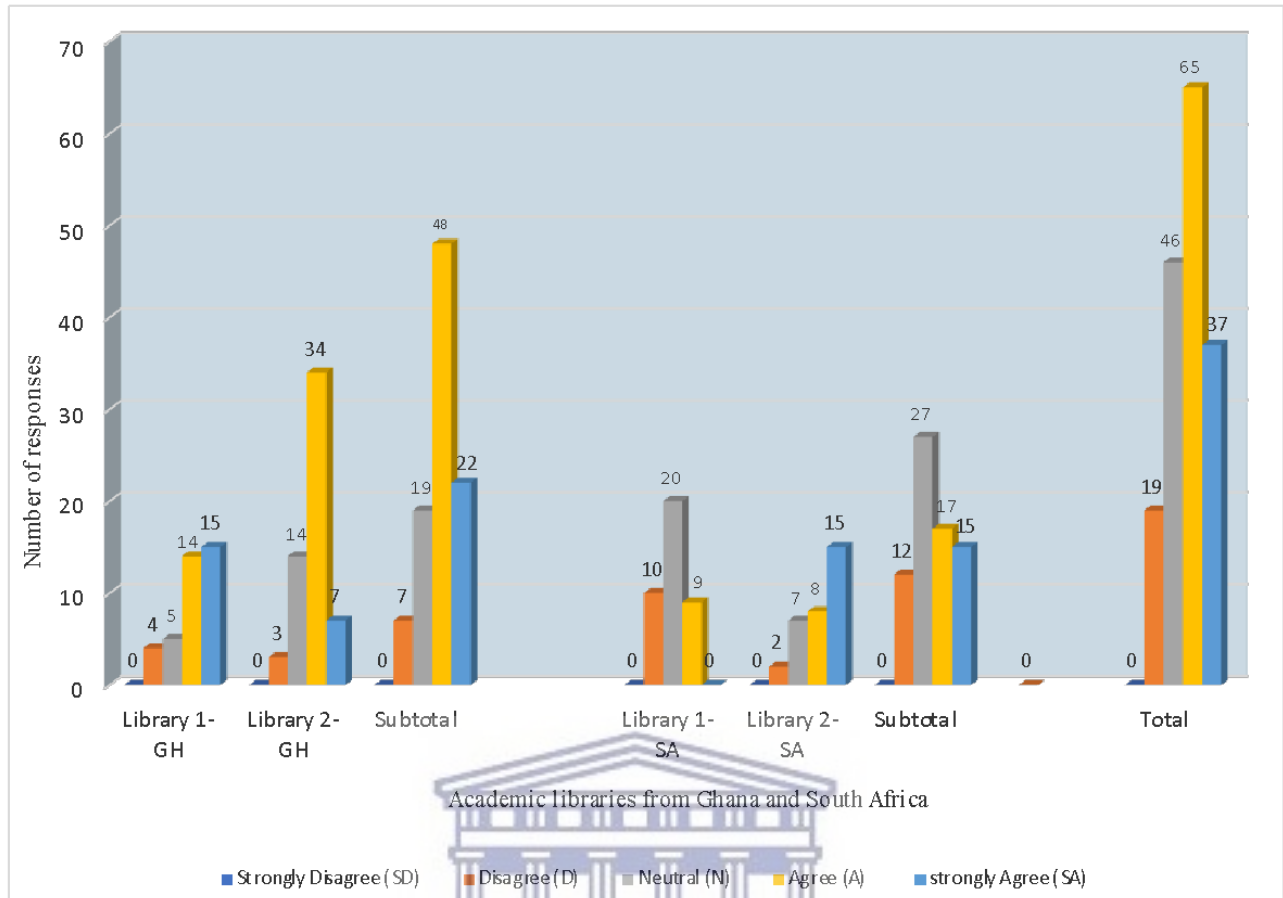


Figure 5.28 Periodic evaluation of staff attitude (N=167)

5.7.1.1.5 Creating mutual understanding statements

Figure 5.29 indicated that 70 respondents from Ghana agreed and strongly agreed with the assertion “creating mutual understanding statements to deal with 4IR challenges”. Nineteen librarians were unsure. Although 32 respondents from South Africa agreed and strongly agreed, 27 respondents felt undecided.

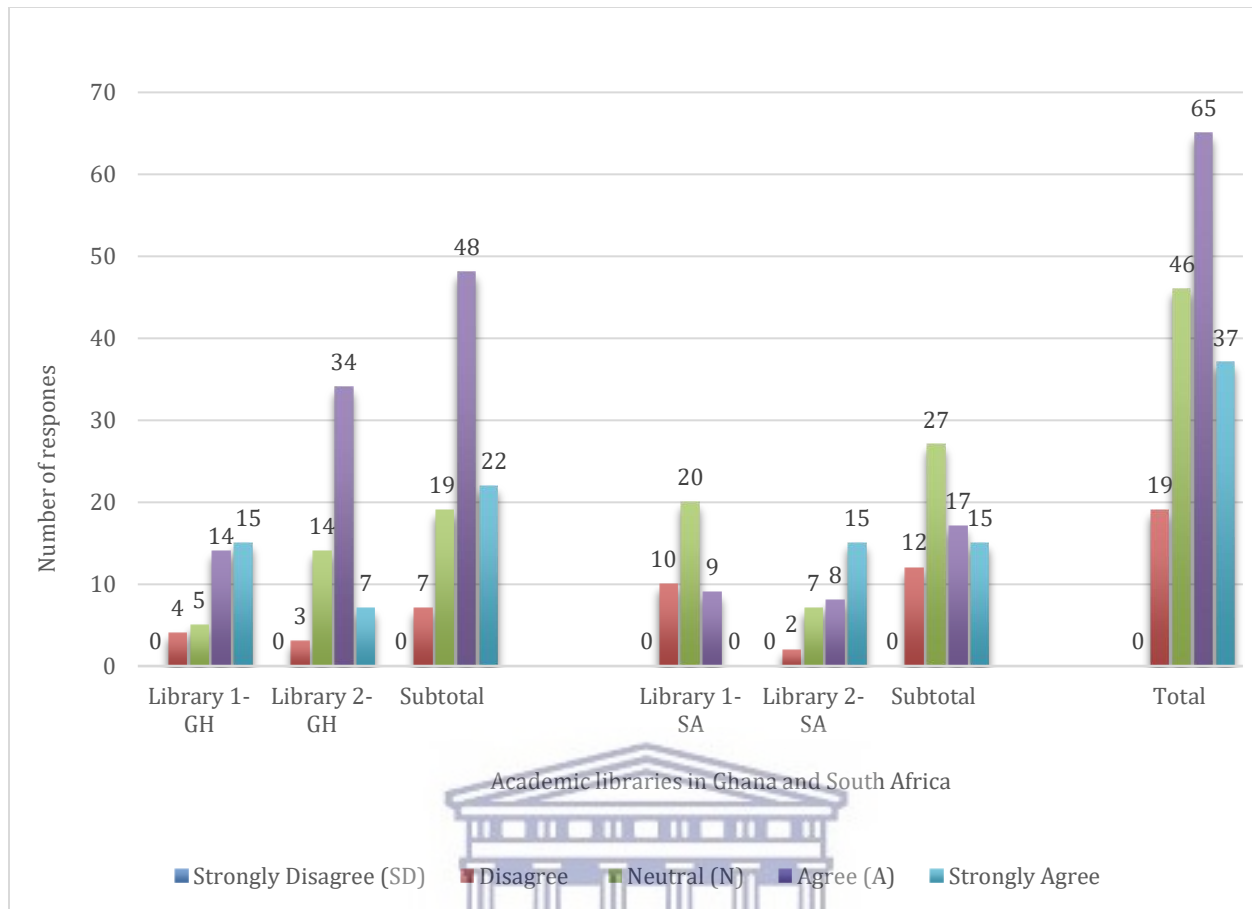


Figure 5.29 Creating mutual understanding statements (N=167)

5.7.1.1.6 Empowering staff and users

Figure 5.30 depicts feedback on the statement “empowering staff and users to embrace new technology and applications”. That is the majority of respondents (77) from Ghana as well as from South Africa (40) agreed and strongly agreed. Of concern is that a high number (31) South African librarians were neutral towards the statement.

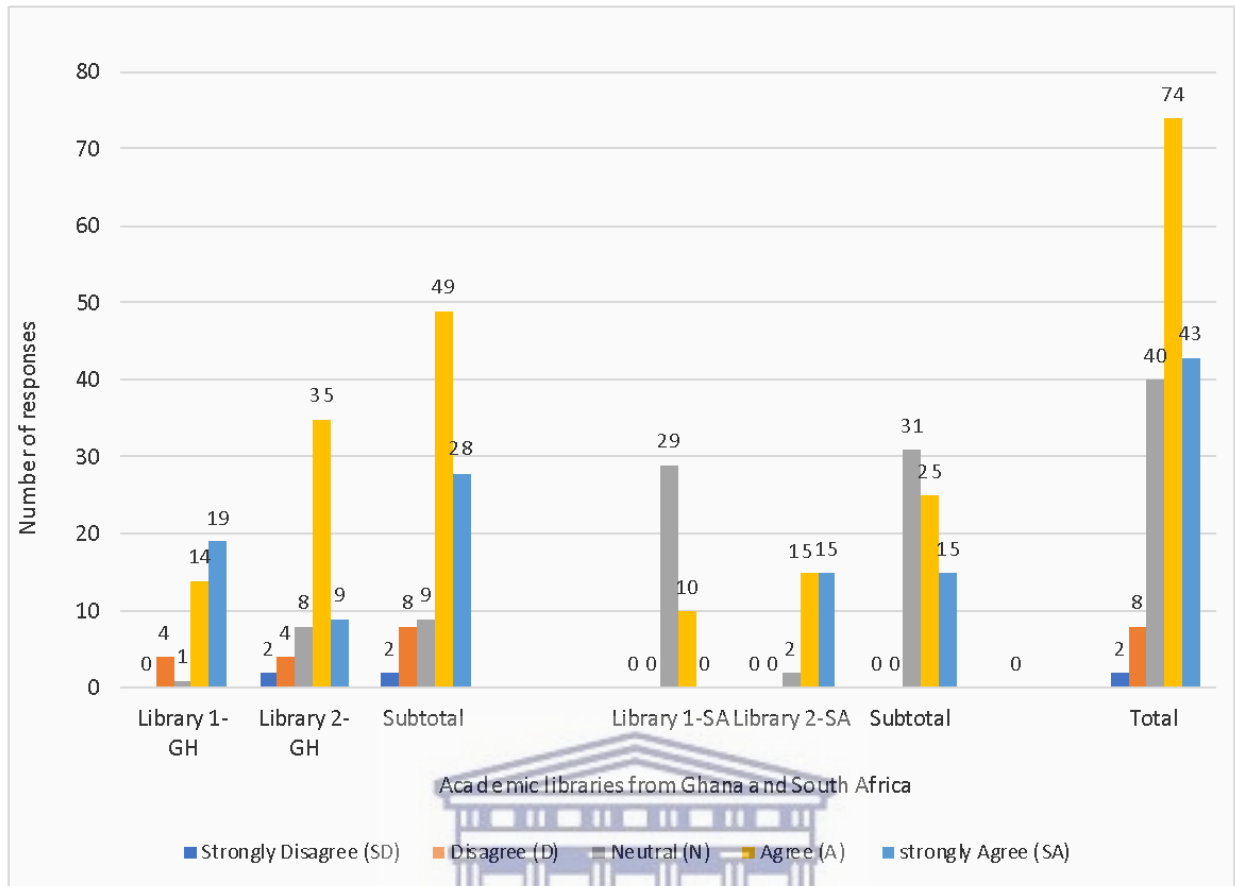


Figure 5.30 Empowering staff and users (N=167)

5.7.1.2 Overall responses people

This section puts together all the items which comprise; well-skilled and experienced staff, constant training, good incentives, periodic evaluation of staff attitude, creating mutual understanding statements, and empowering staff and users. These items assess library staff to obtain an overall impression. The total number of items is six. The breakdown is detailed below.

Number of items = 6

The Likert scale used; Strongly Agree = 5, Agree= 4, Neutral= 3, Disagree = 2, Strongly Disagree = 1

If an individual respondent should score 5 throughout the total score will be the number of items x 5

Therefore, = Strongly Agree= 6X 5 = 30, Agree = 6X 4= 24, Neutral =6 X 3= 18,

Disagree=6 X 2=12 and Strongly Disagree = 6 X 1= 6

Computed individual results are shown in Table 5.52 and 5.53 respectively.

Table 5.52 Overall responses from Ghana (N=96)

Ranking of responses	Score ranges	Freq	Percepts (100%)
Low level of people (library staff) towards the 4IR	14 and below	4	4%
Moderate-level people (library staff) towards the 4IR	15-20	25	26%
High-level people (library staff) 4IR	21 and above	67	70%
Total		96	100

Table 5.53 Overall responses from South Africa (N=71)

Ranking of responses	Score ranges	Freq	Percepts (100%)
Low level of people (library staff) towards the 4IR	14 and below	9	13%
Moderate-level people (library staff) towards the 4IR	15-20	13	18%
High-level people (library staff) at the 4IR	21 and above	49	69%
Total		71	100

Table 5.52 shows that the majority of the respondents from Ghana 67 (70%) had a total range score of 21 and above. Twenty-five (26%) had a moderate score with a range score of 15-20 representing a moderate level and four (4%) representing a low level had a range score of fourteen and below. Table 5.53 reflects that the majority of South African respondents 49 (69%) had a total range score of 21 and above. Thirteen (18%) had a score of 15-20 indicating a moderate level and nine (13%) had a total score of fourteen and below representing a low level. Academic libraries in Ghana have focused on developing their human resources for the 4IR so as those in South Africa even though both had a majority of their respondents on the high-level under-ranking responses.

5.7.1.2 Organizational Structure

Organizational structure projects the flow of work in the organization encapsulating the communication channel, processing, and organizational hierarchy. A good organizational structure motivates employees to work assiduously and welcomes the introduction of IT tools and equipment. As the library is welcoming 4IR technologies and applications, it is germane to find out the librarian's perceptions of their organizational structure.

5.7.1.2.1 Motivation of staff

As shown in Table 5.54, 28.1% (20.4% agree; 7.8% strongly agree) of respondents from Ghana representing the majority were in agreement with the assertion that “the library structure motivates staff to participate in decision-making regarding the implementation of Lib 4.0 technologies and applications”. Similarly, 22.2% (11.4% agree; 10.8% strongly agree) from South Africa indicating a larger portion of the respondents were also in favor of the assertion. This results that library staff being motivated.

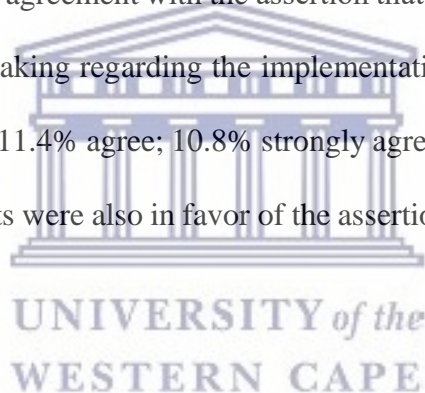
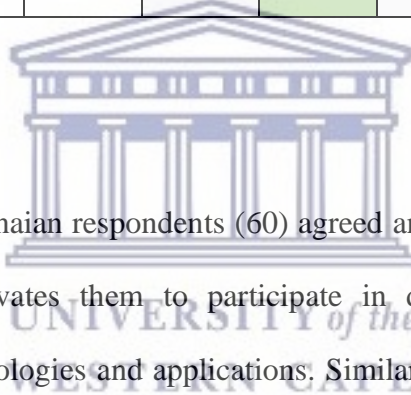


Table 5.54 Motivation staff (N=167)

Organizational Structure			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
The library structure motivates staff to participate in decision-making regarding the implementation of library 4.0 technologies and applications	Strongly Disagree (SD)	Count	2	5	7	0	0	0	7
		%Country	2.1	5.2	7.3	0	0	0	-
		% Total	1.2%	3.0%	4.2	0.0%	0.0%	0.0	4.2%
	Disagree (D)	Count	10	11	21	10	0	10	31
		%Country	10.4	11.5	21.9	14.1	0	14.1	-
		% Total	6.0%	6.6%	12.6	6.0%	0.0%	6.0	18.6%
	Neutral (N)	Count	4	17	21	20	4	24	45
		%Country	4.2	18.0	22.2	28.2	6.0	34.2	-
		% Total	2.4%	10.2%	12.6	12.0%	2.4%	14.4	26.9%
	Agree (A)	Count	15	19	34	9	10	19	53
		%Country	16.0	19.8	35.8	13.0	14.1	27.1	-
		% Total	9.0%	11.4%	20.4	5.4%	6.0%	11.4	31.7%
	Strongly Agree (SA)	Count	7	6	13	0	18	18	31
		%Country	7.3	6.3	13.6	0	25.4	25.4	-
		% Total	4.2%	3.6%	7.8	0.0%	10.8%	10.8	18.6%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%



5.7.1.2.2 Innovation/creativity

Table 5.55 shows that most Ghanaian respondents (60) agreed and strongly agreed with the fact that the library structure motivates them to participate in decision-making regarding the implementation of Lib 4.0 technologies and applications. Similarly, most (49) respondents from South Africa also agreed and strongly agreed with the statement.

Table 5.55 Innovation/creativity (N=167)

Organizational Structure			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
The library structure provides an avenue to encourage staff in innovation/creativity	Strongly Disagree (SD)	Count	2	1	3	0	0	0	3
		% Country	2.1	1.0	3.1	0	0	0	-
		% Total	1.2%	0.6%	1.8	0.0%	0.0%	0.0	1.8%
	Disagree (D)	Count	5	8	13	0	0	0	13
		% Country	5.2	8.3	13.5	0	0	0	-
		% Total	3.0%	4.8%	7.8	0.0%	0.0%	0.0	7.8%
	Neutral (N)	Count	5	15	20	20	2	22	42
		% Country	5.2	16.0	21.2	28.2	3.0	31.2	-
		% Total	3.0%	9.0%	12.0	12.0%	1.2%	13.2	25.1%
	Agree (A)	Count	16	29	45	9	10	19	64
		% Country	17.0	30.2	47.2	13.0	14.1	27.1	-
		% Total	9.6%	17.4%	27	5.4%	6.0%	11.4	38.3%
	Strongly Agree (SA)	Count	10	5	15	10	20	30	45
		% Country	10.4	5.2	15.6	14.1	28.2	42.3	-
		% Total	6.0%	3.0%	9.0	6.0%	12.0%	18.0	26.9%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.7.1.2.3 Good interpersonal relationship

Table 5.56 reflects whether respondents agreed that their library structures create good interpersonal relationships between managers and subordinates. The majority of respondents from Ghana (60) and from South Africa (37) agreed and strongly agreed. However, a large number (34) from South Africa stayed neutral.

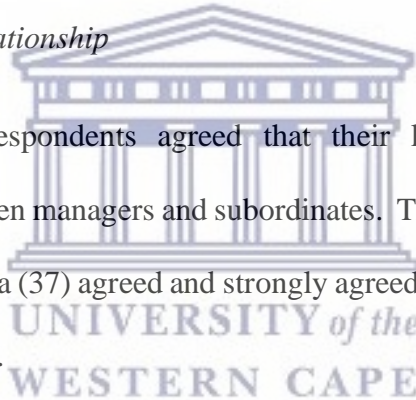
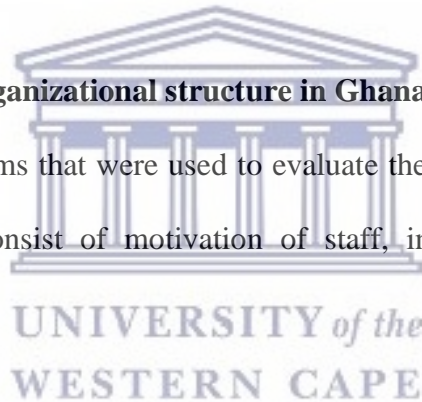


Table 5.56 Good Interpersonal Relationship (N=167)

Organizational Structure:			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
The library structure creates a good interpersonal relationship between managers and subordinate	Strongly Disagree (SD)	Count	1	3	4	0	0	0	4
		%Country	1.0	3.1	4.1	0	0	0	-
		% Total	0.6%	1.8%	2.4	0.0%	0.0%	0.0	2.4%
	Disagree (D)	Count	8	9	17	0	0	0	17
		%Country	8.3	9.4	17.7	0	0	0	-
		% Total	4.8%	5.4%	10.2	0.0%	0.0%	0.0	10.2%
	Neutral (N)	Count	7	8	15	30	4	34	49
		%Country	7.3	8.3	15.6	42.3	6.0	48.3	-
		% Total	4.2%	4.8%	9.0	18.0%	2.4%	20.4	29.3%
	Agree (A)	Count	10	25	35	9	12	21	56
		%Country	10.4	26.0	36.4	13.0	17.0	30.0	-
		% Total	6.0%	15.0%	21.0	5.4%	7.2%	12.6	33.5%
	Strongly Agree (SA)	Count	12	13	25	0	16	16	41
		%Country	13.0	13.5	26.5	0	23.0	23.0	-
		% Total	7.2%	7.8%	15.0	0.0%	9.6%	9.6	24.6%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.7.1.3 Overall responses of organizational structure in Ghana and South Africa

This section put together the items that were used to evaluate the organizational structure of the various libraries. The items consist of motivation of staff, innovation/creativity, and good interpersonal relationships.



Number of items = 3

Likert scale; Strongly Agree = 5, Agree= 4, Neutral= 3, Disagree = 2, Strongly Disagree = 1

If an individual should score 5 throughout the total score will be the number of items x 5

Therefore, = Strongly Agree= 3 X 5 = 15, Agree = 3X 4= 12, Neutral =3 X 3= 9, Disagree=3 X

2=6 and Strongly Disagree = 3 X 1= 3

Individual responses from the three (3) items were calculated and ranked. The results are demonstrated in Table 5.57 and 5.58 respectively.

Table 5.57 Overall responses on Organizational Structure-Ghana (N=96)

Ranking of responses	Score ranges	Freq	Percepts
Low-level of Organizational Structure towards the 4IR	7 and below	13	14%
Moderate-level Organizational Structure toward the 4IR	8-10	25	26%
High-level Organizational Structure toward the 4IR	11 and above	58	60%
Total		96	100

Table 5.58: Overall responses on Organizational Structure- South Africa (N=71)

Ranking of responses	Score ranges	Freq	Percepts
Low level of Organizational Structure towards the 4IR	-	-	-
Moderate-level Organizational Structure toward the 4IR	8-10	42	40%
High-level Organizational Structure toward the 4IR	11 and above	58	60%
Total		71	100

Table 5.57 shows that the majority (60%, 58) of respondents from Ghana scored eleven and above representing a high level of preparation for organizational structure, 25 (26%) were on the moderate level with a score from eight to ten and thirteen (14%) had a score range of seven and below. Table 5.58 reflects that 58 (81.7%) of South African librarians had a total score range from eleven and above representing a high level and the remaining 42 (41%) had a score from eight to ten indicating a moderate level. Even though South Africa had a higher score than that of Ghana It can therefore be concluded that both countries academic libraries have a favorable organizational structure which is a steppingstone toward the 4IR.

5.7.1.3 Technology

The use of 4IR technologies and applications is a core concern for the library to survive in the 4IR. It is crucial to determine what kind of technologies to incorporate and what strategies should be considered to ensure that the technologies incorporated are being utilized to their full potential.

The onus lies on the management of the academic library to deploy suitable but quality technologies to solve problems.

5.7.1.3.1 Underutilized and undervalued technologies

The responses to the statement “Fewer technologies are underutilized and undervalued” are captured in Figure 5.31. From Ghana, 27.6% agreed and strongly agreed with the statement, while 13.2% were undecided. Similarly, 20.4% from South Africa agreed, while 17.4% disagreed.

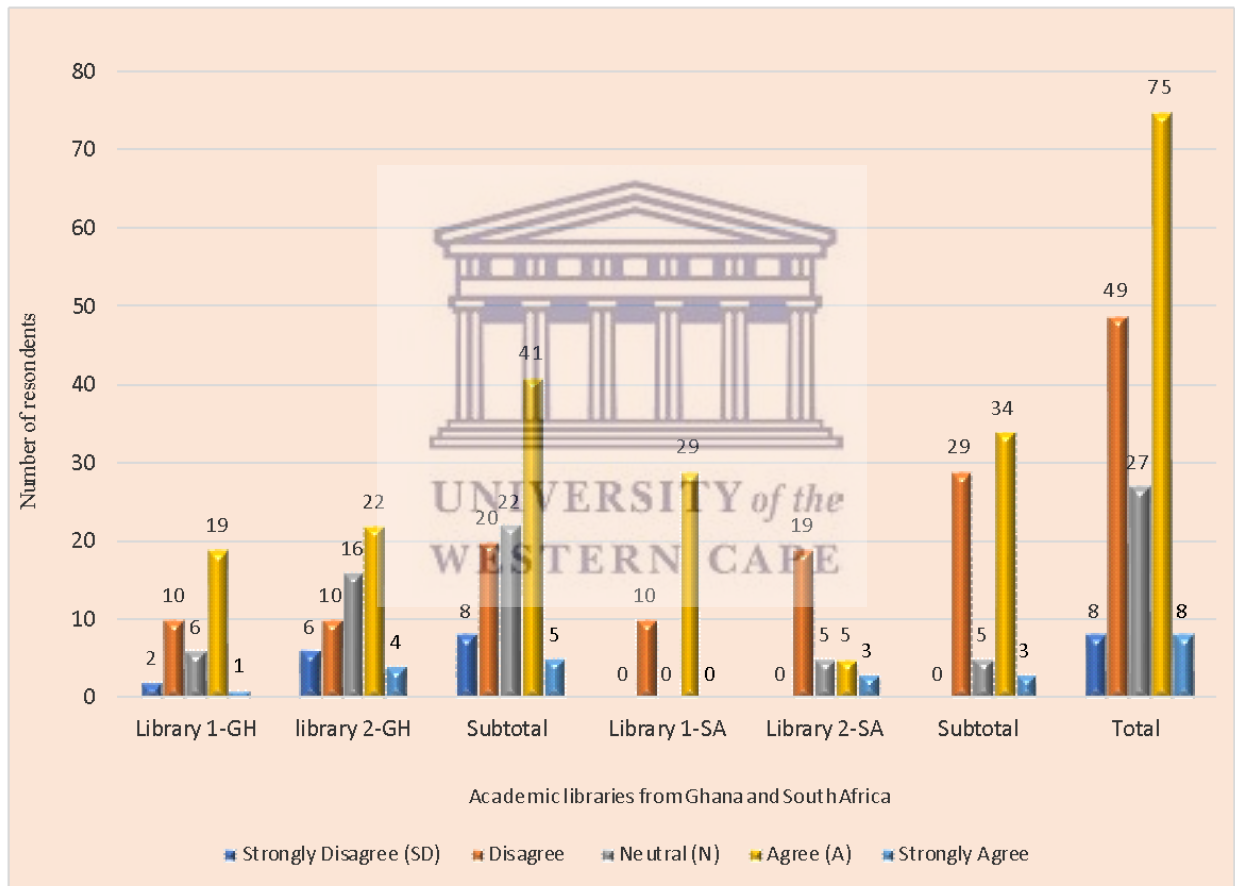


Figure 5.31 Underutilized and undervalued technologies (N=167)

5.7.1.3.2 Resolving technical glitches

In response to the statement “less difficulty in resolving technical glitches”, 21% of Ghanaian respondents were undecided, while 14.4% agreed and 5.4% strongly agreed. Similarly, 22.2% of respondents from South Africa were neutral, and 34 (14.4%) agreed and 6.0% strongly agreed. The results show that there is room for improvement in resolving technical glitches in Ghana as well as South Africa.

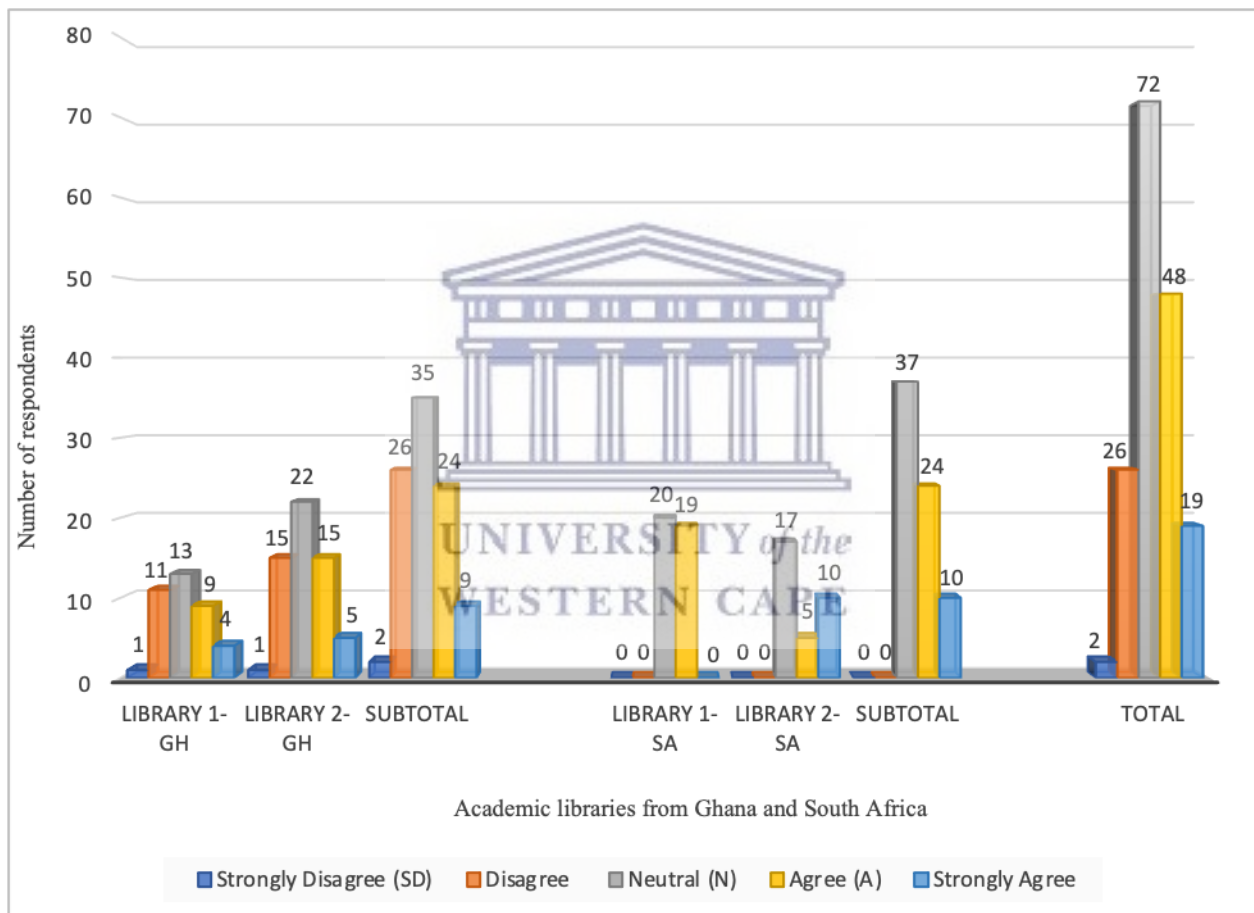


Figure 5.32 Resolving technical glitches (N=167)

5.7.1.3.3 Keeping up and familiarizing with new technologies

Figure 5.33 reflects detailed responses on the assertion “keeping up with new technologies and spend less time familiarizing themselves with technologies.”. Of the Ghanaian librarians, 41 (42.7%) agreed or strongly agreed. From South Africa, 27 (38%) librarians agreed or strongly agreed. Noticeable is that 29.1% and 52.1% of respondents from Ghana and South African respectively were neutral.

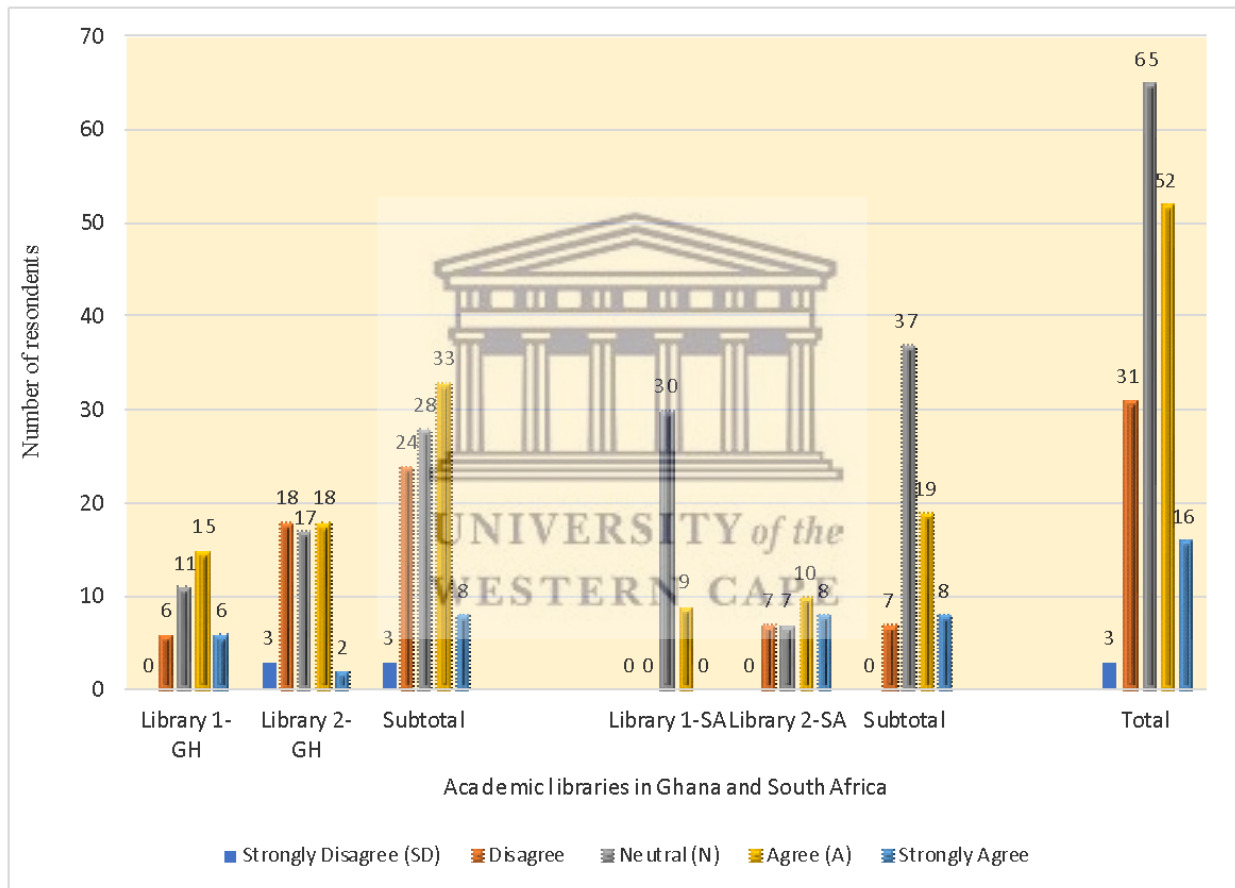


Figure 5.33 Keeping up and familiarizing with new technologies (N=167)

5.7.1.4 Overall responses technologies

This section captures the overall impression of technologies available in these various libraries. There were three sets of items that are put together which comprises: Underutilized and undervalued technologies, resolving technical glitches, and keeping up and familiarizing with new technologies.

Number of items = 3

Likert scale; Strongly Agree = 5, Agree= 4, Neutral= 3, Disagree = 2, Strongly Disagree = 1

If an individual should score 5 throughout the total score will be the number of items x 5

Therefore, = Strongly Agree= 3 X 5 = 15, Agree = 3X 4= 12, Neutral =3X 3= 9, Disagree=3 X 2=6 and Strongly Disagree = 3X 1= 3

Individual responses were then computed and the results are depicted in Table 5.59 and Table 5.60

Table 5.59 Overall responses technologies-Ghana (N= 96)

Ranking of responses	Score ranges	Freq	Percepts (100%)
Low level of technologies towards the 4IR	7 and below	18	19
Moderate-level technologies towards the 4IR	8-10	46	48
High-level technologies for the 4IR	11 and above	32	33
Total		96	100

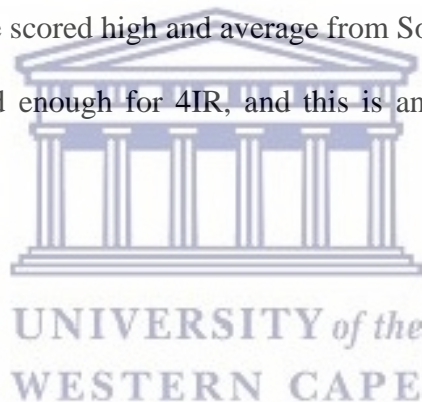
Table 5.60 Overall responses technologies-South Africa (N= 71)

Ranking of responses	Score ranges	Freq	Percepts (100%)
Low level of technologies towards the 4IR	7 and above	7	10
Moderate-level technologies towards the 4IR	8-10	32	45
High-level technologies for the 4IR	11 and above	32	45
Total		71	100

The overall assessment of technologies for Ghana is summarized in Table 5.59. The majority of respondents 46 (48%) had a range score from eight to ten representing a moderate level, followed by 32 (33%) that scored eleven and above representing a high level, and nineteen (19%) out of the total scored seven and below indicating low level.

Table 5.60 reflects that 32 (45%) of South African respondents eleven and above indicate a moderate level, and another 32 (45%) scored eleven and above which reflects a high level and seven (10%) had a total score of seven and below signifying a low level.

From the results above, it is depicted that Ghana is not technologically adequate for the 4IR and even though the same percentage scored high and average from South Africa it indicates that they are not technologically prepared enough for 4IR, and this is an indication for more room for improvement.



5.7.1.4 Tasks

Tasks as part of the variables that need to be measured in the quest of academic libraries preparing towards the 4IR focus on the user's needs, problems, or constraints as well as the environment in which the incorporated 4IR technologies are meant to solve these needs or problems. This section investigated the nature of the tasks to be solved using available Lib 4.0 technologies and applications.

5.7.1.4.1 Complexity of library tasks

Table 5.61 captures responses to the statement “Library tasks are less complex”. From Ghana, 26.4% (18.6% disagree; 7.8% strongly agree) of respondents representing the majority were in discord with the assertion while in South Africa the majority 23.4% of the respondents were indifferent. In comparison, the result is an indication that Ghanaian academic library staff finds their tasks relatively complex as compared to those in South Africa.

Table 5.61: Complexity of library tasks (N=167)

Tasks:			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Library tasks are less complex.	Strongly Disagree (SD)	Count	4	9	13	0	7	7	20
		%Country	4.2	9.4	13.6	0	10.0	10.0	-
		% Total	2.4%	5.4%	7.8	0.0%	4.2%	4.2	12.0%
	Disagree (D)	Count	10	21	31	0	12	12	43
		%Country	10.4	22	32.4	0	17.0	17.0	-
		% Total	6.0%	12.6%	18.6	0.0%	7.2%	7.2	25.7%
	Neutral (N)	Count	5	10	15	30	9	39	54
		%Country	5.2	10.4	15.6	42.3	13.0	55.3	-
		% Total	3.0%	6.0%	9.0	18.0%	5.4%	23.4	32.3%
	Agree (A)	Count	11	14	25	9	4	13	38
		%Country	11.5	15.0	26.5	13.0	6.0	19.0	-
		% Total	6.6%	8.4%	15.0	5.4%	2.4%	7.8	22.8%
Strongly Agree (SA)	Count	8	4	12	0	0	0	12	
	%Country	8.3	4.2	12.5	0	0	0	-	
	% Total	4.8%	2.4%	7.2	0.0%	0.0%	0	7.2%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.7.1.4.2 Good familiarity with library task

In terms of good familiarity with library tasks, from Ghana 52 agree and 21 strongly agreed while 19 felt ambivalent. From South Africa 16 agreed and 19 strongly agreed. Details are reflected in Table 5.62.

Table 5.62 Good familiarity with library task (N=167)

Tasks			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Good familiarity with library task	Disagree (D)	Count	0	4	4	0	0	0	4
		%Country	0	4.2	4.2	0	0	0	-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0	2.4%
	Neutral (N)	Count	5	14	19	4	2	6	25
		%Country	5.2	15.0	20.2	6.0	3.0	9.0	-
		% Total	3.0%	8.4%	11.4	2.4%	1.2%	3.6	15.0%
	Agree (A)	Count	19	33	52	28	18	46	98
		%Country	19.8	34.4	54.2	39.4	25.4	64.8	-
		% Total	11.4%	19.8%	31.2	16.8%	10.8%	27.6	58.7%
	Strongly Agree (SA)	Count	14	7	21	7	12	19	40
		%Country	15.0	7.3	22.3	10.0	17.0	27.0	-
		% Total	8.4%	4.2%	12.6	4.2%	7.2%	11.4	24.0%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.7.1.4.3 Good coordination and collaboration

Table 5.63 summarizes the responses to the statement “good coordination and collaboration with other staff”. From Ghana, the majority of respondents reacted positively where 31.2% agreed and 12% strongly agreed. Similarly, 35.4% (30.0% agreed; 5.4% strongly agreed) of South Africans also agreed and strongly agreed. Both results reflect positives.

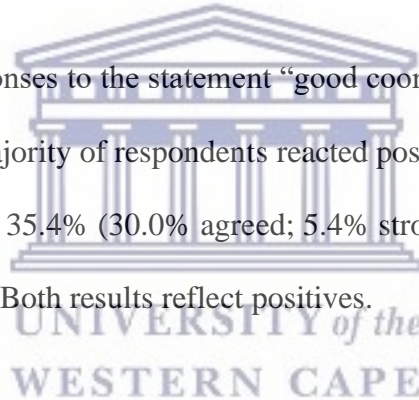


Table 5.63 Good coordination and collaboration (N=167)

Tasks:			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Good coordination and collaboration with other staff	Disagree (D)	Count	2	5	7	0	2	2	9
		%Country	2.1	5.2	7.3	0	3.0	3.0	
		% Total	1.2%	3.0%	4.2	0.0%	1.2%	1.2	5.4%
	Neutral (N)	Count	10	7	17	10	0	10	27
		%Country	10.4	7.3	17.3	14.1	0	14.1	
		% Total	6.0%	4.2%	10.2	6.0%	0.0%	6.0	16.2%
	Agree (A)	Count	12	40	52	29	21	50	102
		%Country	13.0	42.0	55.0	41.0	30.0	71.0	
		% Total	7.2%	24.0%	31.2	17.4%	12.6%	30.0	61.1%
	Strongly Agree (SA)	Count	14	6	20	0	9	9	29
		%Country	15.0	6.3	21.3	0	13.0	13.0	
		% Total	8.4%	3.6%	12.0	0.0%	5.4%	5.4	17.4%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.7.1.4.4 Appropriate work schedule

In terms of appropriate work schedules, Ghanaians agreed (31.8%) and strongly agreed (13.8%). From South Africa, 24% agreed, while nobody strongly agreed. The result is shown in Figure 5.34.

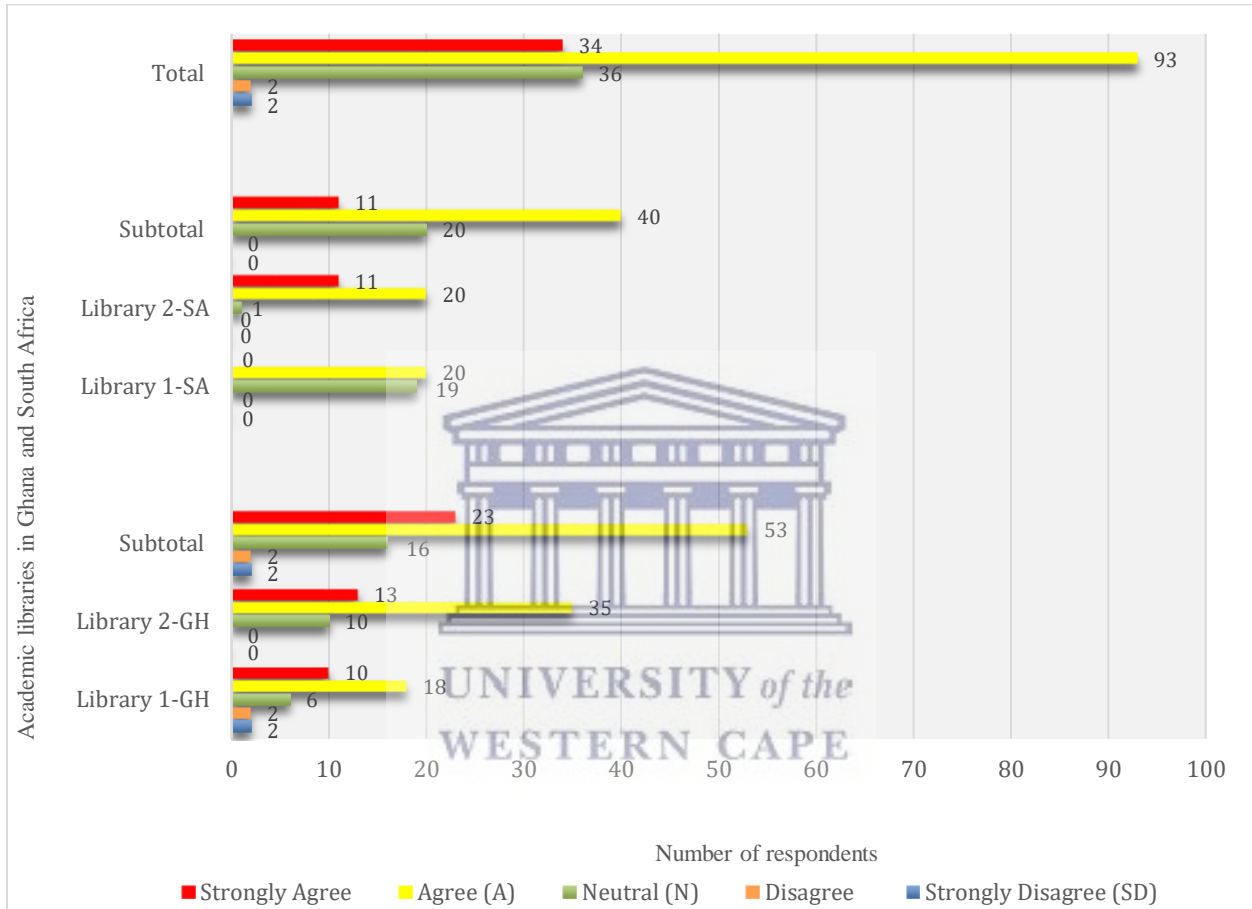


Figure 5.34 Appropriate work schedule (N=167)

5.7.1.4.5 Good work location

As depicted in Figure 5.35, 66 Ghanaians agreed and twelve strongly agreed with the fact that their library has a good work location. Sixty librarians from South Africa were positive with 44 agreeing and sixteen strongly agreeing with the statement.

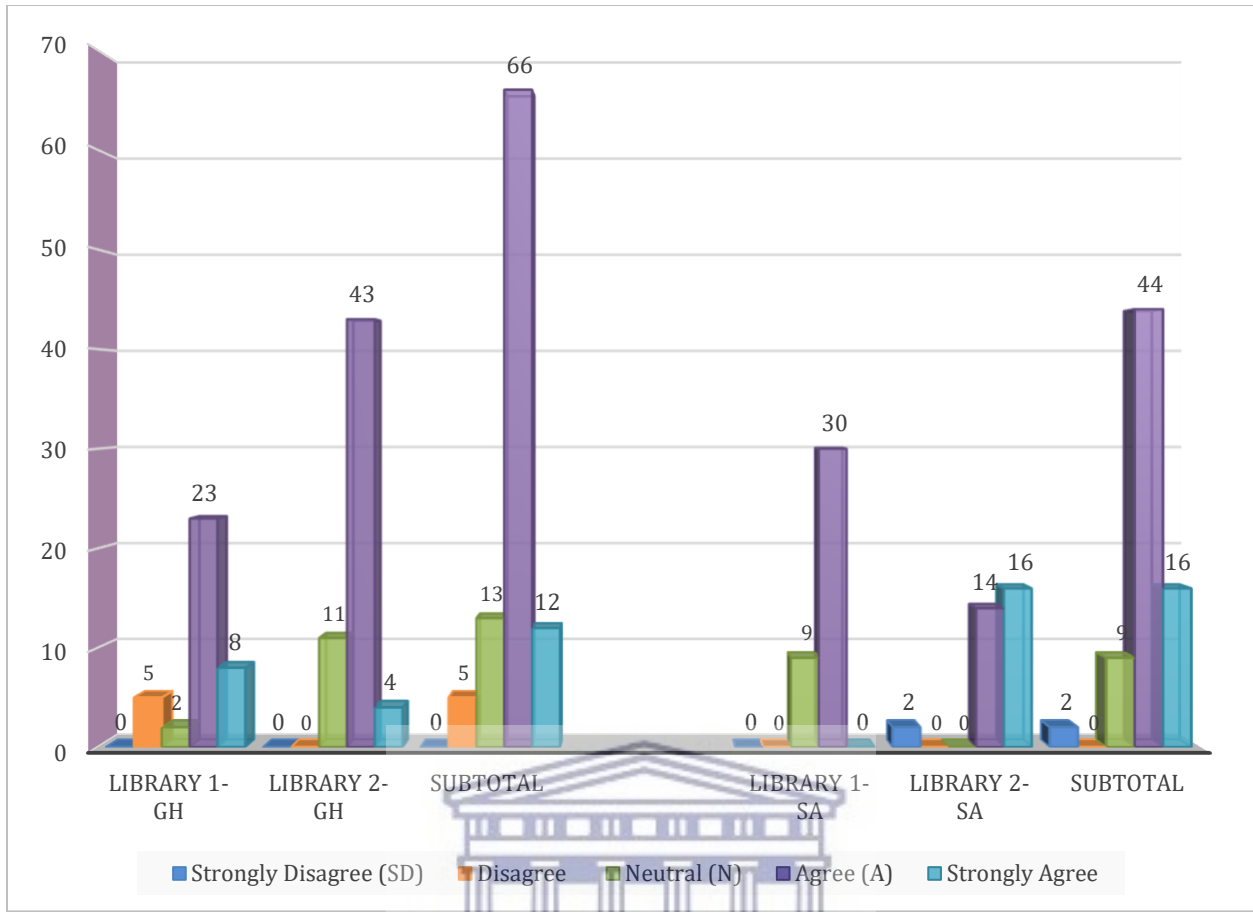


Figure 5.35 Good work location (N=167)

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5.7.1.4.6 Job description

Figure 5.36 captures responses to the statement “Job description is up to date”. From Ghana 47 agreed and eleven (11) strongly agreed. South Africans agreed (27) and strongly agreed (18). This result is an indication that academic libraries from both countries furnish staff with information on an updated job description.

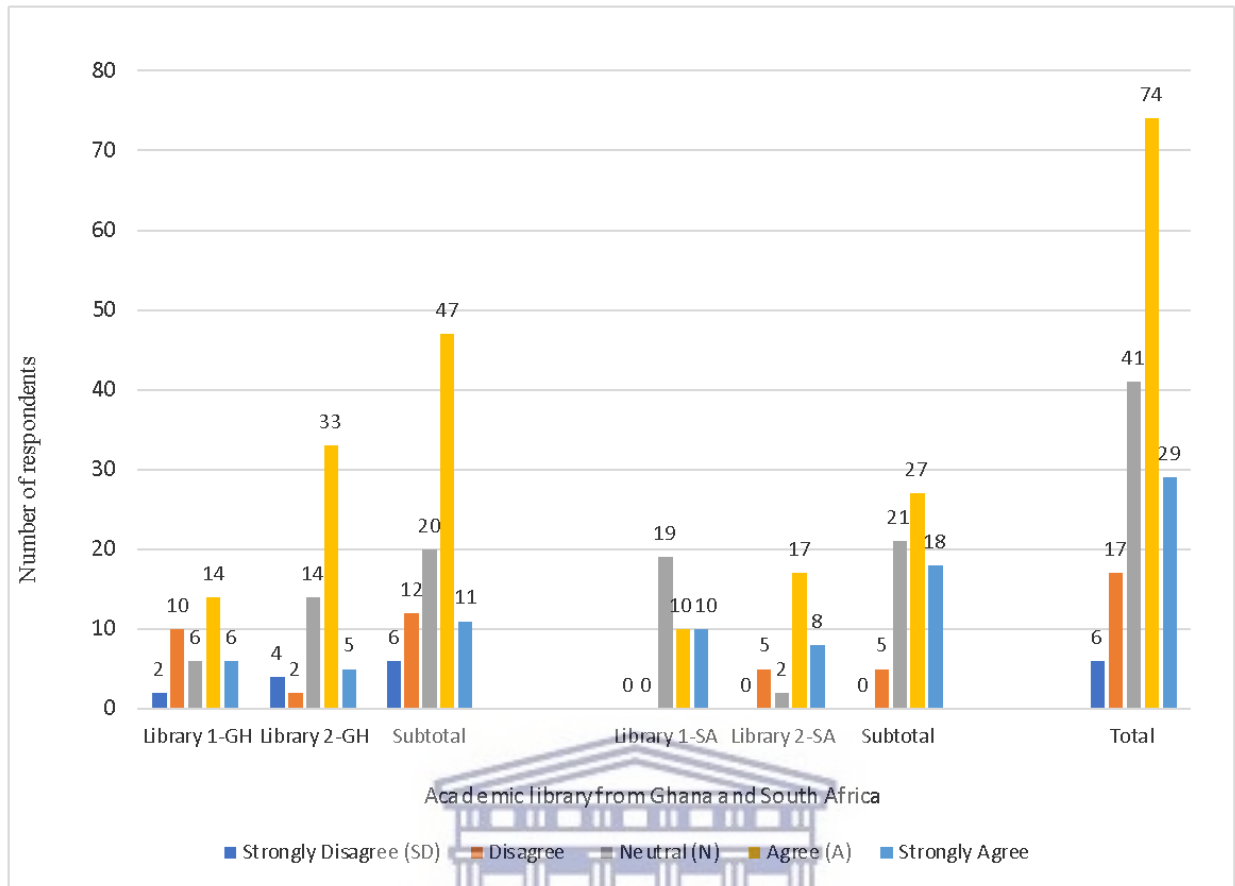


Figure 5.36 Job description (N=167)

From all the responses concerning tasks being performed in the various academic libraries, it can be observed that responses trend towards agreed and strongly agreed, with a few responses showing indifference. This suggests that there is a positive perception of the tasks being performed by academic library staff.

5.7.1.3.4.7 Overall responses on Tasks

This section combines individual responses on the six items on tasks which comprise: complexity of library tasks, good familiarity with library tasks, good coordination and collaboration, appropriate work schedule, good work location, and job description.

The five Likert was used to compute the responses and ranked using the categories as follows; high level, moderate level, and low level. The steps for computing individual total score is detailed below.

Number of items= 6

The Likert scale; Strongly Agree = 5, Agree= 4, Neutral= 3, Disagree = 2, Strongly Disagree = 1

If an individual should score 5 throughout the total score will be the number of items x 5

Therefore, = Strongly Agree= $6 \times 5 = 30$, Agree = $6 \times 4 = 24$, Neutral = $6 \times 3 = 18$, Disagree = $6 \times 2 = 12$ and Strongly Disagree = $6 \times 1 = 6$

See figure 5.37 and 5.38 shows the total score of Ghana and South Africa respectively.

5.7.1.3.4.7.1 Overall responses from Ghana

As seen in Figure 5.37, 70 respondents from Ghana had a total score of 21 and above representing 72.9% indicating a high level, followed by 24 (25.0%) who scored from fifteen to twenty indicating a moderate level. Only two of the respondents representing 2.1% had a score of fourteen and above. This breakdown shows a positive response: the majority of the respondents had a score that falls on the high level.

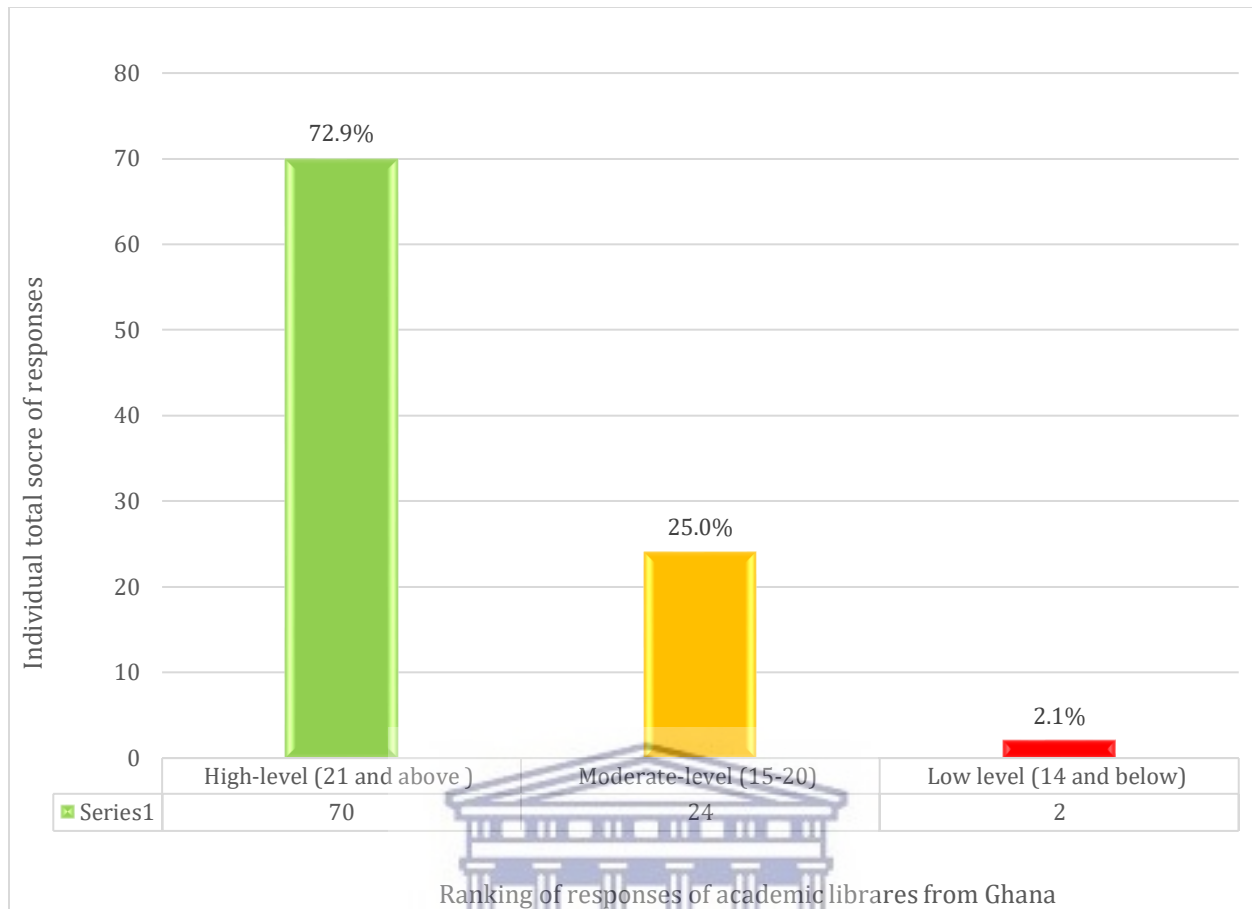


Figure 5.37: Overall responses from Ghana (N=167)

5.7.1.3.4.7.1 Overall responses from South Africa

This section recorded a positive response as depicted in figure 5.38. That is, the larger number of respondents from South Africa had a score equal to 21 and above 67 (69.8%) representing a high level, four of them had a score from fifteen to twenty 4 (4.2%) and none scored fourteen and above.

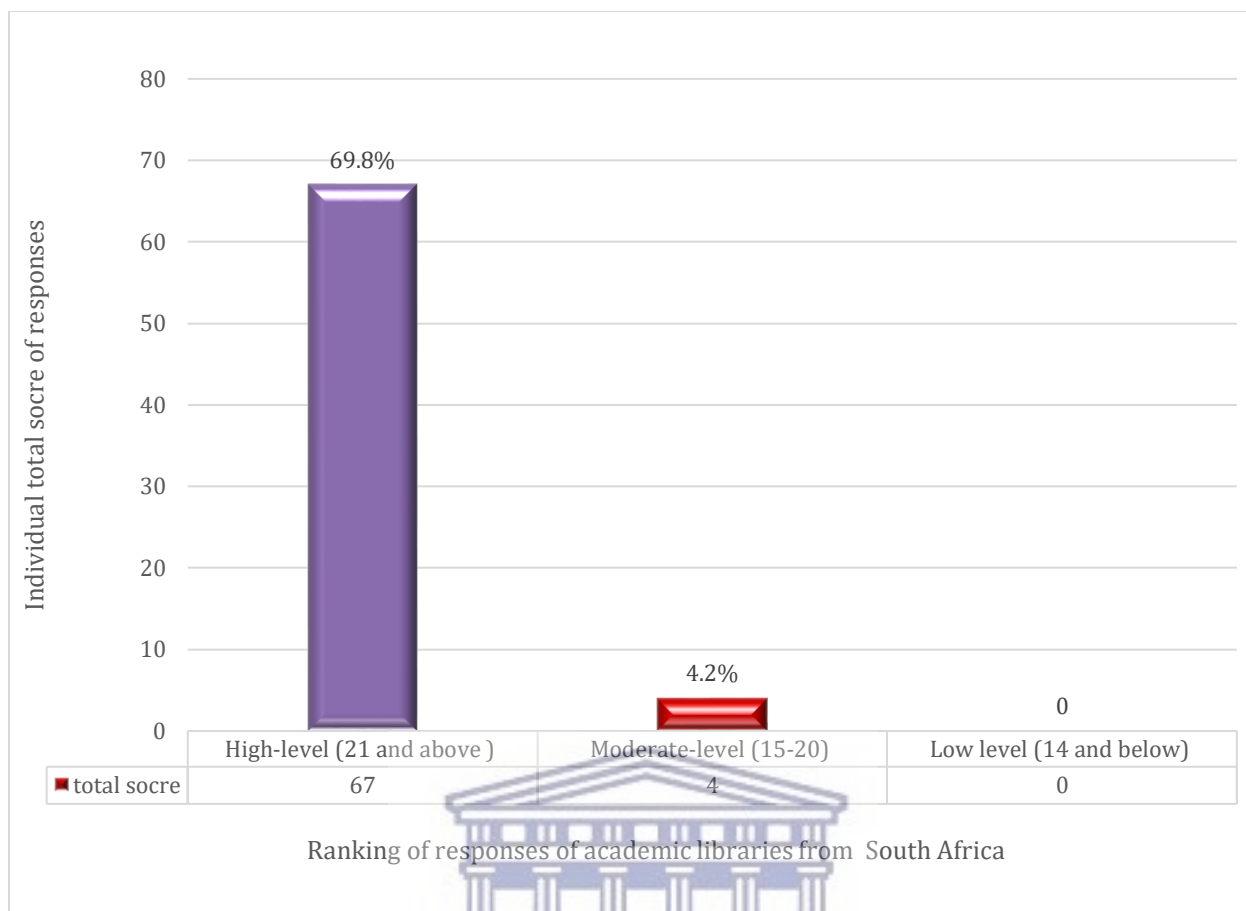


Figure 5.38 Overall responses from South Africa (N=167)

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5.7.2 Policies

Preparing for the 4IR cannot materialize without guided procedures and principles that serve as a navigation compass for current and future library staff. The myriads of what should be considered important make it difficult to decide on what library IT tools and equipment to select and prioritize. A well-structured policy that spells out what needs to be done at every point in time and ensures sustainable development of the 4IR technologies and tools in academic libraries are needed. Given this, the facet of this chapter explores library policies and their provisions for 4IR technologies and applications.

5.7.2.1 Room for Lib 4.0 applications and technologies

Respondents were asked to confirm if their general library policies provide room for Lib 4.0 technologies and applications. Results are shown in Figure 5.37.

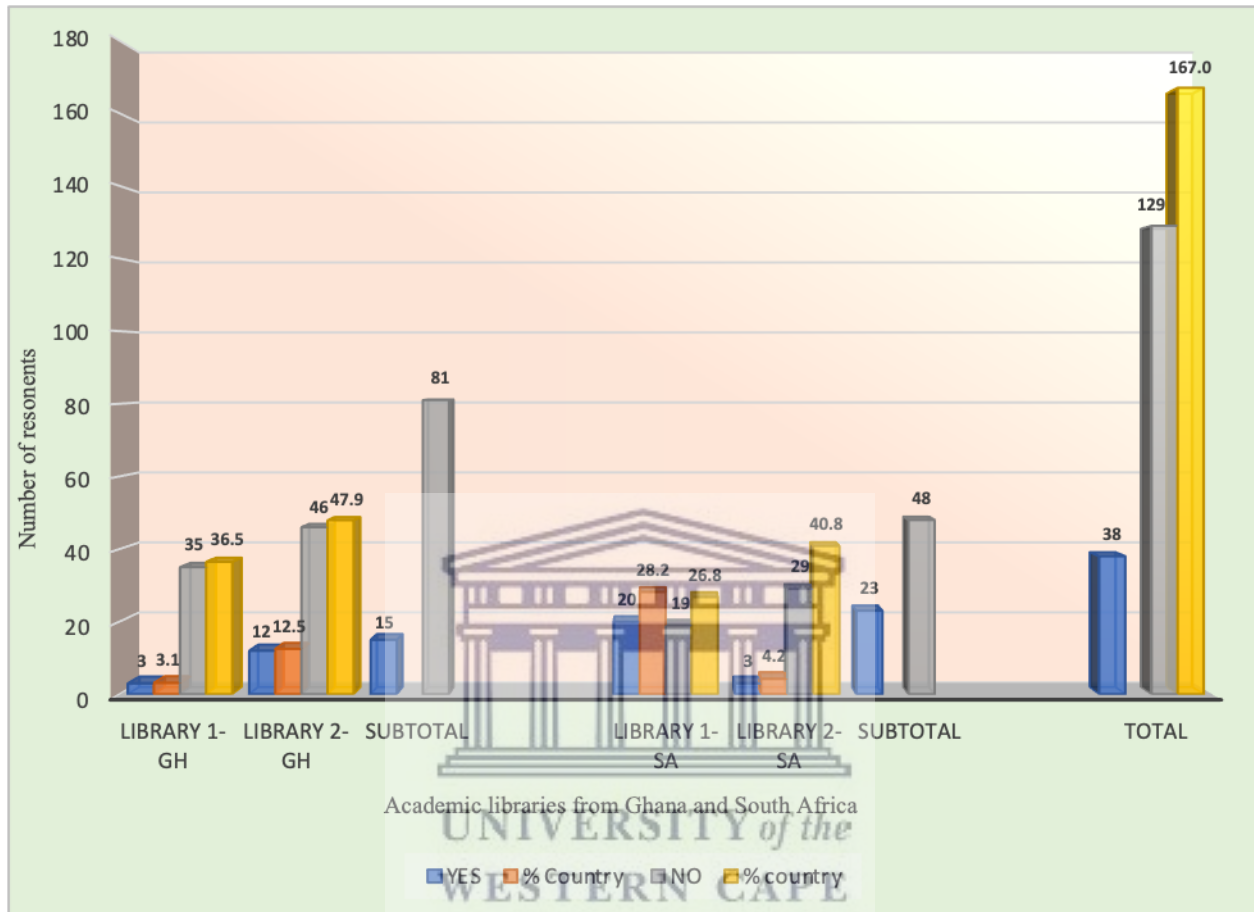


Figure 5.37 Room for Lib 4.0 applications and technologies (N=167)

Eighty-one (84.4%) of respondents from Ghana indicated that their general library policies do not specifically cover Lib 4.0 technologies and applications. Forty-eight (67.7%) South Africans acknowledged that their library policies have a section that has been earmarked for Lib 4.0 technologies and applications.

5.7.2.2 Understanding of academic library policies

Understanding academic library policies is critical for the successful operationalization of every library. Respondents were asked to confirm if they understand the library policies that govern their functional activities. Responses for Ghana are depicted in Figure 5.38. The majority (76%) acknowledged understanding library policies.

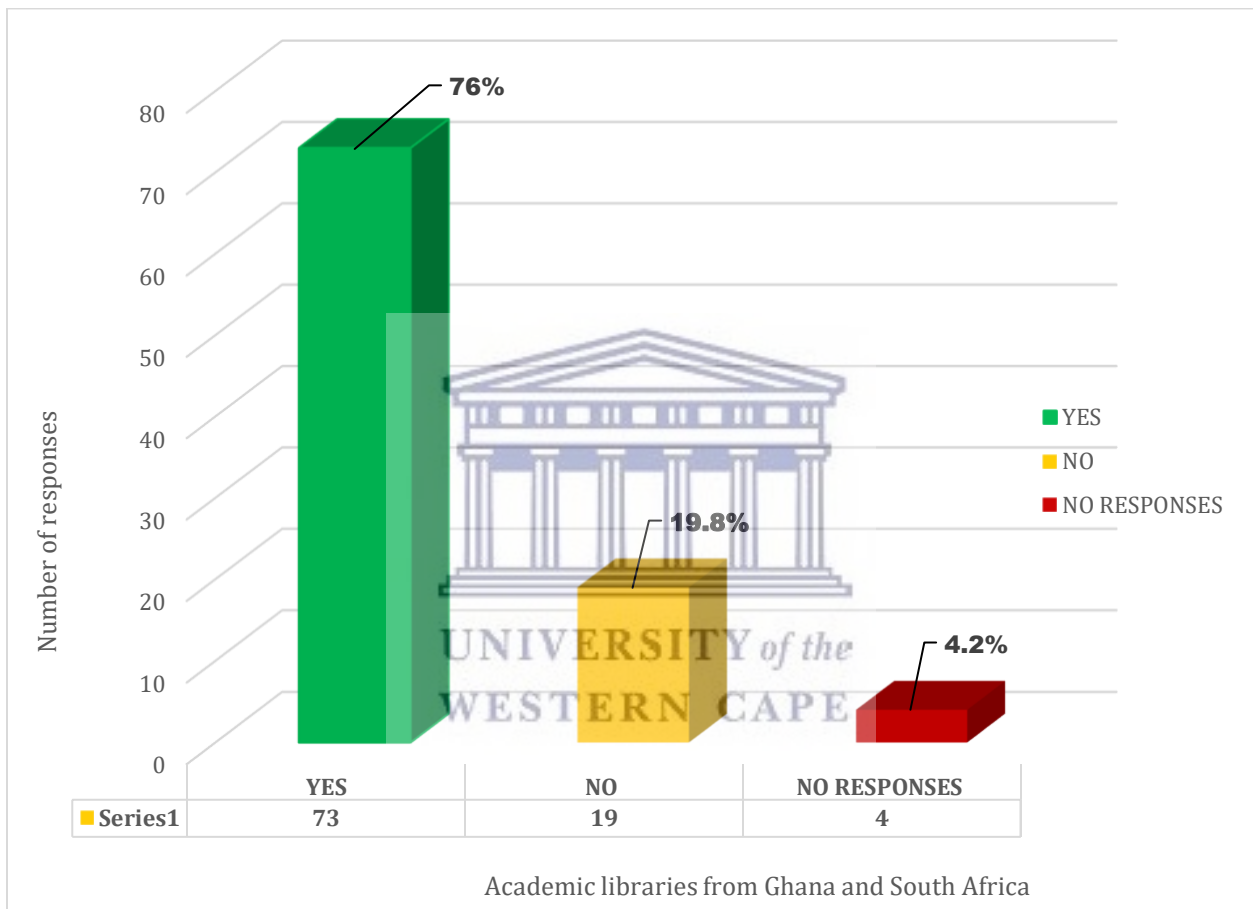


Figure 5.38 Understanding of academic library policies Ghana (N=96)

Responses from South Africa are indicated in Figure 5.39. Like Ghana, the majority (72%) confirmed that they do understand library policies well. libraries need to devise strategies to elucidate the policy to the library staff to enhance growth.

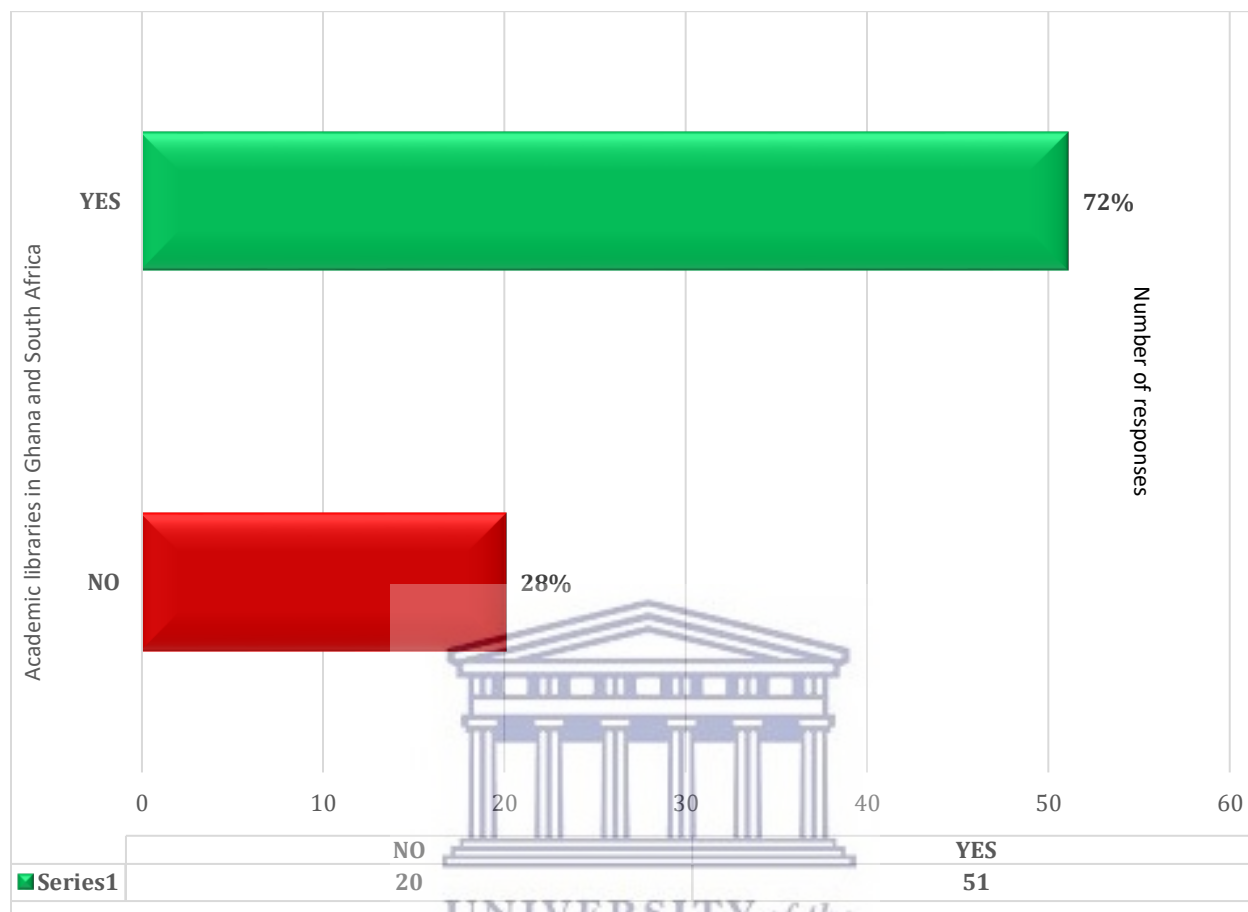


Figure 5.39: Understanding of academic library policies South Africa (N=71)

5.7.2.3 IT security

IT security is pertinent to ensure the protection of the library data as well as its equipment and applications. As more new IT technologies emerge, more users become prone to cybercrime requiring policies with actions and initiatives preventing it. Responses to the questions of whether libraries have policies capturing effective IT security to safeguard 4IR technologies and applications are captured in Figure 5.40 and Figure 5.41.

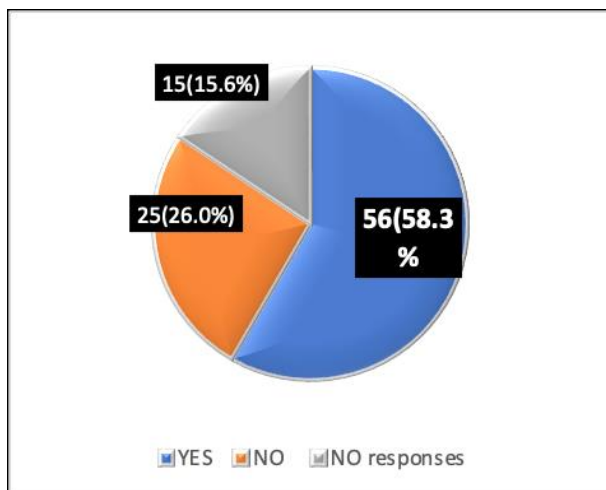


Figure 5.40 Effectiveness of IT security, Ghana (N=96)

From Figure 5.40 it can be seen that 58.3% of Ghanaian respondents indicated an effective IT security policy. Noticeable is that 15.6% didn't respond.

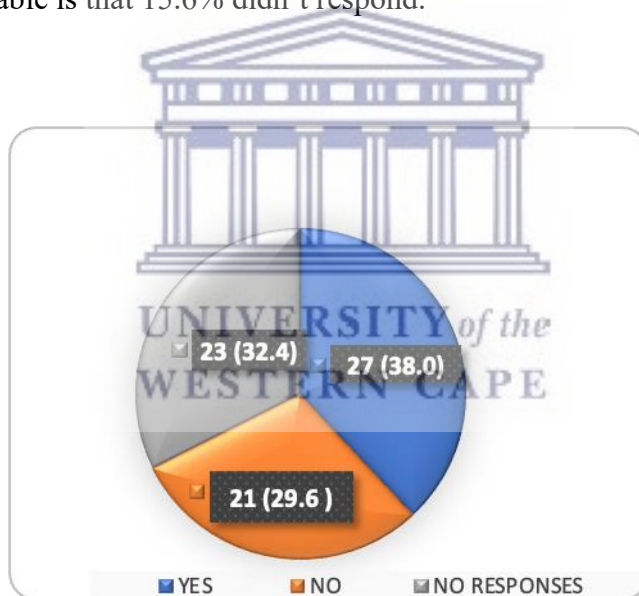


Figure 5.41 Effectiveness of IT security, South Africa (N=71)

Figure 5.41 indicate that 38.0% of South Africans indicated effective IT security measures in the library, 29.6% indicated no policies, and 32.4% did not respond. This is an indication that there is more room for improvement in terms of IT security.

5.7.2.4 Review

Digital transformation is rapidly changing the nature of services in the library. Therefore, in as much as long-time planning towards 4IR technologies and application is apropos for the library to stay relevant, it is also vital for the library to review and adjust its policies to capture 4IR technologies to meet the user needs and demands. In light of this background, respondents were asked if the library policies are often reviewed to capture the needed 4IR technologies and applications to ensure innovation. Figure 5.42 depicts that 47.9% of the respondents from Ghana confirmed the reviewing of library policies, while 15.6% did not respond.

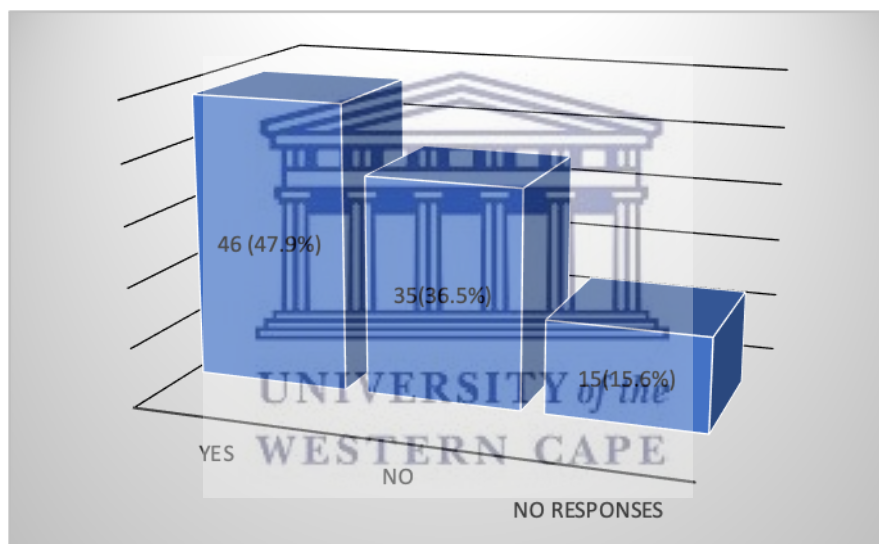


Figure 5.42 The extent of review of library policies-Ghana (N=96)

Figure 5.43 shows that 50.7% of respondents from South Africa acknowledged the fact that library policies undergo review, while a large number (32.4%) did not respond.

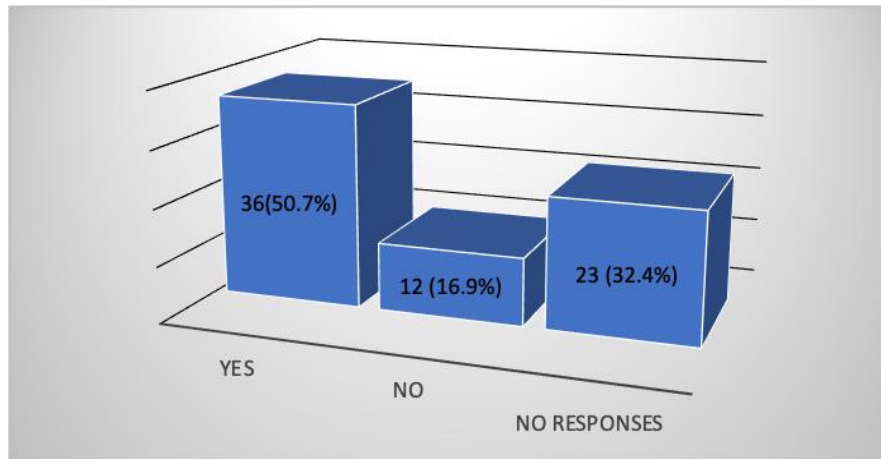


Figure 5.43 The extent of review of library policies, - South Africa (N=71)

This section of the data revealed a notable absence of specific Lib 4.0 policies across all the surveyed libraries, despite a majority of them demonstrating familiarity with general library policies that undergo periodic reviews. Regarding IT security, the findings indicated that positive IT security policies were present in all the libraries, although there is still scope for enhancement. This highlights the need for libraries to develop specialized Lib 4.0 policies to address the emerging challenges and opportunities presented by the evolving digital landscape. Furthermore, although the existing IT security policies are a positive aspect, there remains a potential for refining and bolstering these measures to safeguard against ever-evolving cybersecurity threats and ensure optimal protection of library resources and data.

5.8 Actions toward disruptions

While policies draw attention to written-down plans towards the 4IR, this section focuses on the actual activities and actions academic libraries engaging in to minimize the disruptive changes by the 4IR. This encapsulates ICT infrastructure and emerging technologies, education and training programmes, Innovation, and allocation of adequate funds for the library.

5.8.1 I CT infrastructure and emerging technologies

For the academic library to stay relevant and to provide services meeting the varying demands of patrons, relevant emerging technologies must be bought and used. This section sought to find out the ICT infrastructure available.

5.8.1.1 Virtual gateway

Figure 5.44 reflects that most respondents (79) from Ghana agreed (62) and strongly agreed (17) that there is a well-designed virtual gateway providing strong visibility, access to the library contents, and customer orientation. Similarly, the majority of respondents from South Africa (59) agreed (31) and strongly agreed (28) regarding their libraries virtual gateways.

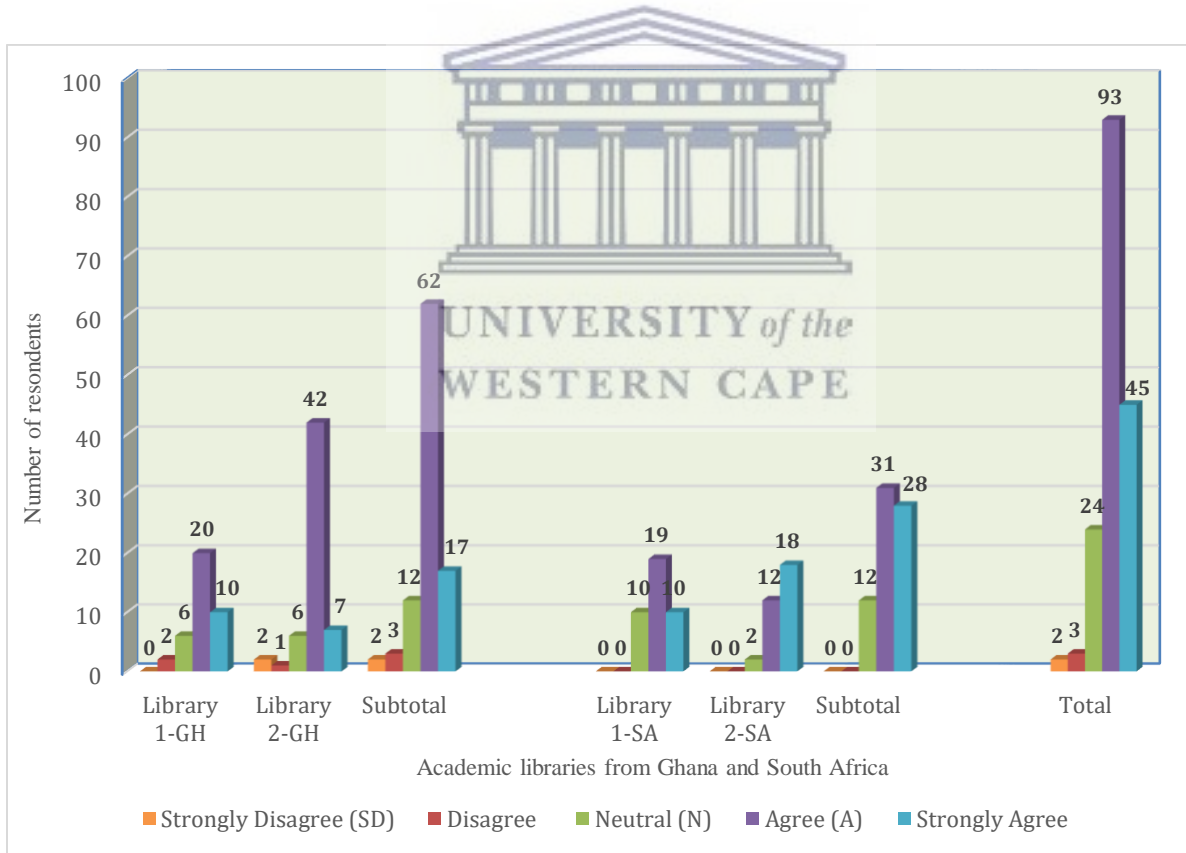


Figure 5.44 Virtual gateway (N=167)

5.8.1.2 Enough Broadband and other internet technologies

Table 5.64 summarizes responses to the assertion “There is enough broadband and other internet technologies”. Respondents from Ghana agreed (38.3%) and strongly agreed (6.6%), while 8.4% felt ambivalent. From South Africa, 24.6% strongly agreed and 12.6% agreed.

Table 5.64 Enough broadband and internet technologies (N=167)

ICT and emerging technologies		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
There is enough broadband and other internet technologies that provide digital connectivity for effective communication	Disagree (D)	Count	4	3	7	0	0	7	
		%Country	4.2	3.1	7.3	0	0	0	-
		% Total	2.4%	1.8%	4.2	0.0%	0.0%	0	4.2%
	Neutral (N)	Count	9	5	14	0	9	9	23
		%Country	9.4	5.2	14.6	0	0	0	-
		% Total	5.4%	3.0%	8.4	0.0%	5.4%	5.4	13.8%
	Agree (A)	Count	17	47	64	10	11	21	85
		%Country	18.0	49.0	67.0	14.1	15.5	29.6	-
		% Total	10.2%	28.1%	38.3	6.0%	6.6%	12.6	50.9%
	Strongly Agree (SA)	Count	8	3	11	29	12	41	52
		%Country	8.3	3.1	11.4	41.0	17.0	58.0	-
		% Total	4.8%	1.8%	6.6	17.4%	7.2%	24.6	31.1%
Total		Count	38	58	96	39	71	167	
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	100.0%	

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5.8.1.3 High specification of computers

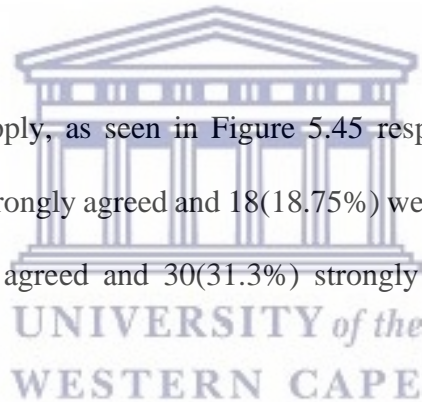
On the statement “There are available high specifications of computers to render enhanced services” 32.4% of Ghanaian respondents agreed (27%) or strongly agreed (5.4%), while 16.8% stayed neutral. South African respondents strongly agreed (15%) and agreed (12%), while 15.6% stayed neutral. Details are presented in Table 5.65

Table 5.65 High specification of computers (N=167)

ICT and emerging technologies			Library	Library	Subtotal	Library	Library	Subtotal	Total
			1-GH	2-GH		1-SA	2-SA		
There are available high specifications of computers to render enhanced services	Strongly Disagree (SD)	Count	0	3	3	0	0	0	3
		%Country	0	3.1	3.1	0	0	0	-
		% Total	0.0%	1.8%	1.8	0.0%	0.0%	0.0	1.8%
	Disagree (D)	Count	7	4	11	0	0	0	11
		%Country	7.3	4.2	11.5	0	0	0	-
		% Total	4.2%	2.4%	6.6	0.0%	0.0%	0.0	6.6%
	Neutral (N)	Count	12	16	28	20	6	26	54
		%Country	13.0	17.0	30.0	28.2	8.5	36.7	-
		% Total	7.2%	9.6%	16.8	12.0%	3.6%	15.6	32.3%
	Agree (A)	Count	15	30	45	10	10	20	65
		%Country	16.0	31.3	47.3	14.1	14.1	28.2	-
		% Total	9.0%	18.0%	27.0	6.0%	6.0%	12.0	38.9%
	Strongly Agree (SA)	Count	4	5	9	9	16	25	34
		%Country	4.2	5.2	9.4	13.0	23.0	36.0	-
		% Total	2.4%	3.0%	5.4	5.4%	9.6%	15.0	20.4%
Total	Count	38	58	96	39	32	71	167	
	% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%	

5.8.1.4 Adequate power supply

In terms of adequate power supply, as seen in Figure 5.45 responses from Ghana reflect that 49(51.0%), agreed, 14(14.5%) strongly agreed and 18(18.75%) were unsure out of 96 respondents. From South Africa, 34(47.9%) agreed and 30(31.3%) strongly agreed respectively out of 71 respondents.



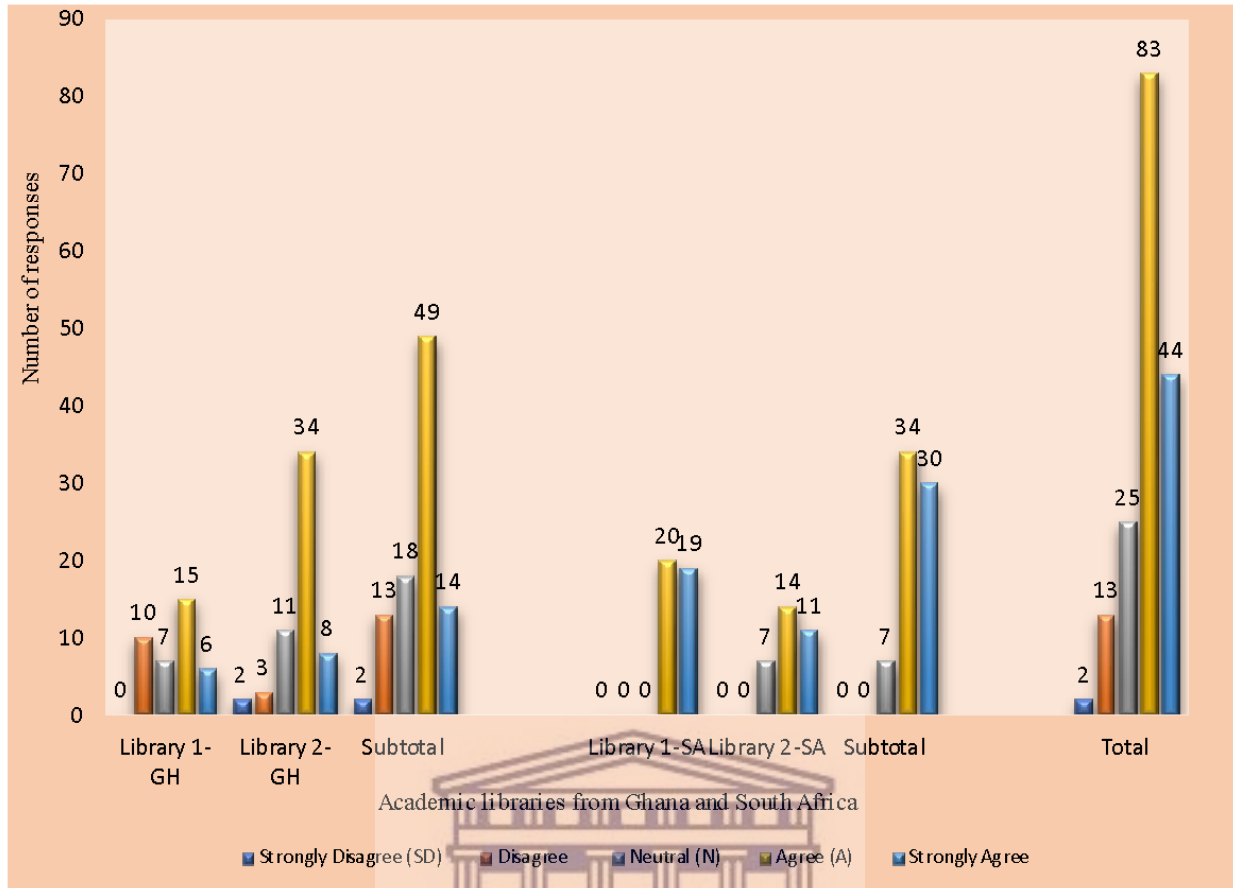


Figure 5.45 Adequate power supply (N=167)

5.8.1.5 Constant maintenance of ICT infrastructure

Responses to the statement “constant maintenance of ICT infrastructure” are captured in Figure 5.46. From Ghana, out of 96 respondents, 70.9% (56) were agreeing while 29 (30.2%) stayed neutral. From South Africa, out of 71 respondents, the distribution between strongly agree, agree, and neutral was almost the same with 23(32.4%), 23(32.4%), and 24(33.8%) respectively.

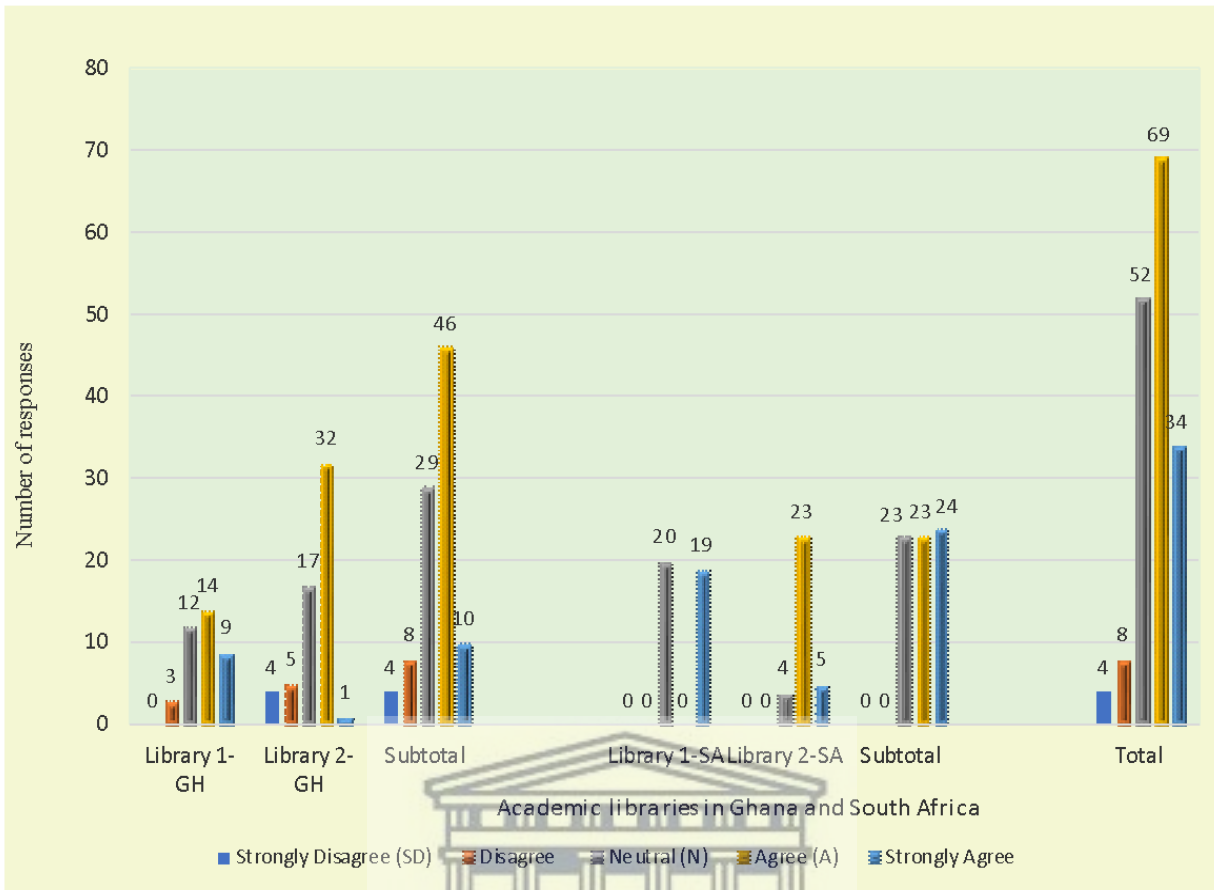


Figure 5.46 Constant maintenance of ICT infrastructure (N=167)

5.8.1.6 Effective automated library cards

Responses to the statement “there are available automated library cards for patrons to access the library ICT infrastructure and services: checkpoint for learning (research and knowledge) commons in the library. The results are captured in Figure 5.47. Out of 96, almost half of the respondents from Ghana 47 (49%) positively reacted positively where 35 and 12 of them respectively agreed and strongly agreed. On the other hand, 57 representing 80.2% of respondents from South Africa strongly agreed (12) and strongly agreed (45) out of 71. Even though both countries have the majority of their respondents reacting positively, responses from South Africa are far higher than that of Ghana.

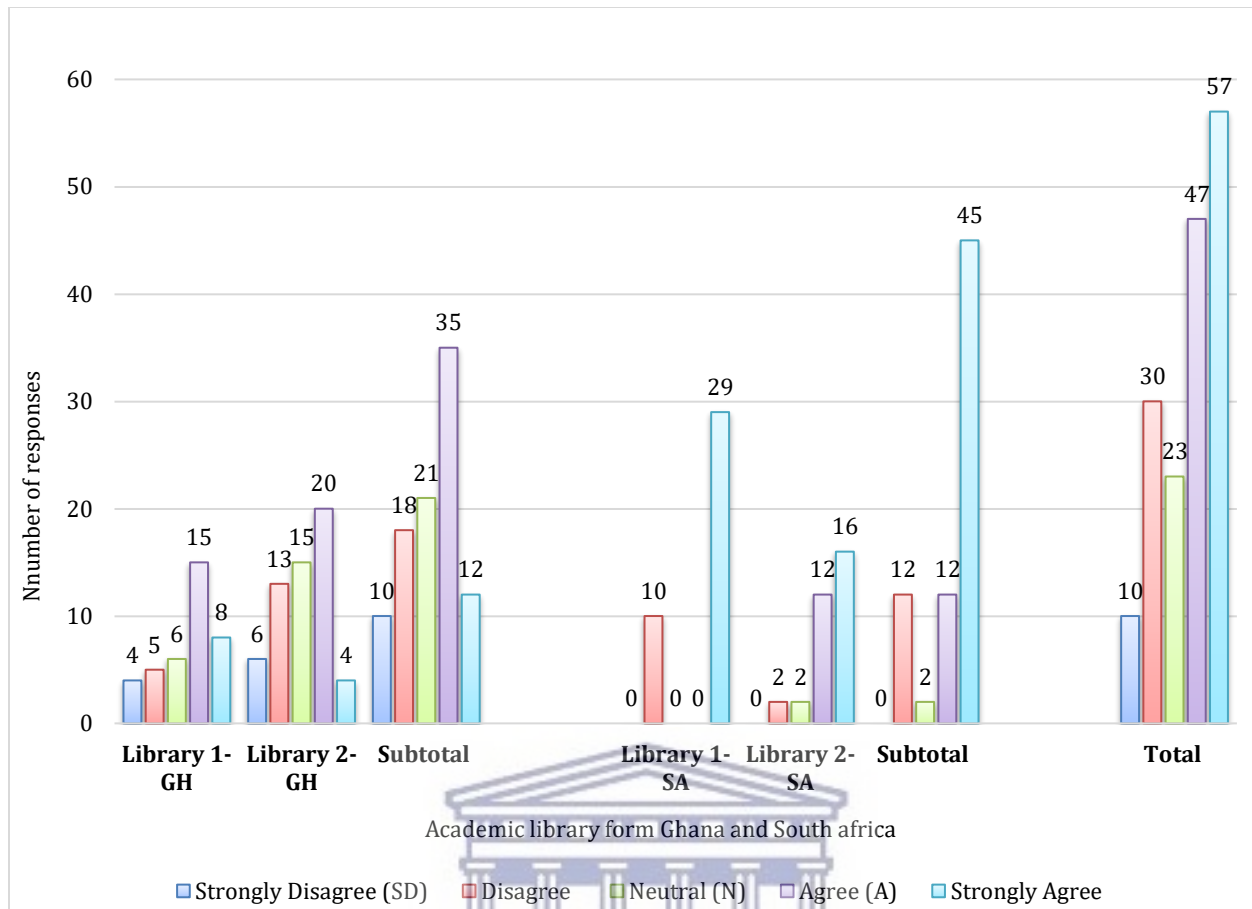


Figure 5.47 Effective automated library cards (N=167)

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5.8.2 Training

The 4IR is an era that is using both digital and human elements in the workforce. Therefore, upskilling, reskilling, learning, and relearning are necessary to obtain the right skillset, mindset, and attitude to embrace the change necessary for the provision of library service to thrive.

5.8.2.1 Content of training programmes

Data were solicited from respondents to ascertain their preparation in terms of the content of training programmes relevant to the 4IR.

5.8.2.1.1 Use of emerging technologies

Table 5.66 demonstrates that training programmes organized for library staff in Ghana and South Africa capture the use of emerging technologies as 29.4% (25.8% agree; 3.6% strongly agree) responded positively. In the same vein, a greater percentage of respondents 25.4% (14.0 agree; 11.4% strongly agree) were in positive agreement.

Table 5.66 Use of emerging technologies (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Complex problem solving	Strongly Disagree (SD)	Count	0	3	3	0	0	0	3
		%Country	0	3.1	3.1	0	0	0	
		% Total	0.0%	1.8%	1.8	0.0%	0.0%	0.0	1.8%
	Disagree (D)	Count	11	6	17	0	0	0	17
		%Country	11.5	6.3	17.8	0	0	0	
		% Total	6.6%	3.6%	10.2	0.0%	0.0%	0.0	10.2%
	Neutral (N)	Count	8	19	27	10	2	12	39
		%Country	8.3	19.8	28.1	14.1	3.0	17.1	
		% Total	4.8%	11.4%	16.2	6.0%	1.2%	7.2	23.4%
	Agree (A)	Count	16	27	43	20	20	40	83
		%Country	17.0	29.2	46.2	28.2	28.2	56.4	
		% Total	9.6%	16.2%	25.8	12.0%	12.0%	14.0	49.7%
Strongly Agree (SA)	Count	3	3	6	9	10	19	25	
	%Country	3.1	3.1	6.2	13.0	14.1	27.1		
	% Total	1.8%	1.8%	3.6	5.4%	6.0%	11.4	15.0%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.2 Critical thinking

Critical thinking is needed to make a good judgment in the 4IR. Responses as reflected in Table 5.67 brought to bear positive responses from both countries. A greater number of respondents 32.4% (agree 29%; 3.1% strongly agree) responded positively. By the same token, 36.6% (22.2% agree; 14.4% strongly agree) of respondents from South Africa reacted positively.

Table 5.67 Critical thinking (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Critical thinking	Strongly Disagree (SD)	Count	2	4	6	0	0	0	6
		%Country	2.1	4.2	6.3	0	0	0	
		% Total	1.2%	2.4%	3.6	0.0%	0.0%	0.0	3.6%
	Disagree (D)	Count	6	5	11	0	0	0	11
		%Country	6.3	5.2	11.5	0	0	0	
		% Total	3.6%	3.0%	6.6	0.0%	0.0%	0.0	6.6%
	Neutral (N)	Count	10	15	15	10	0	10	35
		%Country	10.4	16.0	26.4	14.1	0	14.1	
		% Total	6.0%	9.0%	15.0	6.0%	0.0%	6.0	21.0%
	Agree (A)	Count	17	32	49	20	17	37	86
		%Country	18.0	45.1	63.1	28.2	24.0	52.2	
		% Total	10.2%	19.2%	29.4	12.0%	10.2%	22.2	51.5%
Strongly Agree (SA)	Count	3	2	5	9	15	24	29	
	%Country	3.1	2.1	5.2	13.0	20.3	33.3		
	% Total	1.8%	1.2%	3.0	5.4%	9.0%	14.4	17.4%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.3 Creativity and innovation

In terms of creativity and innovation, a greater number of respondents 29.4% from Ghana indicated agreed and 26.4% of respondents from South Africa also agreed. This is an indication of a positive result as shown in table 5.68.

Table 5.68 Creativity and innovation (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Creativity and innovation	Strongly Disagree (SD)	Count	3	0	3	0	0	0	3
		%Country	3.1	0	3.1	0	0	0	
		% Total	1.8%	0.0%	1.8	0.0%	0.0%	0.0	1.8%
	Disagree (D)	Count	2	4	6	0	0	0	6
		%Country	2.1	4.2	6.3	0	0	0	
		% Total	1.2%	2.4%	3.6	0.0%	0.0%	0.0	3.6%
	Neutral (N)	Count	13	13	26	0	2	2	28
		%Country	13.5	13.4	26.9	0	2.8	2.8	
		% Total	7.8%	7.8%	15.6	0.0%	1.2%	1.2	16.8%
	Agree (A)	Count	15	34	49	30	14	44	93
		%Country	15.6	35.4	51	42.3	19.7	62	
		% Total	9.0%	20.4%	29.4	18.0%	8.4%	26.4	55.7%
Strongly Agree (SA)	Count	5	7	12	9	16	25	37	
	%Country	5.2	7.3	12.5	12.7	22.5	35.2		
	% Total	3.0%	4.2%	7.2	5.4%	9.6%	15.0	22.2%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.4 People management

As shown in Table 5.69, positive results were obtained from responses from both countries where a greater portion of respondents 21.6% and 22.8% representing Ghana and South Africa respectively agreed.

Table 5.69 People management (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
People management	Strongly Disagree (SD)	Count	1	0	1	0	0	0	1
		%Country	1.0	0	1.0	0	0	0	-
		% Total	0.6%	0.0%	0.6	0.0%	0.0%	0.0	0.6%
	Disagree (D)	Count	2	5	7	0	0	0	7
		%Country	2.1	5.2	7.3	0	0	0	-
		% Total	1.2%	3.0%	4.2	0.0%	0.0%	0.0	4.2%
	Neutral (N)	Count	13	15	28	0	5	5	33
		%Country	13.5	16.0	29.5	0	7.0	7.0	-
		% Total	7.8%	9.0%	16.8	0.0%	3.0%	3.0	19.8%
	Agree (A)	Count	15	36	51	20	8	28	79
		%Country	16.0	38.0	54.0	28.2	11.3	39.5	-
		% Total	9.0%	21.6%	30.6	12.0%	4.8%	16.8	47.3%
	Strongly Agree (SA)	Count	7	2	9	19	19	38	47
		%Country	7.3	2.1	9.4	26.0	26.0	52.0	-
		% Total	4.2%	1.2%	5.4	11.4%	11.4%	22.8	28.1%

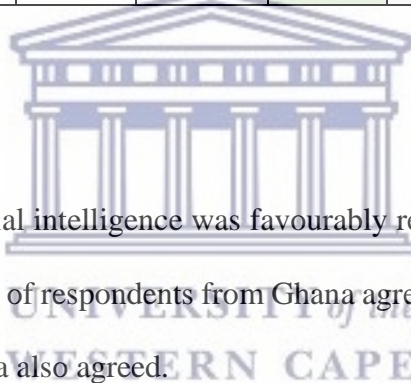


5.8.2.1.5 Coordinating with others

Positive responses were recorded concerning coordinating with others as part of training for librarians. Table 5.70 shows that 42% (30.0% agree; 12 strongly agree) of respondents from Ghana indicating a larger proportion of respondents responded positively. Similar results were also recorded from South Africa where out of 42.6% 22.2% agreed and 18.6% strongly agreed.

Table 5.70 Coordinating with others (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Coordinating with others	Strongly Disagree (SD)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0.0	1.2%
	Disagree (D)	Count	4	4	8	0	0	0	8
		%Country	4.2	4.2	8.4	0	0	0	-
		% Total	2.4%	2.4%	4.8	0.0%	0.0%	0.0	4.8%
	Neutral (N)	Count	11	4	15	0	3	3	18
		%Country	11.5	4.2	15.7	0	4.2	4.2	-
		% Total	6.6%	2.4%	9.0	0.0%	1.8%	1.8	10.8%
	Agree (A)	Count	17	33	50	29	8	37	87
		%Country	18.0	34.4	42.4	41.0	11.3	52.3	-
		% Total	10.2%	19.8%	30.0	17.4%	4.8%	22.2	52.1%
Strongly Agree (SA)	Count	6	15	11	10	21	31	52	
	%Country	6.3	16.0	22.3	14.1	30.0	44.1	-	
	% Total	3.6%	9.0%	12.6	6.0%	12.6%	18.6	31.1%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%



5.8.2.1.6 Emotional intelligence

As shown in Table 5.71, emotional intelligence was favourably reviewed by both countries; 32% (agree 28.8%; 3.6 strongly agree) of respondents from Ghana agreed and 39.6 % (23.4 agree; 16.2 strongly agree) from South Africa also agreed.

5.71 Emotional intelligence (N= 167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Emotional intelligence	Strongly Disagree (SD)	Count	0	4	4	0	0	0	4
		%Country	0	4.2	4.2	0	0	0	-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0	2.4%
	Disagree (D)	Count	6	4	10	0	0	0	10
		%Country	6.3	4.2	10.5	0	0	0	-
		% Total	3.6%	2.4%	6.0	0.0%	0.0%	0.0	6.0%
	Neutral (N)	Count	14	14	28	0	5	5	33
		%Country	15.0	15.0	30.0	0	7.0	7.0	-
		% Total	8.4%	8.4%	16.8	0.0%	3.0%	3.0	19.8%
	Agree (A)	Count	15	33	48	30	9	39	87
		%Country	16.0	34.4	40.4	42.3	13.0	55.3	-
		% Total	9.0%	19.8%	28.8	18.0%	5.4%	23.4	52.1%

	Strongly Agree (SA)	Count	3	3	6	9	18	27	33
		%Country	3.1	3.1	6.2	13.0	25.4	38.4	-
		% Total	1.8%	1.8%	3.6	5.4%	10.8%	16.2	19.8%
Total	Count	38	58	96	39	32	71	167	
	% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%	

5.8.2.1.7 Judgment and decision making

Table 5.72 demonstrates that training programmes for the libraries capture judgment and decision makings skills as a greater percentage of respondents 33.6% and 18.0% from Ghana and South Africa respectively agreed.

Table 5.72 Judgment and decision making (N=167)

Training		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
Judgment and decision making	Strongly Disagree (SD)	Count	0	2	2	0	0	2	
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0.0	1.2%
	Disagree (D)	Count	4	4	4	0	0	0	8
		%Country	4.2	4.2	8.4	0	0	0	-
		% Total	2.4%	2.4%	4.8	0.0%	0.0%	0.0	4.8%
	Neutral (N)	Count	13	13	26	10	5	15	41
		%Country	13.5	13.5	26.5	14.1	7.0	21.1	-
		% Total	7.8%	7.8%	15.6	6.0%	3.0%	9.0	24.6%
	Agree (A)	Count	18	38	56	20	10	30	86
		%Country	19.0	40.0	59.0	28.2	14.1	42.3	-
		% Total	10.8%	22.8%	33.6	12.0%	6.0%	18.0	51.5%
Strongly Agree (SA)	Count	3	1	4	9	17	26	30	
	%Country	3.1	1.0	4.1	13.0	24.0	37.0	-	
	% Total	1.8%	0.6%	2.4	5.4%	10.2%	15.6	18.0%	
Total	Count	38	58	96	39	32	71	167	
	% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%	

5.8.2.1.8 Service orientation

Concerning service orientation, a greater number of respondents 33.6% from Ghana agreed and 25.2% from South Africa agreed to represent positive responses. The results are shown in Table 5.73.

Table 5.73 Service orientation (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Service orientation	Strongly Disagree (SD)	Count	0	1	1	0	0	0	1
		%Country	0	1	1	0	0	0	-
		% Total	0.0%	0.6%	0.6	0.0%	0.0%	0.0	0.6%
	Disagree (D)	Count	2	1	3	0	0	0	3
		%Country	2.1	1.0	3.1	0	0	0	-
		% Total	1.2%	0.6%	1.8	0.0%	0.0%	0.0	1.8%
	Neutral (N)	Count	9	11	20	0	2	2	22
		%Country	9.4	11.5	20.9	0	3.0	3.0	-
		% Total	5.4%	6.6%	12.0	0.0%	1.2%	1.2	13.2%
	Agree (A)	Count	19	37	56	30	12	42	98
		%Country	19.8	38.5	58.3	42.3	17.0	59.3	-
		% Total	11.4%	22.2%	33.6	18.0%	7.2%	25.2	58.7%
	Strongly Agree (SA)	Count	8	8	16	9	18	27	43
		%Country	8.3	8.3	16.6	13.0	25.4	38.4	-
		% Total	4.8%	4.8%	9.6	5.4%	10.8%	16.2	25.7%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.9 Influencing and negotiation

Table 5.74 shows an account of influencing and negotiation as part of training programmes for library staff. The majority of respondents from Ghana 30% (33.6% agree; 9.6% strongly agree) agreed and similarly, 39.6% (28.8% agree; 10.8% strongly agree) representing the greater portion of the respondents from South Africa agreed.

Table 5.74 Influencing and negotiation (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Influencing and negotiation	Strongly Disagree (SD)	Count	1	3	4	0	0	0	4
		%Country	1.0	3.1	4.1	0	0	0	-
		% Total	0.6%	1.8%	2.4	0.0%	0.0%	0.0	2.4%
	Disagree (D)	Count	5	5	10	0	0	0	10
		%Country	5.2	5.2	10.4	0	0	0	0
		% Total	3.0%	3.0%	6.0	0.0%	0.0%	0.0	6.0%
	Neutral (N)	Count	13	19	32	0	5	5	37
		%Country	13.5	19.8	32.8	0	5	5	-
		% Total	7.8%	11.4%	19.2	0.0%	3.0%	3.0	22.2%
	Agree (A)	Count	16	26	42	39	9	48	90
		%Country	17.0	27.0	44.0	55.0	13.0	68.0	-
		% Total	9.6%	15.6%	25.2	23.4%	5.4%	28.8	53.9%
Strongly Agree (SA)	Count	3	5	8	0	18	18	26	
	%Country	3.1	5.2	8.3	0	25.4	25.4	-	
	% Total	1.8%	3.0%	4.8	0.0%	10.8%	10.8	15.6%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.10 Cognitive flexibility

Table 5.75 depicts that library training programmes capture cognitive flexibility where 29.4% indicated agreed, followed by 19.8% who selected neutral representing Ghana. From South Africa, the majority of respondents 31.8% out of 42.6% indicated agreed which signifies a greater percentage as compared to Ghana.

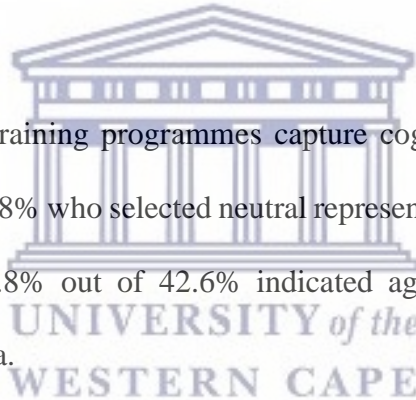


Table 5.75 Cognitive flexibility (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Cognitive flexibility	Strongly Disagree (SD)	Count	1	2	3	0	0	0	3
		%Country	1.0	2.1	3.1	0	0	0	-
		% Total	0.6%	1.2%	1.8	0.0%	0.0%	0.0	1.8%
	Disagree (D)	Count	3	3	6	0	0	0	6
		%Country	3.1	3.1	6.2	0	0	0	-
		% Total	1.8%	1.8%	3.6	0.0%	0.0%	0.0	3.6%
	Neutral (N)	Count	15	18	33	0	0	0	33
		%Country	16.0	25.4	41.4	0	0	0	-
		% Total	9.0%	10.8%	19.8	0.0%	0.0%	0.0	19.8%
	Agree (A)	Count	17	32	49	39	14	53	102
		%Country	18.0	45.1	63.1	55.0	20.0	75.0	-
		% Total	10.2%	19.2%	29.4	23.4%	8.4%	31.8	61.1%
Strongly Agree (SA)	Count	2	3	5	0	18	18	23	
	%Country	2.1	3.1	5.2	0	25.4	25.4	-	
	% Total	1.2%	1.8%	3.0	0.0%	10.8%	10.8	13.8%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.11 Online learning

Online learning was confirmed by both respondents as part of the training programme for library staff where the majority of respondents 32.4% and 34.2% of Ghana and South Africa agreed and strongly agreed, respectively. Detailed results are shown in Table 5.76

Table 5.76 Online learning (N=167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Online learning	Strongly Disagree (SD)	Count	0	2	2	0	0	2	2
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0.0	1.2%
	Disagree (D)	Count	6	1	7	0	0	0	7
		%Country	6.3	1.0	7.3	0	0	0	-
		% Total	3.6%	0.6%	4.2	0.0%	0.0%	0.0	4.2%
	Neutral (N)	Count	4	13	17	0	2	2	19
		%Country	4.2	13.5	17.7	0	3.0	3.0	-
		% Total	2.4%	7.8%	10.2	0.0%	1.2%	1.2	11.4%
	Agree (A)	Count	20	34	54	10	2	12	66
		%Country	21.0	35.4	55.4	14.1	3.0	17.1	-
		% Total	12.0%	20.4%	32.4	6.0%	1.2%	7.2	39.5%
Strongly Agree (SA)	Count	8	8	16	29	28	57	73	
	%Country	8.3	8.3	16.6	41.0	39.4	80.4	-	
	% Total	4.8%	4.8%	9.6	17.4%	16.8%	34.2	43.7%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.12 Aggregated data gathering

As demonstrated in Table 5.77, the respondents reviewed the aggregated data gathered. A greater number of respondents from South Africa 34.6 % indicated Agree. However, the larger number of respondents 18.6% from Ghana were indifferent.

Table 5.77 Aggregated data gathering (N= 167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Aggregated data gathering	Strongly Disagree (SD)	Count	2	4	6	0	0	0	6
		%Country	2.1	4.2	6.3	0	0	0	-
		% Total	1.2%	2.4%	3.6	0.0%	0.0%	0.0	3.6%
	Disagree (D)	Count	3	9	12	10	0	10	22
		%Country	3.1	9.4	12.5	14.1	0	14.1	-
		% Total	1.8%	5.4%	7.2	6.0%	0.0%	6.0	13.2%
	Neutral (N)	Count	14	17	31	0	7	7	38
		%Country	15.0	18.0	33.0	0	10.0	10.0	-
		% Total	8.4%	10.2%	18.6	0.0%	4.2%	4.2	22.8%
	Agree (A)	Count	14	25	39	29	12	41	80
		%Country	15.0	26.0	41.0	41.0	17.0	58.0	-
		% Total	8.4%	15.0%	13.4	17.4%	7.2%	34.6	47.9%
Strongly Agree (SA)	Count	5	3	8	0	13	13	21	
	%Country	5.2	3.1	8.3	0	18.0	26.3	-	
	% Total	3.0%	1.8%	4.8	0.0%	7.8%	7.8	12.6%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%



5.8.2.1.13 Digital information management

As indicated in Table 5.78, the highest percentage of respondents 34.4% indicated they strongly agreed to digital information management forming part of training programmes organized for the library staff from South Africa. Also, from the greater portion of respondents, 35.4% confirmed by indicating Agree.

Table 5.78 Digital information management (N= 167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Digital information management	Strongly Disagree (SD)	Count	0	4	4	0	0	0	4
		%Country	0	4.2	4.2	0	0	0	-
		% Total	0.0%	2.4%	2.4	0.0%	0.0%	0.0	2.4%
	Disagree (D)	Count	4	1	5	0	0	0	5
		%Country	4.2	1.0	5.2	0	0	0	-
		% Total	2.4%	0.6%	3.0	0.0%	0.0%	0.0	3.0%
	Neutral (N)	Count	7	7	14	10	0	10	24
		%Country	7.3	7.3	14.6	14.1	0	14.1	-
		% Total	4.2%	4.2%	8.4	6.0%	0.0%	6.0	14.4%
	Agree (A)	Count	20	39	59	19	17	36	95
		%Country	21.0	41.0	62.0	26.0	24.0	50.0	-
		% Total	12.0%	23.4%	35.4	11.4%	10.2%	21.6	56.9%
Strongly Agree (SA)	Count	7	7	14	10	15	25	39	
	%Country	7.3	7.3	14.6	14.1	20.3	34.4		
	% Total	4.2%	4.2%	8.4	6.0%	9.0%	15.0	23.4%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.1.14 Collaboration and partnership

With regard to Collaboration and partnership, a positive result was obtained from respondents. As shown in Table 5.77, 32.4% out of 57.5% from Ghana indicated Agree, and 23.4% representing the majority from South Africa strongly agreed. The results are demonstrated in Table 5.79.



Table 5.79 Collaboration and partnership (N= 167)

Training			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
Collaboration and partnership	Strongly Disagree (SD)	Count	0	2	2	0	0	0	2
		%Country	0	2.1	2.1	0	0	0	-
		% Total	0.0%	1.2%	1.2	0.0%	0.0%	0	1.2%
	Disagree (D)	Count	4	5	9	0	0	0	9
		%Country	4.2	5.2	9.4	0	0	0	-
		% Total	2.4%	3.0%	5.4	0.0%	0.0%	0	5.4%
	Neutral (N)	Count	9	10	19	10	0	10	29
		%Country	9.4	10.4	19.8	14.1	0	14.1	-
		% Total	5.4%	6.0%	11.4	6.0%	0.0%	6.0	17.4%
	Agree (A)	Count	21	33	54	10	12	22	76
		%Country	22	34.3	56.3	14.1	17.0	31.1	-
		% Total	12.6%	19.8%	32.4	6.0%	7.2%	13.2	45.5%
Strongly Agree (SA)	Count	4	8	12	19	20	39	51	
	%Country	4.2	8.3	12.5	26.0	28.2	54.2	-	
	% Total	2.4%	4.8%	7.2	11.4%	12.0%	23.4	30.5%	
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

Summing up, the result shows that the use of emerging technologies, complex problem solving, critical thinking, creativity, and innovation, people management, coordinating with others, emotional intelligence, judgment and decision making, service orientation, influencing and negotiation, online learning, aggregated data gathering, digital information management, collaboration, and partnership are skewed towards positive as a greater percentage of responses were agreed and strongly agreed with a few neutrals. This report suggests that the content of education and training programmes encapsulates items that are critical for 4IR.

5.8.2.2 The extent of training needed on new technologies in the library

New technologies are evolving exponentially in the 4IR as compared to the previous revolution. Therefore, academic libraries must invest in training and enabling library staff to acquire needed new skill-sets to embrace change to ensure smooth digital transformation in the library. Given this,

respondents were asked about how often they needed training on new technologies. Responses are shown in Table 5.80.

Table 5.80 Extent of training needed (N=167)

The extent of training needed on new technologies in the library		Very often	Often	Once a while	Every six months	Ones Every year	Only when there is a new implementation of a system or product in the library	Not sure	Total
Library 1-GH	Count	3	12	8	1	1	12	1	38
	%Country	3.1	12.5	8.3	1.0	1.0	12.5	1.0	-
	%Total	1.8%	7.2%	4.8%	0.6%	0.6%	7.2%	0.6%	22.8%
Library 2-GH	Count	8	8	20	0	16	5	1	58
	%Country	8.3	8.3	20.8	0	16.7	5.2	1.0	-
	%Total	4.8%	4.8%	12.0%	0.0%	9.6%	3.0%	0.6%	34.7%
Subtotal		11 (6.6%)	20(12%)	28(16.8%)	1(0.6%)	17(10.2%)	17(10.2%)	2(1.2%)	96(57.5%)
Library 1-SA	Count	0	19	10	0	0	10	0	39
	%Country	0	26.8	10.4	0	0	26.8	0	-
	%Total	0.0%	11.4%	6.0%	0.0%	0.0%	6.0%	0.0%	23.4%
Library 2-SA	Count	25	5	0	0	0	2	0	32
	%Country	35.2	7.0	0	0	0	2.8	0	-
	%Total	15.0%	3.0%	0.0%	0.0%	0.0%	1.2%	0.0%	19.2%
Subtotal		25 (15.0%)	24 (14.4%)	10(6.0%)	0 (0.0%)	0(0.0%)	12 (7.2%)	0(0.0%)	71(42.6%)

Responses from Ghana were once a while (16.8%), often (12%), yearly (10.2%), only when there is a new implementation of a system (10.2%), and very often (6.6%). Responses from South Africa indicated very often (15%), often (14.4%), only when there is a new implementation of a system selected (7.2%), and once a while (6.0%).

5.8.2.3 Training in 4IR technologies

Respondents were asked to indicate the various 4IR technologies and applications on which they have received training either internally or externally regardless of whether it has been implemented or yet.

5.8.2.3.1 Big data

It can be seen from above Table 5.81 that a large group (81.2%) of Ghanaian librarians have not received training on big data. Similarly, 52.2% of South African librarians have not received training on big data.

Table 5.81 Big data (N=167)

1. Big data		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Sub total	Library 1-SA	Library 2-SA	Sub Total	
Yes	Count	6	12	18	9	25	34	52
	%Country	6.25	12.5	18.8	12.7	35.2	47.9	-
	%Total	3.6%	7.2%	10.8%	5.4%	15.0%	20.4%	31.1%
No	Count	32	46	78	30	7	37	115
	%Country	33.3	47.9	81.2	42.3	9.9	52.2	-
	%Total	19.2%	27.5%	46.7	18.0%	4.2%	22.2%	68.9%

5.8.2.3.2 Artificial intelligence applications

Table 5.81 indicates that 67.8% of respondents from Ghana and 43.35 from south Africa have not received training in artificial intelligence applications.

Table 5.82 Artificial intelligence applications (N=167)

2. Artificial intelligence applications	Ghana			South Africa			Total	
	Library 1-GH	Library 2-GH	Sub Total	Library 1-SA	Library 2-SA	Sub Total		
Yes	Count	15	16	31	9	32	41	72
	% Country	15.6	16.7	32.3	12.7	45.1	57.8	-
	% Total	9.0%	9.6%	18.6%	5.4%	19.2%	24.6%	43.1%
No	Count	23	42	65	30	0	30	95
	% Country	24.0	43.8	67.8	42.3	0	43.3	-
	% Total	13.8%	25.1%	52.7%	18.0%	0.0%	18.0%	56.9%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.8.2.3.3 Internet of Things applications

Figure 5.48 indicated that not all the respondents had training on the Internet of things applications.

From Ghana, 39.9% and from South Africa 31% received training.



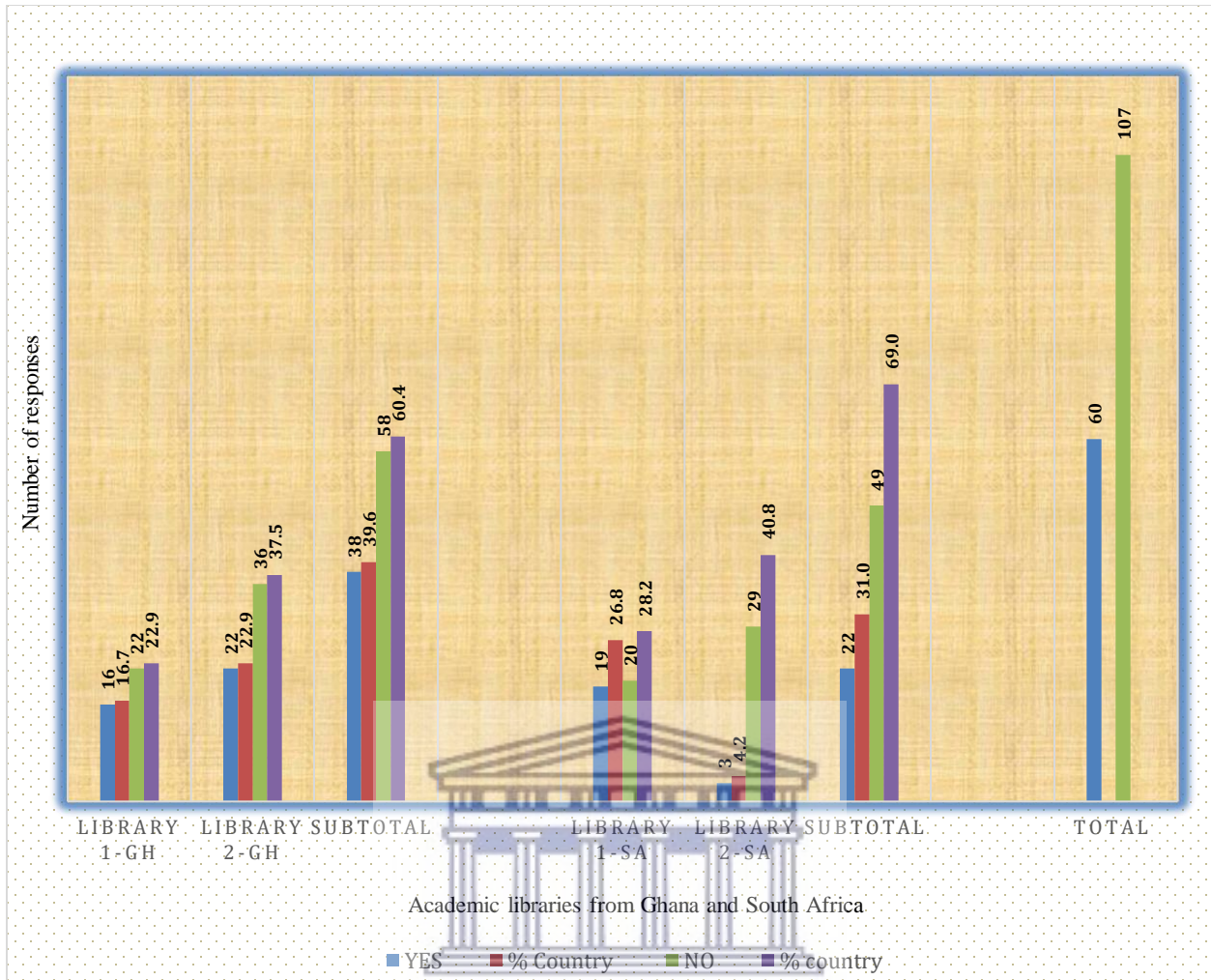


Figure 5.48 Internet of Things (IoT) applications (N=167)

5.8.2.3.4 Advanced robotics

Training in advanced robotics is demonstrated in Table 5.83. From Ghana 95.8% and from South Africa 83.2% of librarians still need to be trained.

Table 5.83 Advanced robotics (N=167)

3. Advanced robotics		Ghana			South Africa			
		Library 1-GH	Library 2-GH	Sub Total	Library 1-SA	Library 2-SA	Subtotal	Total
Yes	Count	1	3	4	0	12	12	16
	%Country	1.0	3.1	4.1	0	17.0	17.0	-
	%Total	0.6%	1.8%	2.4%	0.0%	7.2%	7.2%	9.6%
No	Count	37	55	92	39	20	59	151
	%Country	38.5	57.3	95.8	55.0	28.2	83.2	-
	%Total	22.2%	32.9%	55.1%	23.4%	12.0%	35.4%	90.4%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.8.2.3.5 Virtual and augmented reality

Table 5.49 captures responses on whether respondents had training in virtual and augmented reality. The majority (72.9%) of Ghanaians had no training yet, while 62% of South Africans already received some training.



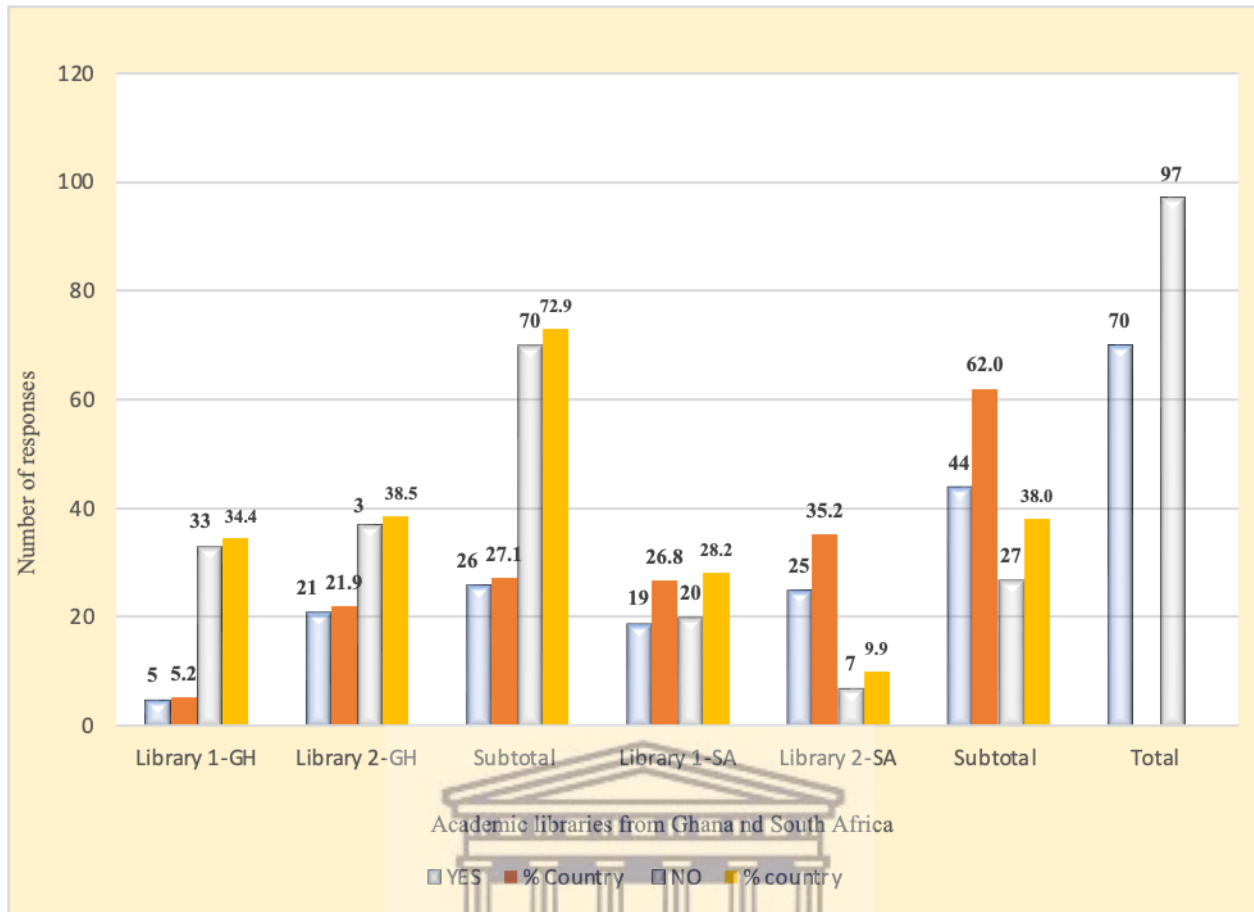


Figure 5.49 Virtual and augmented reality (N=167)

5.8.2.3.6 Simulation

It can be seen from Figure 5.50 that the majority of respondents from each country have not received training on simulation. Respectively 95.8% and 83.1% of Ghanaian and South African respondents still need to be trained on the use of simulation applications.

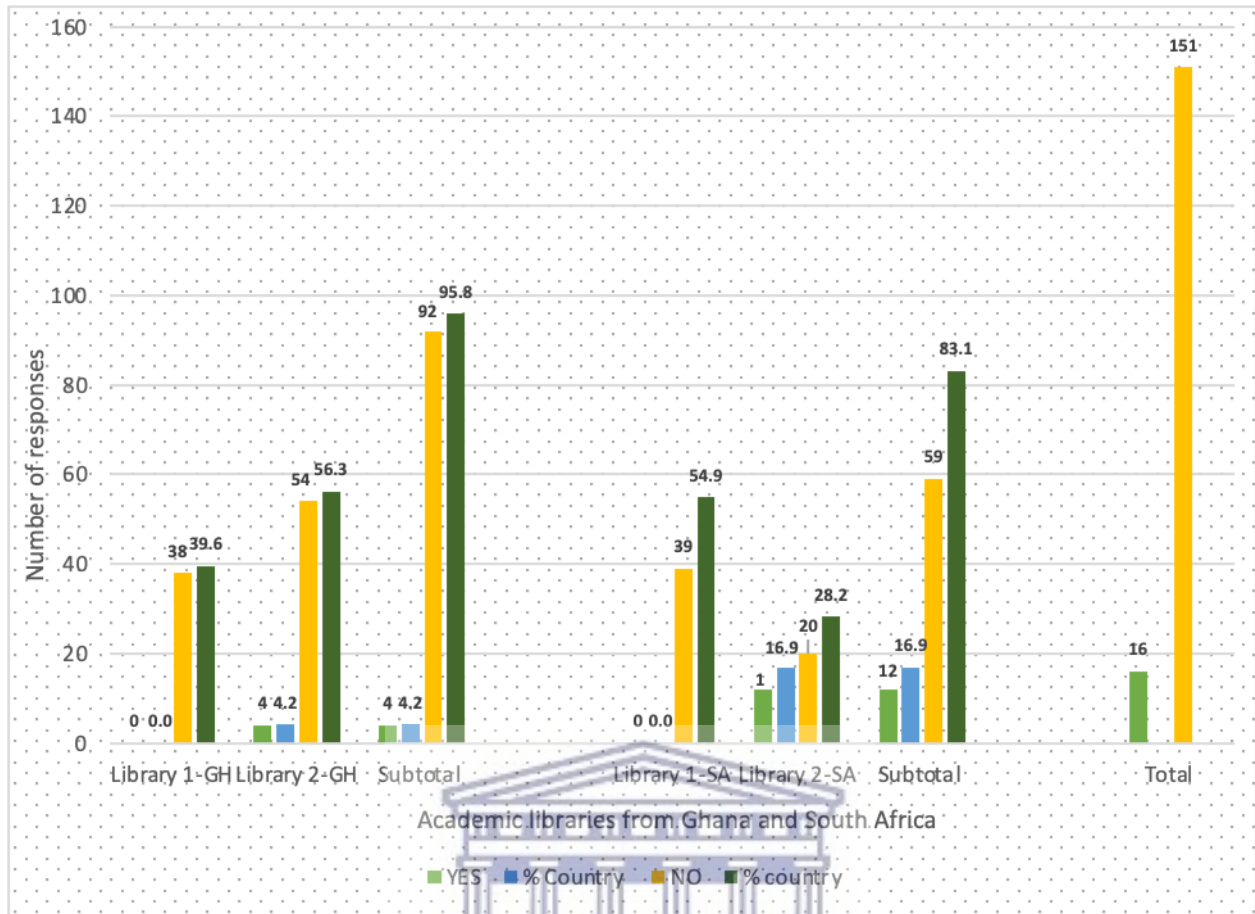


Figure 5.50 Simulation (N=167)

5.8.2.3.7 Blockchain technologies

As portrayed in Table 5.83, not all the respondents have received training in blockchain technologies. From Ghana 82 (95.8%) and from South African 29 (40.5%) had not received training in blockchain technologies.

Table 5.84 Blockchain technologies (N=167)

1. Blockchain technologies	Ghana			South Africa				
		Library 1-GH	Library 2-GH	Sub Total	Library 1-SA	Library 2-SA	Sub Total	Total
Yes	Count	1	3	4	20	22	42	46
	%Country	1.0	3.1	4.1	28.2	40.0	59.1	-
	%Total	0.6%	1.8%	1.4%	12.0%	13.2%	25.2%	27.5%
No	Count	37	55	82	19	10	29	121
	%Country	38.5	57.3	95.8	26.4	14.1	41.0	-
	%Total	22.2%	32.9%	55.1%	11.4%	6.0%	17.4%	72.5%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.8.2.3.8 3D printing

Table 5.85 shows responses on training on 3D printing. Not all respondents from both countries were exposed to training. From Ghana 45.9% and from South Africa 59.2% received training.

Table 5.85 Training on 3D printing (N=167)

3D printing		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Sub Total	
Yes	Count	16	28	44	19	23	42	86
	%Country	16.7	29.2	45.9	26.8	32.4	59.2	-
	%Total	9.6%	16.8%	26.4%	11.4%	13.8%	25.2%	51.5%
No	Count	22	30	52	20	9	29	81
	%Country	22.9	31.3	54	28.2	12.7	40.9	-
	%Total	13.2%	18.0%	31.2%	12.0%	5.4%	17.4%	48.5%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.8.2.3.9 Cloud computing

Figure 5.51 captures responses on training in cloud computing. From Ghana 38.4% of librarians had no training. From South Africa 17.4% indicated no training yet.

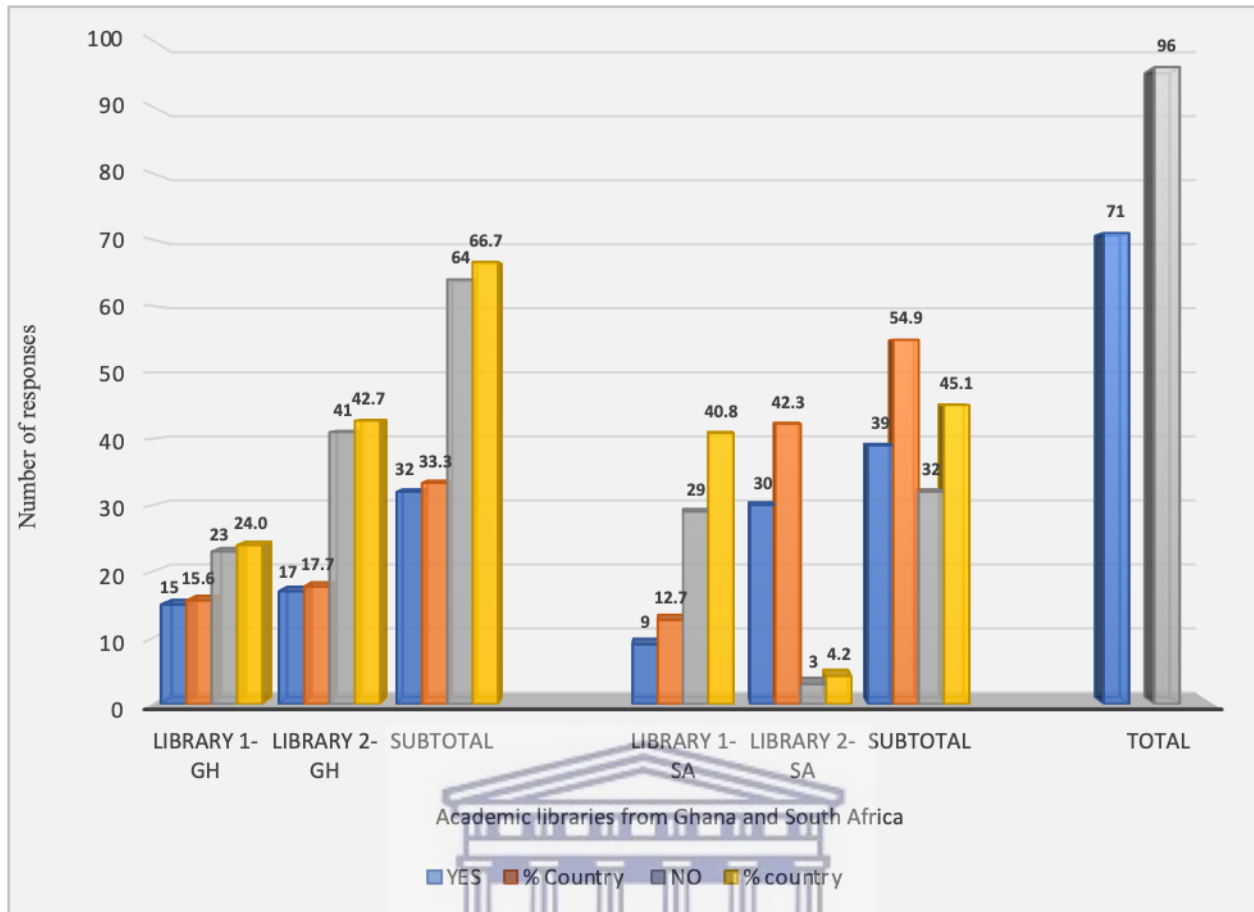


Figure 5.51 Cloud computing (N=167)

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5.8.2.3.10 Makerspace

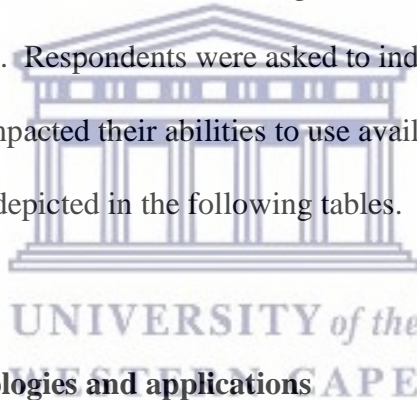
Responses on training on Makerspace are reflected in Table 5.86. The majority (90.7%) of respondents from Ghana have not received training. From South Africa, the majority of respondents (52.1%) received training. Both countries show a large number of librarians still to receive training on Makerspace.

Table 5.86 Training on Makerspace (N=167)

Makerspace		Ghana			South Africa			Total
		Library 1- GH	Library 2- GH	Sub Total	Library 1- SA	Library 2- SA	Sub Total	
Yes	Count	5	4	9	9	28	37	46
	%Country	5.2	4.2	9.4	12.7	39.4	52.1	-
	%Total	3.0%	2.4%	5.4%	5.4%	16.8%	22.2%	27.5%
No	Count	33	54	87	30	4	34	121
	%Country	34.4	56.3	90.7	42.3	5.7	48	-
	%Total	19.8%	32.3%	52.1%	18.0%	2.4%	20.4%	72.5%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5%	23.4%	19.2%	42.6%	100.0%

5.8.2.4 Impact of training

The impact of training programmes on determining if their intended purpose has been accomplished should be assessed. Respondents were asked to indicate how the various education and training programmes have impacted their abilities to use available and emerging technologies and applications. Responses are depicted in the following tables.



5.8.2.4.1 Abreast in new technologies and applications

On the impact of training, respondents were asked to respond to the assertion “It has helped library staff to be abreast of new technologies and applications”, a greater number of respondents 37.7% from Ghana agreed. Also from South Africa, the majority of respondents 23.4% strongly agreed. Detail results can be found in Table 5.87

Table 5.87 Abreast of new technologies and applications (N=167)

Impact of library training programmes			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA		Total
It has helped library staff to be abreast of new technologies and applications	Strongly Disagree (SD)	Count	1	0	1	0	0	0	1
		%Country	1.0	0	1.0	0	0	0	-
		% of Total	0.6%	0.0%	0.6%	0.0%	0.0%	0.0%	0.6%
	Disagree (D)	Count	3	2	5	0	0	0	5
		%Country	3.1	2.1	5.2	0	0	0	-
		% of Total	1.8%	1.2%	3	0.0%	0.0%	0.0%	3.0%
	Neutral (N)	Count	8	3	11	0	2	2	13
		%Country	8.3	3.1	11.4	0	2.8	2.8	-
		% of Total	4.8%	1.8%	6.6	0.0%	1.2%	1.2	7.8%
	Agree (A)	Count	19	44	63	20	10	30	93
		%Country	19.8	45.8	65.6	28.2	14.1	42.3	-
		% of Total	11.4%	26.3%	37.7	12.0%	6.0%	18	55.7%
Strongly Agree (SA)	Count	7	9	16	19	20	39	55	
	%Country	7.3	9.4	16.7	26.8	28.2	55	-	
	% of Total	4.2%	5.4%	9.6	11.4%	12.0%	23.4	32.9%	
Total		Count	38	58	96	39	32	71	167
		% of Total	22.8%	34.7%	57.5	23.4%	19.2%	72.6	100.0%

5.8.2.4.2 Efficient and effective in work delivery

As demonstrated in figure 5.88, respondents were asked to respond to the assertion the training programme “has helped me to be efficient and effective in my work delivery”. Responses show that the training programmes have yielded positive results as the majority of respondents 65 out of 96 from Ghana indicated Agree. Also, out of 71 respondents from South Africa, 39 of them strongly agreed.

Table 5.88 Efficient and effective in work delivery (N=167)

Impact of library training programmes			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
It has helped the library staff to be efficient and effective in their work delivery	Disagree (D)	Count	1	0	1	0	0	1	1
		%Country	1.0	0	1	0	0	0	-
		% Total	0.6%	0.0%	0.6	0.0%	0.0%	0	0.6%
	Neutral (N)	Count	7	5	12	0	2	2	14
		%Country	7.3	5.2	12.5	0	3.0	3.0	-
		% Total	4.2%	3.0%	7.2	0.0%	1.2%	1.2	8.4%
	Agree (A)	Count	20	45	65	20	10	30	95
		%Country	21.0	47.0	68.0	28.2	14.1	42.3	-
		% Total	12.0%	26.9%	38.9	12.0%	6.0%	18.0	56.9%
	Strongly Agree (SA)	Count	10	8	18	19	20	39	57
		%Country	10.4	8.3	18.7	26.0	28.2	54.2	-
		% Total	6.0%	4.8%	10.8	11.4%	12.0%	23.4	34.1%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.4.3 Understand the varying information needs of the user

Table 5.89 illustrates that a greater portion of respondents 61 representing 36.5% from Ghana agreed with the assertion “It has helped librarians to understand the varying information needs of the user”. Another positive result was obtained from respondents from South Africa where 51 (30.6%) depicting the majority strongly agreed.

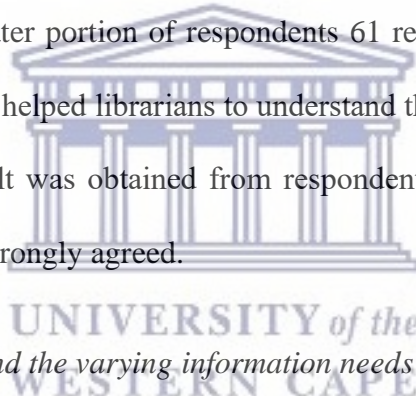


Table 5.89 Understand the varying information needs of the user (N=167)

Impact of library training programmes			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
It has helped librarians to understand the varying information needs of the user	Disagree (D)	Count	1	0	1	0	0	0	1
		%Country	1.0	0	1	0	0	0	-
		% Total	0.6%	0.0%	0.6	0.0%	0.0%	0.0	0.6%
	Neutral (N)	Count	8	6	14	0	2	2	16
		%Country	8.3	6.3	14.6	0	3.0	3.0	-
		% Total	4.8%	3.6%	8.4	0.0%	1.2%	1.2	9.6%
	Agree (A)	Count	19	42	61	10	8	18	79
		%Country	19.8	44.0	64.0	14.1	11.3	25.4	-
		% Total	11.4%	25.1%	36.5	6.0%	4.8%	10.8	47.3%
	Strongly Agree (SA)	Count	10	10	20	29	22	51	71
		%Country	10.4	10.4	20.8	41.0	31.0	72.0	-
		% Total	6.0%	6.0%	12.0	17.4%	13.2%	30.6	42.5%
Total		Count	38	58	96	39	32	71	167

5.8.2.4.4 Reduction of the negative perception

On the assertion, the training programme “has reduced the negative perception (E.g. fear of losing a job) towards the implementation of new technologies and applications” 55 of respondents from Ghana agreed and 29 from South Africa also agreed. Detail results are demonstrated in Table 5.90

Table 5.90 Reduction of the negative perception (N=167)

Impact of library training programmes		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total	
It has reduced the negative perception (E.g. fear of losing a job) towards the implementation of new technologies and applications	Disagree (D)	Count	6	4	10	0	0	10	
		%Country	6.3	4.2	10.5	0	0	0	-
		% Total	3.6%	2.4%	6.0	0.0%	0.0%	0	6.0%
	Neutral (N)	Count	9	8	17	10	8	18	35
		%Country	9.4	8.3	17.7	14.1	11.3	25.4	-
		% Total	5.4%	4.8%	10.2	6.0%	4.8%	10.8	21.0%
	Agree (A)	Count	12	43	55	19	10	29	84
		%Country	13.0	45.0	58.0	26.0	14.1	40.1	-
		% Total	7.2%	25.7%	32.9	11.4%	6.0%	17.4	50.3%
	Strongly Agree (SA)	Count	11	3	14	10	14	24	38
		%Country	11.5	3.1	14.6	14.1	20.0	34.1	-
		% Total	6.6%	1.8%	8.4	6.0%	8.4%	14.4	22.8%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.4.5 Confidence in complex systems and applications

Respondents were asked to respond to the fact that the training programme has helped them build confidence in complex systems and applications. Table 5.91 shows that 57 of the respondents from Ghana agreed, and 34 representing almost half of the respondents strongly agreed.

Table 5.91 Confidence in complex systems and applications (N=167)

Impact of library training programmes			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
I have been able to build my confidence in complex systems and applications through library training programmes	Disagree (D)	Count	5	0	5	10	0	10	15
		%Country	5.2	0	5.2	14.1	0	14.1	-
		% Total	3.0%	0.0%	3.0	6.0%	0.0%	6.0	9.0%
	Neutral (N)	Count	9	10	19	10	4	14	33
		%Country	9.4	10.4	19.8	14.1	6.0	20.1	--
		% Total	5.4%	6.0%	11.4	6.0%	2.4%	8.4	19.8%
	Agree (A)	Count	16	41	57	0	13	13	70
		%Country	17.0	43.0	60.0	0	18.0	18.0	-
		% Total	9.6%	24.6%	34.2	0.0%	7.8%	7.8	41.9%
	Strongly Agree (SA)	Count	8	7	15	19	15	34	49
		%Country	8.3	7.3	15.6	26.0	20.3	46.3	-
		% Total	4.8%	4.2%	9.0	11.4%	9.0%	20.4	29.3%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.2.4.6 Advanced search techniques assistance

This section is to evaluate if the training programme organized for library staff has aided them to assist patrons with advanced search techniques Table 5.92 represents a positive result; Ghana 37.7% agree; 27.4 strongly Agree.

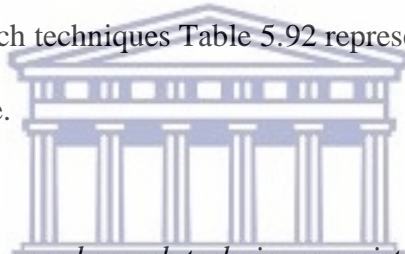


Table 5.92 Advanced search techniques assistance (N=167)

Impact of library training programmes			Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	Total
I can now assist patrons with advanced search techniques with ease	Neutral (N)	Count	5	8	13	0	0	0	13
		%Country	7.0	11.3	18.3	0	0	0	-
		% Total	3.0%	4.8%	7.8	0.0%	0.0%	0.0	7.8%
	Agree (A)	Count	18	45	63	10	12	22	85
		%Country	19.0	47.0	66.0	14.1	17.0	31.1	-
		% Total	10.8%	26.9%	37.7	6.0%	7.2%	13.2	50.9%
	Strongly Agree (SA)	Count	15	5	20	29	20	49	69
		%Country	16.0	5.2	21.2	41.0	28.2	69.2	-
		% Total	9.0%	3.0%	12.0	17.4%	12.0%	27.4	41.3%
Total		Count	38	58	96	39	32	71	167
		% Total	22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

Putting all together it can be seen that 4IR library training programmes organized for staff have had a positive impact as most of the responses on the six (6) items were skewed towards the positive. Most were agreeing that the training has helped them to become abreast of new

technologies with new technologies and applications, to become efficient and effective in their work delivery, and to understand the varying information needs of the user. They also agreed that it had contributed to reducing the negative perception (e.g. fear of losing a job) towards the implementation of new technologies and applications, to building their confidence in complex systems and applications through library training programmes, and to equipping them such that they can now assist patrons with advanced search techniques with ease.

5.8.2.5 Assessment of training

Respondents were asked to generally assess the training received on emerging technologies to determine whether such training programmes are enough for the 4IR. Table 5.93 portrays responses generated from participants.

Table 5.93: Overall assessment of training (N=167)

I think that there are not enough training programmes on emerging technologies in the libraries.		Yes	No	Total
Library 1-GH	Count	32	6	38
	%Country	33.3	6.3	-
	%Total	19.2%	3.6%	22.8%
Library 2-GH	Count	41	17	58
	%Country	42.7	17.7	-
	%Total	24.6%	10.2%	34.7%
Library 1-SA	Count	20	19	39
	%Country	20.8	19.8	-
	%Total	12.0%	11.4%	23.4%
Library 2-SA	Count	14	18	32
	%Country	14.5	18.8	-
	%Total	8.4%	10.8%	19.2%
Total	Count	107	60	167
	%Total	64.1%	35.9%	100.0%

As found earlier, library programmes have yielded positive results. However, as indicated in Table 5.73, the majority of respondents from Ghana have confirmed that there are not enough

training programmes on emerging technologies in the libraries were (19.2%) and (24.6%) of Library 1-GH and Library 2-GH respectively responded with a “Yes”. Also, the majority of respondents (12.0%) from Library 1-SA indicated “Yes” however, Library 2-SA had a larger number of respondents who indicated “No”. Summing them up, it is evident that, academic libraries have not had enough training programmes on emerging technologies pertinent to the 4IR.

5.8.3 Innovation

Innovation is the hallmark for academic libraries to thrive due to exponential changes in new services to satisfy the varying needs of patrons. Given this respondents were asked to indicate what available actions their libraries have in place toward the disruptive change caused by the 4IR.

5.8.3.1 Effective instant messaging

Table 5.94 depicts that, academic libraries in both countries have effective instant messaging through SMS and emails as 80.2% and 85.9% of respondents from Ghana and South Africa respectively acknowledge using effective instant messaging.

Table 5.94 Effective instant messaging (N=167)

Effective instant messaging (through SMS and emails to patrons)		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Yes	Count	32	45	77	29	32	61	138
	%Country	33.3	46.9	80.2	40.8	45.1	85.9	-
	%Total	19.2%	26.9%	46.1	17.4%	19.2%	36.6	82.6%
No	Count	6	13	19	10	0	10	29
	%Country	6.3	13.5	19.8	14.1	0	14.1	-
	%Total	3.6%	7.8%	11.4	6.0%	0.0%	6.0	17.4%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.3.2 Effective mobile library services

Effective mobile library services were favorably rated by all the participating libraries as 123 (64 Ghana; 59 South Africa) acknowledge their libraries as having mobile library services. Details are captured in Figure 5.52.

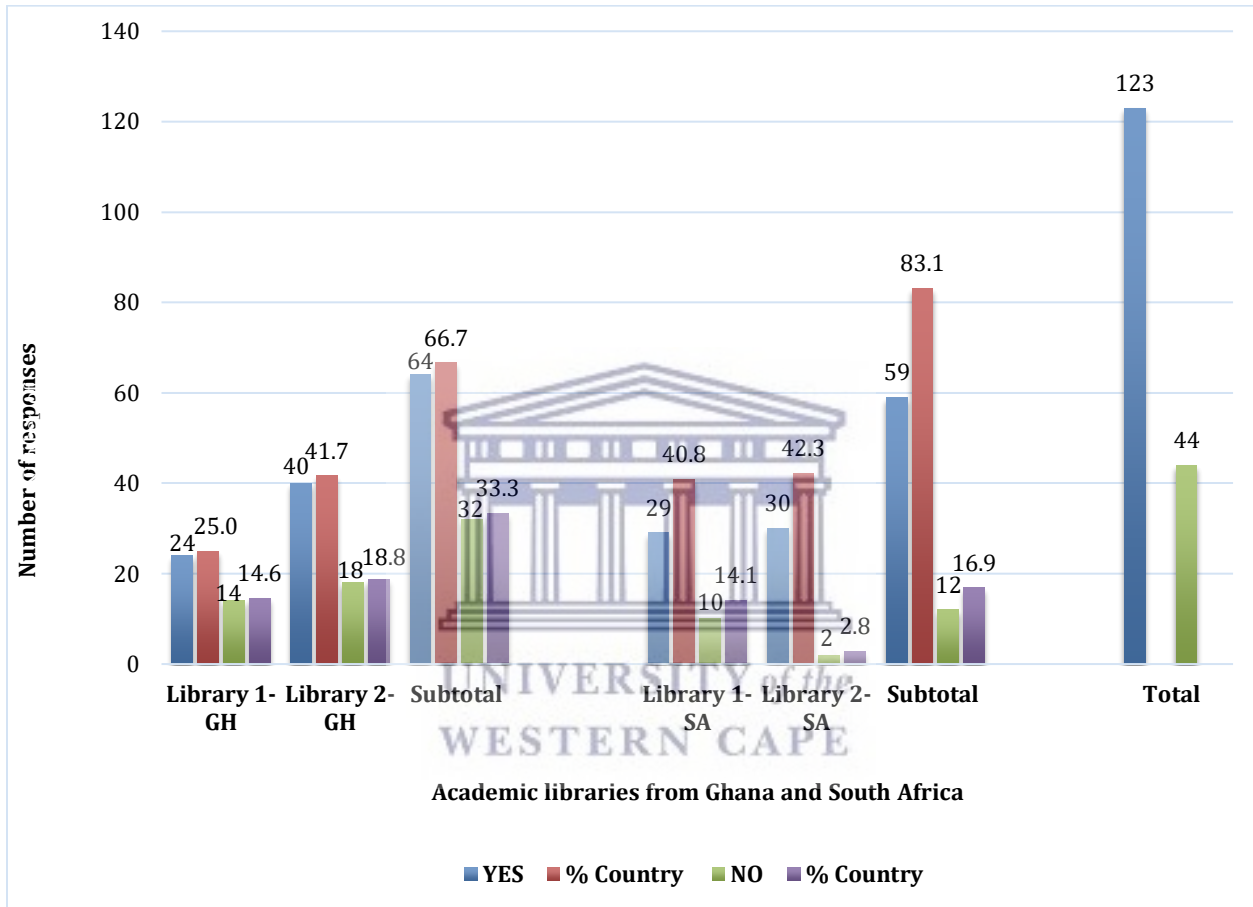


Figure 5.52 Effective mobile library services (N=167)

5.8.3.3 Periodic exhibition of programmes

Table 5.95 indicates the various responses received on whether the academic libraries offered a periodic exhibition of programmes on new services and technologies. The majority of respondents

from both countries confirmed that their libraries offered such programmes. Affirmative responses from Ghana were 85%, while from South African 73.3%.

Table 5.95 Periodic exhibition programmes (N=167)

Periodic exhibition programmes on new services and technologies to patrons.		Ghana		Subtotal	South Africa		Subtotal	Total
		Library 1-GH	Library 2-GH		Library 1-SA	Library 1-SA		
Yes	Count	32	50	82	20	32	43	134
	%Country	33.3	52.1	85	28.2	45.1	73.3	-
	%Total	19.2%	29.9%	49.1	12.0%	19.2%	31	80.2%
No	Count	6	8	14	19	0	19	33
	%Country	6.3	8.3	14.6	26.8	41.4	68.2	-
	%Total	3.6%	4.8%	8.4	11.4%	0.0%	11.4	19.8%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

5.8.3.4 Delivery of digital knowledge

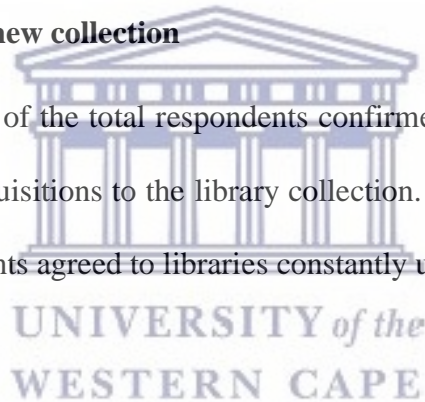
Table 5.96 demonstrates that 87.4% of the total respondents confirmed the assertion “The delivery of digital knowledge is being supplied at low cost to patrons”. This result suggests that delivering services that is cost-effective to patrons is, hence, an indicating factor to attract to patronize digital library services.

Table 5.96 Delivery of digital knowledge (N=167)

The delivers of digital knowledge that is being supplied at low cost to patrons	Ghana			South Africa			Subtotal	Total
	Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal		
Yes	Count	33	45	78	39	29	68	146
	%Country	34.4	46.9	81.3	54.9	40.8	95.7	-
	% Total	19.8%	26.9%	46.7	23.4%	17.4%	40.8	87.4%
No	Country	5	13	23	0	3	3	21
	%Country	5.2	13.5	18.7	0	4.2	4.2	-
	%Total	3.0%	7.8%	10.8	0.0%	1.8%	1.8	12.6%
Total		38	58	96	39	32	71	167
		22.8%	34.7%		23.4%	19.2%		100.0%

5.8.3.5 Constant updates on a new collection

Figure 5.53 displays that 64.1% of the total respondents confirmed that to inform patrons, there are constant updates on new acquisitions to the library collection. From Ghana, 60.4% and from South Africa 67.6% of respondents agreed to libraries constantly updating their collections.



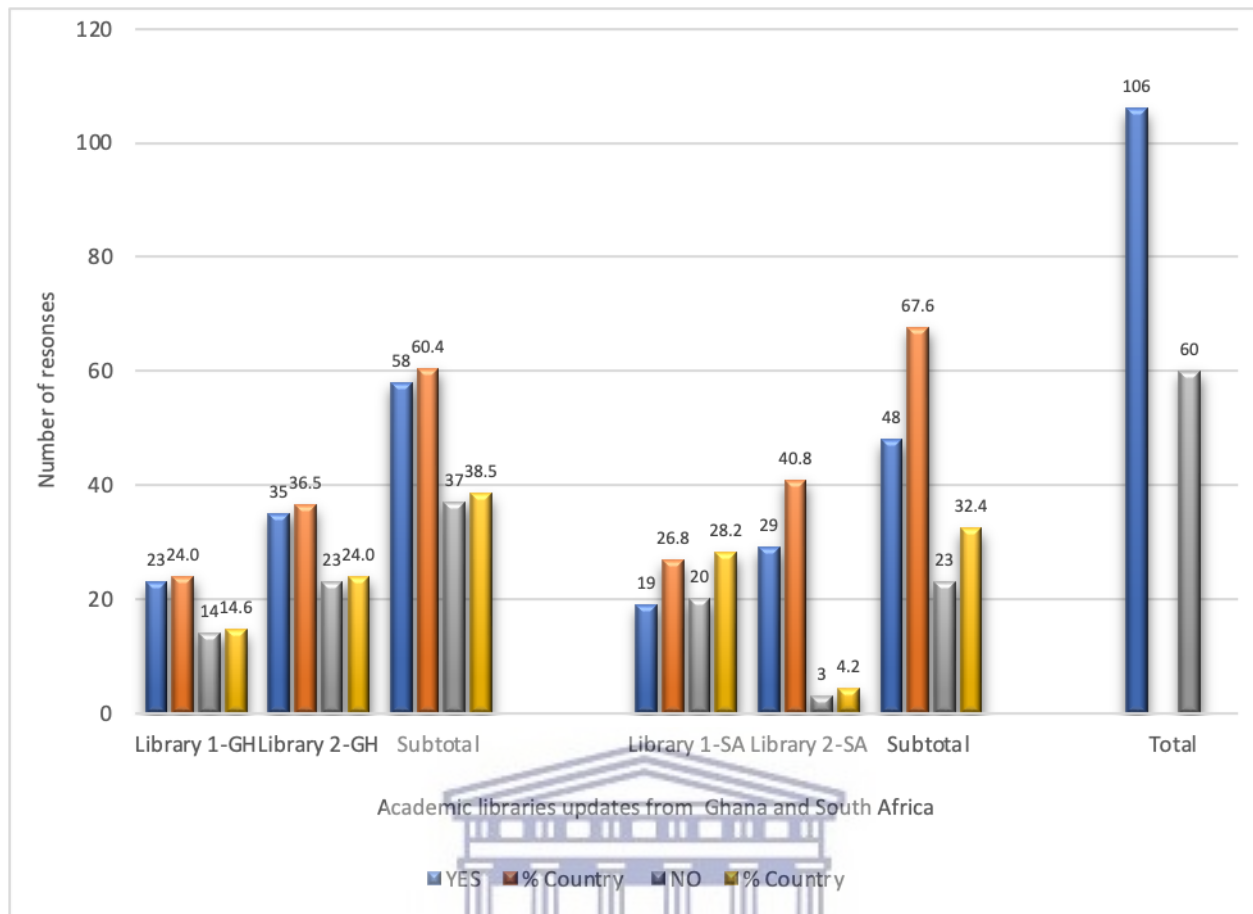


Figure 5.53 Constant updates on new collections (N=167)

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5.8.3.6 Periodic live online library instruction

Responses to whether academic libraries provide periodic live online library instruction are captured in Table 5.97. The majority of respondents from Ghana (73.9%) and South Africa (85.9%) acknowledged period live online library instruction to enhance the performance of the library.

Table 5.97 Periodic live online library instruction (N=167)

There are periodic live online library instruction programmes through a webinar and social media platforms.		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Subtotal	Library 1-SA	Library 2-SA	Subtotal	
Yes	Count	34	37	71	29	32	61	132
	%Country	35.4	38.5	73.9	40.8	45.1	85.9	-
	%Total	20.4%	22.2%	42.6	17.4%	19.2%	36.6	79.0%
No	Count	4	21	25	10	0	10	35
	%Country	4.2	21.9	26.1	14.1	0	14.1	-
	%Total	2.4%	12.6%	15	6.0%	0.0%	6.0	21.0%
Total		38	58	96	39	32	71	167
		22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

From the foregoing, it may be deduced from the findings that all the academic libraries have made efforts to initiate the following innovative services to enhance library services which include effective instant messaging, effective mobile library services, periodic exhibition of programmes, delivery of digital knowledge constant updates on a new collection and periodic live online library instruction.



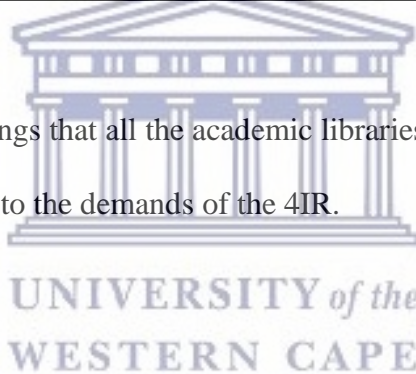
5.8.4 Funding

An adequate fund is one of the critical variables that influence the readiness of academic libraries as with adequate funds, academic libraries will be in a better position to deploy emerging IT technologies, invest in education and training, and bring out apt innovations to transform library services positively. Table 5.98 shows respondents' reactions toward the allocation of funds for Lib 4.0 technologies and applications. The majority of the responses from Ghana (63.6%) were either very high (20.9%) or high (42.7%). From South Africa, the majority of respondents (64.7%) rated the funding as moderate, while 32.4% rated it as low.

Table 5.98 Allocation of adequate funds (N=167)

Allocation of adequate funds towards Lib 4.0 technologies and applications		Ghana			South Africa			Total
		Library 1-GH	Library 2-GH	Sub Total	Library 1-SA	Library 2-GH	Sub Total	
Very High	Count	4	16	10	0	0	0	20
	% Country	4.2	16.7	20.9	0	0	0	-
	% Total	2.4%	9.6%	12	0.0%	0.0%	0	12.0%
High	Count	18	22	40	0	2	2	42
	% Country	18.8	22.9	42.7	0	2.8	2.8	-
	Total	10.8%	13.2%	24	0.0%	1.2%	1.2	25.1%
Moderate	Count	16	15	31	29	17	46	77
	% Country	16.7	15.6	32.3	40.8	23.9	64.7	-
	% Total	9.6%	9.0%	18.6	17.4%	10.2%	27.6	46.1%
Low	Count	0	3	3	10	13	23	26
	% Country	0	3.1	3.1	14.1	18.3	32.4	-
	% Total	0.0%	1.8%	1.8	6.0%	7.8%	13.8	15.6%
Very Low	Count	0	2	2	0	0	0	2
	% Country	0	2.1	2.1	0	0	0	2.1
	% Total	0.0%	1.2%	1.2	0.0%	0.0%	0	1.2%
Total		38	58	96	39	32	72	167
		22.8%	34.7%	57.5	23.4%	19.2%	42.6	100.0%

Source: Field data 2021



It may be deduced from the findings that all the academic libraries are saddled with limited funding in their quest to respond to the demands of the 4IR.

5.8.5 Hypothesis Testing

Hypothesis testing determines the relationship among variables with the intent of drawing a conclusion. The Chi-Square was used to test the association between selected variables as follows:

- a. Technological readiness and Innovation readiness for 4IR
- b. Extent of Training and interest in adopting 4IR technologies.

Hypothesis one

H₀ : Technological readiness will not affect innovation readiness for 4IR

H₁: Technological readiness will affect innovation readiness for 4IR

H₀ is the Null hypothesis.

H₁ is the Alternative hypothesis.

The Significant level (α) for this study is 0.05 and the Chi-Square is given as;

$$\chi^2 = \sum_i \frac{(O_i - E_i)^2}{E_i}$$

Where

O_i are the observed frequencies and

E_i are the expected frequencies

χ^2 is Chi-Square

DF is a Degree of Freedom

COR is Correlation Coefficient.



5.8.5.1 Relationship between technological readiness and innovation readiness

This section intends to investigate the association between technological readiness and innovation readiness. Given this, a correlation between available high specifications computers to render enhanced library services between the availability of mobile library services for patrons. Mobile library services in this sense refer to library services and materials that are available 24 hours a day on any type of device. One item from each construct comprising technological readiness and Innovation readiness was selected to test the association between them.

Table 5.99 Relationship between technological readiness and innovation readiness

Technological readiness: There are available high specs computers to render enhanced library services		Innovation readiness: Availability of mobile library services for patrons	
		Yes	No
Strongly Disagree (SD)	Count	1	2
	Expected Count	2.2	.8
Disagree (D)	Count	4	7
	Expected Count	8.1	2.9
Neutral (N)	Count	35	19
	Expected Count	39.8	14.2
Agree (A)	Count	54	11
	Expected Count	47.9	17.1
Strongly Agree (SA)	Count	29	5
	Expected Count	25.0	9.0
Total	Count	123	44
	Expected Count	123.0	44.0

$X^2=17.918$. $DF=4$, $COR= 0.302$

The degree of freedom (DF) is given as $(r-1)(c-1)$

Where r is the number of rows, c is the number of columns, from the table, the degree of freedom is $(5-1)(2-1) = 4 \times 1 = 4$

From the chi-square table, a DF of 5 at $\alpha = 0.05$ is given as 9.488

Table 5.100: Chi-Square Tests

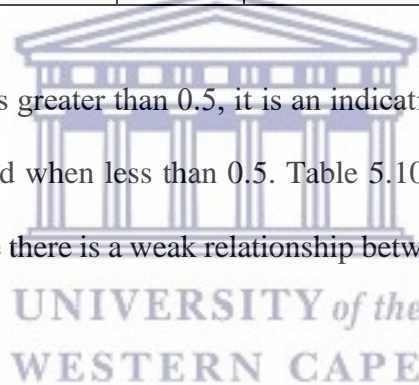
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.918 ^a	4	.001
Likelihood Ratio	16.816	4	.002
Linear-by-Linear Association	15.101	1	.000
N of Valid Cases	167		

As seen in Table 5.100 the calculated Chi-square value = 17.918 and the Chi-Square value from a Chi-square distribution table at a Degree of Freedom of 5 = 9.488 based on this statistic, H_0 is rejected and H_1 is accepted since the Calculated Chi-square value is greater than the value from the Chi-Square table. Therefore, the technological readiness of academic libraries will affect innovation readiness.

Table 5.101 Symmetric Measures

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	.302	.076	4.064	.000 ^c
Ordinal by Ordinal	Spearman Correlation	.291	.075	3.902	.000 ^c
N of Valid Cases		167			

When the value of Pearson's R is greater than 0.5, it is an indication of a strong relationship, and a weak relationship is established when less than 0.5. Table 5.101 shows the Person's R = .302 and this is less than 0.5, therefore there is a weak relationship between technological readiness and innovation readiness.



This test result signifies that, if academic libraries do not have adequate technological infrastructure, they will not be able to embark on innovation strategies for the 4IR.

Hypothesis Two

H_0 : The extent of Training will not affect the interest of library staff in embracing 4IR technologies.

H_1 : The extent of Training will affect the interest of library staff in embracing 4IR technologies.

H₀ is the Null hypothesis.

H₁ is the Alternative hypothesis.

The Significant level (α) for this study is 0.05 and the Chi-Square is given as;

$$\chi^2 = \sum_i \frac{(O_i - E_i)^2}{E_i}$$

Where

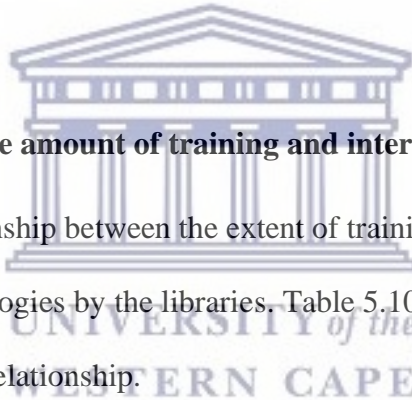
O_i are the observed frequencies

E_i are the expected frequencies

X² is Chi-Square

DF is a Degree of Freedom

COR is Correlation Coefficient.



5.8.5.1 Relationship between the amount of training and interest in new technologies.

This section establishes a relationship between the extent of training in new technologies and interest in newly adopted technologies by the libraries. Table 5.102 shows the selected variables that were used to determine the relationship.

Table 5.102 Relationship between training and interest in new technologies

I think that there are not enough training programmes on emerging technologies in the libraries		Lack of interest in newly adopted technologies					Total
		Strongly Disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree (SA)	
Yes	Count	6	51	21	24	5	107
	Expected Count	7.0	42.9	33.3	19.9	3.8	107.0
No	Count	5	16	31	7	1	60
	Expected Count	4.0	24.1	18.7	11.1	2.2	60.0
Total	Count	11	67	52	31	6	167

	Expected Count	11.0	67.0	52.0	31.0	6.0	167.0
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$X^2 = 20.699$. $DF = 4$, $COR = 0.024$

The degree of freedom (DF) is given as $(r-1)(c-1)$

Where r is the number of rows

c is the number of columns

From the table, the degree of freedom is $(2-1)(5-1) = 1 \times 4 = 4$

From the Chi-square table, a DF of 4 at $\alpha = 0.05$ is given as 9.488

Table 5.103 Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.699 ^a	4	.000
Likelihood Ratio	20.608	4	.000
Linear-by-Linear Association	.006	1	.937
N of Valid Cases	167		

The calculated Chi-square as seen in Table 5.103 = 20.699 and the value from the Chi-Square distribution table at a degree of Freedom of 4 = 9.488, since the calculated Chi-square is greater than the value from the Chi-square distribution table, H_0 is rejected, and H_1 is accepted. Therefore, the amount of training received by library staff will affect their interest in embracing 4IR technologies.

Table 5.104: Symmetric Measures

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	.024	.078	.304	.762 ^c
Ordinal by Ordinal	Spearman Correlation	.027	.078	.353	.725 ^c
N of Valid Cases		167			

Measuring the extent of association between the variables, Table 5.104 shows the Persons' $\chi^2 = .024$ which is less than 0.5 indicating a weak association between the amount of training received and the interest of library staff in embracing 4IR technologies.

5.9 Concluding summary

In this chapter, data obtained from the questionnaire was analyzed using SPSS based on the broad sub-themes; awareness and general knowledge about the 4IR, Lib 4.0 technologies and applications used in academic libraries, librarian's knowledge, skills, and competencies, challenge, responsive strategies, and available policies as well as available actions towards. Chi-square was used to test the relationship among variables.

The next chapter presents a qualitative analysis.



CHAPTER SIX: QUALITATIVE DATA ANALYSIS

6.1 Introduction

This chapter presents data gathered through an interview. In-depth data was needed from the library staff at the top managerial level to complement and give a holistic understanding of data from the questionnaire. Given this background, the university librarians, also known as the executive director of libraries of each participating institution, were interviewed. They were four (4) in total. Academic libraries in Ghana and South Africa refer to their overall head librarian as university librarian and executive director of library respectively. Interviews were recorded using Microsoft teams and ZOOM platforms and the anonymity of respondents was ensured. The verbatim data solicited was neither linked to any of the respondents nor specific institutions. All four library heads were available for the interview; hence a 100% response rate was obtained. Data was based on a thematic content analysis approach and organized under sub-themes based on the objectives of the study.



6.2 4IR Awareness and general knowledge

This section assess respondents' awareness and their general knowledge about the 4IR. The aim is to provide a premise for other research questions to be investigated.

6.2.1 Awareness

Respondents were asked to confirm if they were aware of the 4IR in academic libraries. All the respondents confirmed in the affirmative that they are much aware of the 4IR, hence universal awareness of 4IR was recorded. Detailed responses are depicted in Table 6.1.

Table 6.1: Awareness of 4IR (N=4)

Themes	Responses
Awareness of 4IR	<p>Librarian 1-GH- <i>Yes, I have heard about some activities in 4IR technologies in some South Sahara African universities</i></p> <p>Librarian 2-GH- <i>Yes of course I am aware, as people who use technology a lot. The last Carnegie conference was on 4IR</i></p> <p>Librarian 1-SA- <i>I am much aware of the 4IR technologies for enhanced and increased efficiencies, but I think academic libraries have, you know, are already functioning within highly sophisticated connected environments.</i></p> <p>Librarian 2-SA- <i>Yes</i></p>

6.2.2 Channel of awareness

In terms of the channel of awareness, all four respondents became aware of the 4IR through conferences and webinars and three of them indicated staff meetings: two from Ghana and one from South Africa. One respondent from Ghana identified awareness through reading or research and one from South Africa through a website. This suggests that conferences and other related programmes such as seminars, symposiums, and colloquia play critical roles by informing academic libraries to be proactive and hinting to them about the consequences of not preparing adequately to embrace the inevitable disruptive changes caused by the 4IR. Table 6.2 shows the responses and themes.

Table 6.2 Channel of awareness (N=4)

Themes	Responses
Conferences and Webinars	<p>Librarian1-GH- Through conferences</p> <p>Librarian2-GH- I am somebody who reads a lot about emerging technology, by reading, and my participation in conferences outside</p> <p>Librarian1-SA- So, all universities have got a big drive of being world leaders in the 4TH Industrial Revolution, so I learned about it at the university, through e.g. conferences, website, staff meeting</p> <p>Librarian 2-SA- I got to know about 4IR through conferences</p>
Staff meetings	<p>Librarian 1-GH: One of my colleagues is undertaking a study on references services under the 4IR so I got to know about it</p> <p>Librarian 2-GH- My association with some experts on some emerging technologies usually at staff meetings</p> <p>Librarian 1-SA- So, all universities have got a big drive on being world leaders in the 4th Industrial Revolution, so I learned about it at the university. e.g. conferences website, conferences, staff meetings</p>
Website	<p>Librarian 1-SA- So, all universities have got a big drive on being a world leader in the 4th Industrial Revolution, so I learned about it at the university. e.g. conferences, website, conferences, staff meeting</p>
Research	<p>Librarian 1-GH: Through literature</p> <p>Librarian 2-GH- I am somebody who reads a lot about technology, by reading</p>

6.3 Lib4.0 technologies and applications

Respondents were asked to mention some Lib 4.0 technologies and applications that are available in their libraries. Table 6.3 portrays details of the responses.

Table 6.3 Available Lib4.0 technologies and applications (N=4)

Themes	Responses
Makerspace	<p>Librarian 1-SA The Faculty of Engineering has a massive Makerspace, so we don't have to repeat it because, you know, the library should have a Makerspace. But we are looking at other aspects, you know, we would like to create a studio in the library where students can come and do their recordings, they can come and do their presentations, etc. And so that is different thinking. And say we do not have to follow the same trends</p> <p>Librarian 2-SA Yeah for 4IR technologies, we have a Makerspace where our patrons and other researchers come to learn, and it serves as an opportunity for them to create something innovative. So, it is a place for creativity</p>
3D printing	<p>Librarian 2-SA- We also have virtual reality library checkout and 3D printing</p>
Virtual reality	<p>Librarian 2-SA- Yeah, we have Makerspace, the virtual reality room we've been going to have a hybrid event room next year."</p>

Cloud computing	Librarian 1-SA: <i>Technology certainly has enabled us, particularly cloud-based technologies, to enable users and staff to access the systems and to be able to provide services, irrespective of where they're located. This is where you see the difference between having cloud-based systems versus traditional systems.</i>
Chatbot	Librarian 1-SA: <i>We have a chatbot also known as Oscar librarian. We treat it as part of an integrated system. That's why I'm saying the bells and whistles of the robots that float around.</i>
Ask a Librarian	Librarian 1-GH: <i>For instance, we have the "chat the librarian", it was very well patronized, so we need such kind of services to be able to work everywhere, so whether we are in lockdown or not.</i> Librarian 2-GH: <i>Some of them are virtual libraries, research guides, circulation modules, library mobile applications, electronic newspapers, ask-a-librarian, as well as a virtual reality tour.</i>
Library mobile app	Librarian 2-SA: <i>It is also through mobile app technologies etc that allows anytime access to library resources. It allows students from wherever they are; at home, off-site, on-site, in the country, and beyond the country, to access our resources. That is the one important thing, access, right? It goes beyond physical borders. Advanced mobile with the back slogan, take the university library everywhere you go</i>
Internet of Things yourself (IoT),	Librarian 1-SA: <i>We have the Internet of Things (IoT), check-in-out machines, and book detection machines, all of that are connected as well as library management systems, etc.</i>
Check-in-out machines	Librarian 1-SA: <i>We have Internet of Things yourself (IoT), check-in-out machines, and book detection machines, all of that are connected as well as library management systems, etc.</i> Librarian 2-SA: <i>We also have virtual reality library checkout and 3D printing</i>
Book detection machines	Librarian 1-GH: <i>We have book detection machine</i> Librarian 1-SA: <i>We also have book detection systems; security systems are then added on as an additional layer.</i>
Cataloguing software assistance	Librarian 1-GH: <i>We have cataloguing software assistance, circulation modules, the acquisition module, reporting modules, UG space to reach out to our patrons wherever they are, digital material collection, especially the Africana collection, access to our e-books too, and online databases.</i> Librarian 1-GH: <i>Some of them are virtual libraries, research guides, circulation modules, library mobile applications, electronic newspapers, ask a librarian, as well as virtual reality tours.</i>

As indicated in Table 6.3, all two libraries in South Africa confirmed they have available Makerspace, however, one of the heads librarians brought to the fore that the university has a Makerspace on campus that allows students to think innovatively so there was no need to implement the same thing in the library but they work collaboratively with other faculties that handle such space. It was also added that they are thinking of establishing a studio for the patrons where they can do recordings and presentations. None of the libraries in Ghana has Makerspace

available. Only one of the respondents from South Africa has 3D printing, virtual reality applications, cloud computing, and chatbot. Ask-a-librarian and cataloguing software assistance were confirmed by all respondents from Ghana. Both respondents from South Africa acknowledged using check-in-out machines, library mobile apps, and the Internet of Things. One respondent from Ghana and another one from South Africa selected book detection machines.

The result is an indication that academic libraries from South Africa have more advanced Lib 4.0 technologies and applications than those from Ghana.

6.3.1 Reasons for using lib 4.0 technologies and applications

Respondents were asked to mention reasons that have necessitated the attempt to incorporate Lib 4.0 technologies and applications in their various libraries. All four respondents pinpointed that Lib 4.0 technologies and applications will make them stay relevant, gain greater access to library resources and be effective and efficient. Both South African respondents and one from Ghana testified that the Lib 4.0 technology and application will save cost. Table 6.4 shows in detail the various responses.



Table 6.4 Reasons for using Lib 4.0 technologies and applications (N=4)

Themes	Responses
To stay relevant	<p>Librarian2-GH- <i>Current users are not enthused about the traditional library. So, the global initiatives, the global changes in the library, and the drive for our library to stay relevant are part of it</i></p> <p>Librarian1-SA- <i>But from my side as the executive director, it is also being much more about enabling to upskill staff to keep us cutting-edge libraries and relevant and to use technology to make the lives of members of our staff and patrons better with our services</i></p> <p>Librarian2-SA- <i>To stay active and relevant</i></p>
Greater access	<p>Librarian 1-GH- <i>Once they are able to log on to the off-campus online catalogue, they are able to access our services. So, I realized it was technology that was driving it</i></p> <p>Librarian 2-GH- <i>The impact has been very positive. It allows greater access, greater discoverability, and greater levels of communication. It makes the staff think critically. It is also through mobile app technologies etc that allows anytime access to library resources</i></p> <p>Librarian 1-SA- <i>Allows students from wherever they are, at home, on-site in the country, and beyond the country, to access our resources. That is the one important thing. Access, right? It goes beyond physical borders</i></p> <p>Librarian 2-SA- <i>To optimize the Lib 4.0 resources that are made available for easy access to information. The technology we have enabled us to seamlessly provide and migrate to a virtualized resource space to allow our users remotely access our services and we are able to provide the service so efficiently</i></p>
Effectiveness and efficiency	<p>Librarian 2-GH- <i>It enabled them to be more confident because they are using new types of technology effectively</i></p> <p>Librarian 2-GH- <i>To improve service delivery to our client, to ensure efficiency and productivity, and to cut down the cost of operation with these advanced technologies. It is user-driven</i></p> <p>Librarian 1-SA- <i>It allows people to work and function effectively also from onsite and offsite. It allows for greater. It facilitates greater access to the work environment</i></p> <p>Librarian 2-SA- <i>To be more engaged and effective. Under these conditions, it allows people to work and function effectively also from onsite and offsite</i></p>
Cost-effective	<p>Librarian 2-GH- <i>To improve service delivery to our client, to ensure efficiency and productivity, and to cut down the cost of operation with these advanced technologies</i></p> <p>Librarian 1-SA <i>It saves users' time and librarians focus time on giving better customer care support to our patrons</i></p> <p>Librarian 2-SA- <i>You know for accessing cost, content, etc. You must be working on a learning management system</i></p>

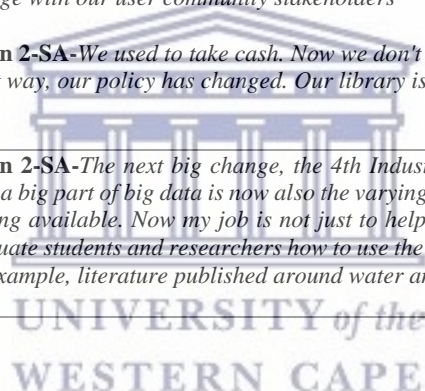
6.3.2 Changes caused by 4IR technologies.

Respondents were asked to indicate practical changes that they have witnessed in their various libraries due to the implementation of 4IR technologies and applications. As depicted in Table 6.5, all four respondents noted that they have developed an online Chat portal like Ask-a-librarian and BotSA as well as that their libraries are connected for quick access to library resources. Both South African libraries and another from Ghana specified the development of library mobile applications to assist access to library resources. South African libraries respectively highlighted the installation of automatic shelving technology and circulation applications which is steadily changing the role of circulation services. One of the South African librarians emphasized the use of big data and the effect thereof on librarianship.

Table 6.5 Changes caused by 4IR technologies (N=4)

Themes	Responses
Automatic shelving technology	Librarian1-SA- <i>We have an automatic shelving machine. We have developed a program where the program sits on an iPhone and when Shelves put the books back onto the shelves, a big part of their job is to check that all the books have been put into the right place and to do a constant stock take, so they put their phone in front of a shelf of books and the software automatically reads which books are missing. Which books are miss shelved, and then gives a stock update</i>
Library mobile app	Librarian 2-GH- <i>We have UCC mobile app</i> Librarian1-SA: <i>The UCT mobile app helps patrons access information online</i> Librarian 2-SA- <i>The second thing is that we have got a library app and our app enables people to locate a particular resource, just as you would do on a Google map system. But you can also pay your fines and take out books on the system. The advanced mobile app with the back slogan, take the UJ library everywhere you go helps to:</i> <ul style="list-style-type: none"> • <i>Search the library catalogue and reserve items</i> • <i>Manage your checkouts, holds, fines, and reading history</i> • <i>View upcoming events and news at our library</i> • <i>Access learning tools and digital resources</i>
Circulation app	Librarian 2-SA- <i>So, our circulation staff work is also changing. Instead of issuing books, they are now becoming information librarians. Their job now is to teach students how to use our circulation app, teach students how to pay their fines, how to check out a book, and how to find things on the site. So, in many ways, they are doing the work now of our general information librarians. They all have a tablet, so they've moved away from the circulation desk to moving around the library and being available for people where and when they are needed, rather than being stuck behind a desk</i>

online chat portal	<p>Librarian 1-GH: <i>Yes, so in the area of references services, we tried to go digital, and we were able to carry out reference services. We were able to do that because we had an intervention in which we were able to interact with our patrons virtually. For instance, we have the “chat the librarian” it was very well patronized, so we need such kind of services to be able to work everywhere, so whether we are in lockdown or not</i></p> <p>Librarian 2-GH <i>patrons have access to the online chat portal.</i></p> <p>Librarian 1-SA- <i>The BotSA help to answer patrons’ question, it has inbuilt artificial intelligence</i></p> <p>Librarian 2-SA- <i>We have asked the librarian online web to chat online or offline</i></p>
Connected library	<p>Librarian 1-GH-<i>We have our remote access which enables our patrons both faculty and students to be able to access our online databases and e-books without any problem. Once they are able to log on to the off-campus online catalogue, they are able to access our services</i></p> <p>Librarian 2-GH-<i>Yeah, as far as technological advancement is concerned, we can attribute most of our initiatives to some of these technologies. We have automated our library, more connected. The impact on the library is massive in all operations of the library, in cataloguing, circulation, information delivery and services, and in all managing our information resources</i></p> <p>Librarian 1-SA <i>So firstly, the change that we have ensured is that our entire infrastructure is a connected environment, right? With this infrastructure that we have, what is the best system to put into place? Secondly, what are the added layers? These are complimentary web-based tools. Web-based applications will have to enable us to function as an academic library to interface and engage with our user community stakeholders</i></p> <p>Librarian 2-SA-<i>We used to take cash. Now we don't take any cash. Everything is on the app, so in that way, our policy has changed. Our library is connected online for quick access</i></p>
Big data	<p>Librarian 2-SA-<i>The next big change, the 4th Industrial Revolution, has brought about, is big data and a big part of big data is now also the varying forms of analytics that different publishers are making available. Now my job is not just to help people find information, but also to teach postgraduate students and researchers how to use the big data that is available. So how to search for, for example, literature published around water and sustainable development?</i></p>



6.4 Librarian’s knowledge and skills in Lib 4.0 technologies

The Head of libraries needs to possess an appreciable level of knowledge of 4IR applications and technologies to be able to contribute and assist in making both short-term and strategic decision that affects the entire library management. With the right knowledge and skills, they are able to guide IT teams and other key players to make prudent decisions about the needs, expenditure, and cost-effectiveness of Lib 4.0 technologies and applications.

6.4.1 General knowledge of Lib4.0

Respondents were asked to rate their general knowledge in Lib 4.0 on a scale of 1 to 10. From South Africa, two of the respondents rated themselves between seven and eight, and from Ghana one mentioned 6 and the other 8. Responses are shown in Table 6.6

Table 6.6 Level of librarian's knowledge and skills in Lib 4.0 technologies. (N=4)

Theme	Responses
<i>General knowledge in lib 4.0</i>	Librarian 1-GH- Technological skills (6) Librarian 2-GH Technological skills (8) Librarian1-SA- I will say Technological skills (7-8) Librarian2-SA- Technological skills (7-8)

6.4.2 The extent of training on new technologies and applications

Library heads were asked how often the library provided staff training. Responses from Table 6.6 show training is organized when needed as confirmed by two South African and one Ghanaian library. Additionally, one librarian from Ghana acknowledged training often, while another from South Africa indicated that training is an ongoing process among the various sections in the library. Various responses are depicted in Table 6.7.

Table 6.7 Extent of training on new technologies and applications. (N=4)

Themes	Responses
Often	Librarian1-GH We do it as often as possible COVID has thought us that skills and the technological gap will be a big hindrance if we become slow on training
Continuous	Librarian1-SA- So, it is pretty much continuous, but we look to do something at least once every two months
Ones every month	Librarian1-SA: We look to do something at least once every two months

As and when needed	<p>Librarian 2-GH- <i>It is a large library with large members. As and when Carnegie, Estra, GLA, or any other organization organizes a programme that is relevant to the library we send members to attend. We provide training when needed. Also, as a library, we have annual programmes that are tailored towards training needs. We also outsourced based on the training needs of the library and as when they become available</i></p> <p>Librarian 1-SA- <i>We acquired Leganto which is a reading list management tool and so it is an added layer to our management system which users use to upload or create their reading list. With this system, training was essential for users to find it easy to navigate its features. When we came to the user implementation, the staff had to learn how to use the platform, so we created a community of practice. We had librarians who emerged as specialists in the tool to train users through workshops when the need be. We train as and when we need it</i></p> <p>Librarian 2-SA- <i>We believe very much in the concept of 'learning organization'. So, people learn and share their experiences. Should there be a need for formal instruction, then we would organize it accordingly. We also upgraded our Learning Management System (LMS) and this is an added layer on the LMS that students use and we had to train users</i></p>
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6.4.3 Impact on the training

Evaluation plays a pivotal role in training programmes organized for employees during and after the implementation stage of any system. Given this, respondents were asked to give their general impression of how impactful training programmes for library staff have been. The results show that head librarians rated the impact of training as positive. Three respondents emphasized the fact that training programmes build up their confidence and two of them indicated it enhances library services as well as better use of new technologies. Detailed responses can be found in Table 6.8.

Table 6.8 Impact on the training (N=4)

Themes	Responses
Build up confidence	<p>Librarian1-GH- <i>They feel more confident in helping our patrons to access our online resources.</i></p> <p>Librarian1-SA- <i>Yep, uh, it's enabled them to be more confident because they are using new types of technology effectively. This saves them time and they can focus on utilizing the saved time in giving better customer care support to our patrons. Training also enables them to become much better teachers in information literacy</i></p> <p>Librarian2-SA- <i>To become technical know-how</i></p>
Embrace and better use of new technologies.	<p>Librarian2-GH: <i>The training has impacted staff on the delivery of services. No matter how much technology you bring to the library if people don't embrace it and make use of it.? It has also impacted management too to effectively embrace and utilize ICT tools to render managerial services</i></p>

Librarian1-SA- *The impact of the training has helped staff to be able to use technology that they couldn't use five years ago*

Improved services.

Librarian2-GH- *It has also impacted management too as well in terms of their goals to ensure that we use technologies to provide good services*

Librarian1-SA- *These types of technology effectively save them time and they can focus time on giving better customer care support to our patrons*

6.5 Challenges face in incorporating 4IR technologies

Respondents were asked to highlight major challenges that their libraries are saddled with in the pursuit of incorporating the 4IR applications and technologies. The responses are captured in Table 6.9. Challenges identified by all the respondents are limited budgets and the lack of Lib 4.0 skillsets. Other challenges identified by two librarians each were inadequate ICT facilities, fear of losing jobs, and bureaucracy in procuring new IT applications and equipment. Challenges mentioned by one librarian each comprise of lack of managerial support, what technology to embrace, unwillingness to learn new skills, high cost of training, and change management.



Table 6.9 Challenges face in incorporating 4IR technologies (N=4)

Themes	Responses
Limited budget	<p>Librarian1-GH- <i>We have a lot of issues with funding</i></p> <p>Librarian2-GH- <i>These new technologies are quite expensive. So, getting money to acquire some of these latest technologies has not been easy. Budgetary allocation for technology has been tough</i></p> <p>Librarian1-SA- <i>So, one of the challenges is an obviously limited budget</i></p> <p>Librarian-SA- <i>One very prevalent challenge is the cost of these technologies. Not everything gives open source and so if you want to ensure effectiveness. Utilization of your library management system and the added layers. It comes at a price and so I think that one of the major challenges is the cost of these tools with insufficient</i></p>
Inadequate ICT facilities	<p>Librarian2-GH- <i>Lack of IT support from suppliers is another issue</i></p> <p>Librarian2-SA- <i>The second challenge is having the right sort of hardware and software to be able to incorporate 4IR technologies and stable Wi-Fi connectivity with adequate bandwidth</i></p>

Lack of library 4.0 skillset		<p>Librarian 2-GH- Skills and expertise are also very important. Some of these technologies are new to the staff and most of the library staff are not IT Savvy</p> <p>Librarian 1-SA- We definitely lack the skills and because people lack the underlying skills, very often, skills of the third industrial revolution. It makes it more difficult to upskill people to be able to use fourth-industrial revolution technologies</p> <p>Librarian 2-SA-As technology tools become more sophisticated, not everybody can manage them. Not everybody wants to be responsible, for instance, in our systems management, I need a librarian for that. Or do I need a computer science graduate to manage it? I think that is a question that we are grappling with at the moment because of the wide-range nature of technologies we now have</p> <p>There is a skill-sets gap, and if we want to function in this environment, then librarians need to enhance their technical skills. Eg. In information systems or computer science skills programming skills because that it is a natural progression. If we are going to be embracing these new tools in this environment, we need to have a new skill-set</p>
Fear of losing a job		<p>Librarian 2-SA- We are also witnessing a change in roles and responsibilities and this scares some of our employees</p> <p>Librarian 1-SA- Fear of people losing their jobs. This has been a crucial issue that slows down staff readiness to accept these disruptive technologies</p>
Bureaucracy in procuring new IT applications and equipment		<p>Librarian 1-GH- The issue of bureaucracy. It takes a very long time for technology procurement to be approved. Even when it was finally approved, there are also delays in terms of approving them for use</p> <p>Librarian 2-GH- Bureaucracy of procurement. Sometimes you will buy a system but by the time the items get to procurement, it will be already obsolete. It is also an issue worth mentioning.</p>
Other challenges	Lack of managerial support	Librarian 2-GH- Management support is another challenge. Some of the management thinks these 4IR technologies are a waste of money. They do not understand the value. Given constant training and alignment of these emerging 4IR technologies will be relevant
	What technology to embrace	Librarian 1-SA- Uh, then another challenge is being able to determine what technologies we should be investing money in, and which ones are not really going to have a long-term impact on our researchers and students
	Unwilling to learn new skills	Librarian 1-SA- The other challenge is, are staff continuously motivated to learn new things
	High cost of training	Librarian 1-SA- So staying up to date with Lib 4.0 or being a Lib4.0 mean that you have to consciously give at least 10% of people time to ongoing training, which is a challenge
	Change management	Librarian 2-SA Staying abreast with all the latest developments and putting in place the right sort of change management strategies.

6.6 Responsive structures needed and policies

Data was solicited from respondents regarding the responsive structures needed and policies in place for the disruptive challenges caused by 4IR.

6.6.1 Responsive structure needed

As part of the responsive structure needed, two of the respondents - one from Ghana and the other from South Africa - stated that they have channeled their efforts into training because it is the gateway to a successful implementation of new technologies and tools. Two of the respondents from Ghana emphasized that they are still in the process of drafting a good strategy for the library and shared light on what should be encapsulated in the strategy as far as the mission of the library is concerned. Marketing and lobbying as well as awareness creation were mentioned by one librarian each. External funding as part of the responsive structures needed for 4IR was suggested by two librarians. Details are presented in Table 6.10.

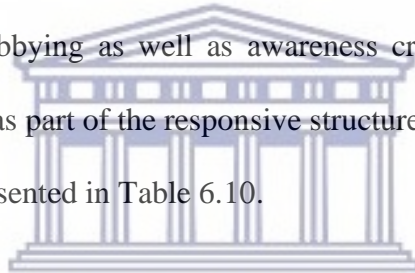


Table 6.10 Responsive structures needed (N=4)

Themes	Responses
Revising library policies	<p>Librarian2-GH- Fortunately, we have the opportunity to develop a library policy or say revised it for the library. We are trying to incorporate some of these technologies into the library policies. We are waiting for approval and one advantage is that when we have 4IR technologies incorporated into the library policies, it is easy to get support from the management</p> <p>Librarian1-SA- Ok. We are in the process of rewriting our strategy. I think it is important for any academic library to have an easy strategy because these technologies are ubiquitous; it influences every aspect of our functionality and operations</p>
Training	<p>Librarian1-GH- We have channeled more efforts into the training of staff. Once our staff is equitable with the new required skill-sets in digital land space, they should be able to carry out any policy, or new programmes.</p> <p>Librarian2-GH- Creating awareness about the 4IR system has also been useful as well as training staff. Bringing new staff with much knowledge in 4IR technologies, and getting staff to understand the benefits of these technologies have also been useful</p>
Marketing and lobbying	<p>Librarian2-GH- Marketing and lobbying have also been useful. Getting people at your side to speak for you, to support you at meetings to support your initiatives and views has also been useful, making presentations to management, getting proposals, and staying strong behind you</p>

Awareness creation	Librarian2-GH- <i>Creating awareness about the 4IR system has also been useful as well as training staff. Getting people to understand the benefits of these technologies has also been useful</i>
External funding	Librarian2-GH- <i>Getting external funding apart from the university has also been supportive as far as the agenda of 4IR technologies is concerned</i>

6.6.2 Available Policies

Table 6.11 shows that none of the participating libraries has a special policy for 4IR but has rather attempted to fuse it into revised general library policies.

Table 6.11 Available Policies (N=4)

Themes	Responses
No specific policy for 4IR	<p>Librarian1-SA- <i>We don't have a particular policy on Library 4.0 but we've got particular policies around it. The only policy in line with lib 4.0 is in line with circulating policies. We used to take cash. Now we don't take any cash. Everything is on the app, so in that way, our policy has changed</i></p> <p>Librarian1-GH- <i>No, as and when we go on and we have the policies, for instance, we are seeking approval for research data management platforms where we have research-based materials collected</i></p> <p>Librarian2-GH- <i>We don't have but we are trying to incorporate some of these technologies into the library policies and let the library board and academic board understand the need to adapt and spend on these 4IR technologies. We are waiting for approval and one advantage is that when we have 4IR technologies incorporated into the library policies, it is easy to get support from the management</i></p>

6.7 Actions towards disruptions

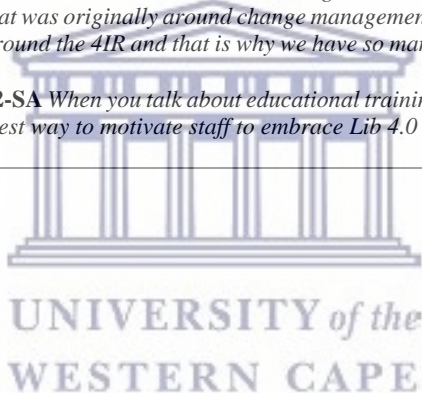
Respondents were asked to share some available practical actions in place to champion the incorporation of 4IR technologies and tools. These actions were grouped into three main areas which comprise: training, funding, and innovation.

As indicated in Table 6.12, all four respondents considered training germane for 4IR technologies. Respondents from South Africa point out that training will help reduce the fear and anxiety of embracing new technologies and to overcome the fear of people losing their job. Ghanaian

librarians emphasized training to motivate staff to embrace new technology and to create awareness to accept policies in connection with 4IR.

Table 6.12: Training (N=4)

Themes	Responses
Training	<p>Librarian1-GH- <i>Fear of people losing their job. So, we have to assure them that even though they will be affected by disruptive technologies, there will be opportunities for them to upgrade them. Given this, continuous training and education is the surest way to get them oriented and embrace Lib 4.0 technologies. We also send our staff to conferences and take part in seminars and Webinars to acquire knowledge about what is happening towards the 4IR for knowledge acquisition. In the past, only a few people partake in conferences. However, this time around we have a lot more of our staff attending conferences and taking advantage of Webinars which are not expensive</i></p> <p>Librarian2-GH- <i>Training and awareness creation programmes for staff and user communities. This is the best way to get people to accept and embrace the implementation of these policies regarding the 4IR systems</i></p> <p>Librarian1-SA- <i>...and then training staff how to use them and then ensuring that these researchers and students use these technologies that we have bought. I have done a lot of the research that was originally around change management and helping people overcome fears and anxieties around the 4IR and that is why we have so many training programs and workshops, etc</i></p> <p>Librarian2-SA <i>When you talk about educational training programs, we cannot do without them; it is the surest way to motivate staff to embrace Lib 4.0 technologies and tools</i></p>



6.7.1 Funding

Limited budget and funding were identified earlier by all librarians as the most dominant issue. Respondents were asked to detail actions put in place toward securing funding for Lib 4.0. From the responses listed in Table 6.13, it can be seen that one South African librarian has fairly contained funds available for new technologies but need to substantiate the cost-effectiveness of new technology to management. Responses from Ghana show that they do not have specific plans for funding toward 4IR.

Table 6.13 Funding (N=4)

Themes	Responses
Funding	<p>Librarian1-SA- <i>I think it would be budgeting, ensuring that we get the budget required for the new technologies. We have a substantial budget, which is very fairly contained, we do make provisions for a fund that will help acquire what will enable the library to function effectively, to advance and enhance our services. If we are able to substantiate the value of the new technology, we can always apply for central funding</i></p> <p>Librarian1-GH- <i>We get our main funding directly from the government that is the university</i></p> <p>Librarian2-GH- <i>We look for sustainable funding to make for the implementation of the 4IR system</i></p>

6.7.2 Innovation

In response to the question on innovation, one of the respondents from South Africa informed about a center for research and innovation that scans and investigates the environment to advise on new trends of technology apropos for the library. From Ghana, one respondent stated webinars and conferences to learn more about new technology, while the other did not specifically mention any innovation action but hinted that they are planning to implement Artificial intelligence machines, and 3D rooms to create an environment for critical thinking and creativity. Table 6.14 shows that while innovative ideas in line with 4IR are yet to be implemented in Ghanaian academic libraries, those in South Africa have attempted running them to enhance library services and add additional layers that are needed for the current trend and needs of technologically savvy patrons.

Table 6.14 Innovation (N=4)

Themes	Responses
Innovation	<p>Librarian1-GH- <i>are taking advantage of webinars, and conferences to learn more about new trends that are necessary for us to implement.</i></p> <p>Librarian2-GH- <i>I think, anything we are doing is aimed at achieving that, to transform the library into a modern technologically enriched library space. We are getting there; we are thinking of creating Artificial intelligence machines, and 3D rooms. We have some basic ones now but there will be an add-on. We need to move towards 4.0 because we have stayed at 2.0 and 3.0 for so long</i></p> <p>Librarian1-SA- <i>Innovation should not be split out separately; innovation should be part and parcel of the way we do. Obviously, in the research environment, we definitely have a research contract and an innovation office. We function on the basis that they encourage innovation. For instance, there is a section in the library called research and innovation. Members of this particular unit do environment scanning; they explore and look into the trend and what will be required of us to introduce those trends, which ones can be incorporated into the services of the library</i> <i>...so staff are encouraged to think differently, introduce new services, and introduce new ways of thinking. Some of the services created directly linked to research support etc. eg enhanced bibliometric, advanced bibliometric</i> <i>Yeah the Makerspace, the virtual reality room we are going to have a hybrid event room next year</i></p>



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6.10 Concluding summary

This chapter encapsulates qualitative analysis to complement data analyzed quantitatively to offset its limitations. Qualitative data was organized under the six (6) main themes of 4IR awareness and general knowledge, librarian’s knowledge and skills in Lib 4.0 technologies, challenges to incorporating the 4IR, responsive structures needed, available policies, and actions towards disruptions.

The next chapter interprets both the quantitative and qualitative findings.

CHAPTER SEVEN: DISCUSSION AND INTERPRETATION OF FINDINGS

7.1 Introduction

This chapter presents a discussion of the findings based on the central objective and research questions of the study. The study assesses the readiness of academic libraries toward the 4IR where Ghana and South Africa were compared. The academic libraries from these two countries were rigorously assessed to ascertain the preparation they have made so far toward the digital transformation needed for the epoch of the 4IR. The discussion of findings ties together results from quantitative and qualitative data under each subtopic and was placed side by side with the relevant literature. Also, a conceptual model which emanated from the Global Competitiveness Index (GCI) and Socio-Technical Theory was used to guide, validate and elucidate the findings of the study. The discussion of major findings is based on the following sub-themes:

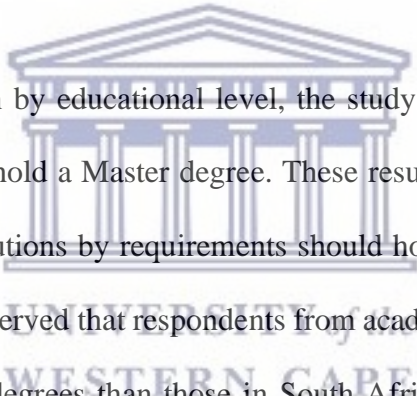
- 
- viii. Demographic data of respondents
 - ix. 4IR awareness and general knowledge
 - x. Lib4.0 technologies and applications
 - xi. Librarian knowledge, skills, and abilities needed
 - xii. Challenges academic libraries in incorporating 4IR technologies
 - xiii. Responsive structures needed and policies
 - xiv. Actions toward disruptions

7.2 Demographic data of respondents

The biographic data of respondents of this study consist of demographic distribution by country, gender, Educational Level, and by Section of work in the library.

In terms of country, of the total population of 203, 167 completed questionnaires were received, 96 were from Ghana, and 71 were from South Africa.

Comparing the demographic distribution by gender from the two countries, it was found that male respondents (38.3%) from academic libraries in Ghana were more than those from South Africa (16.7%). More female respondents (25.7%) were from South Africa compared to 17.9% from Ghana. There were more male respondents 92 (55.1%) than female respondents 75 (44.9%). These results might be because it is suggested in the literature that males are more likely to take tasks that are IT-related and that male librarians are more likely to use Lib 4.0 technologies since the nature of the task is preliminarily IT-related (He & Freeman, 2021).



For the demographic distribution by educational level, the study found that the majority of the respondents 57.3% from Ghana hold a Master degree. These results can be attributed to the fact that librarians in academic institutions by requirements should hold an MPhil degree to become faculty librarians. It was also observed that respondents from academic libraries in Ghana (57.3% of 96) have more postgraduate degrees than those in South Africa (45.1% of 71). This can be attributed to the internal policies that compel library staff of academic institutions to upgrade to the post-graduate level to become faculty members.

The majority of the respondents in both countries 33.7% (17.4 Ghana; 16.2% South Africa) work in the reference/information services of academic libraries. Many also work in e-resources such as IT support units, library systems, cataloguing, circulation, acquisition, and digital institutional repository. This finding can be attributed to the fact that reference/information services are usually

in high demand where patrons visit most to read and photocopy information needed to meet their information needs. This accounts for a greater number of reference librarians.

7.3 4IR awareness and general knowledge

The disruptive changes caused by the 4IR are ubiquitous and already affecting almost every facet of human life. This drastic digital transformation is also evident in the provision of library services. The staff of academic libraries must be aware of and possess enough knowledge of the 4IR to thrive. Librarians' awareness and knowledge form part of the determinants to measure the extent of readiness towards the 4IR and for appropriate actions to be taken.

The study revealed that staff of academic libraries from both countries are much aware of the 4IR and its potential effects on the provision of library services. Further analysis has proven that library staff from South Africa 67 (94.4%) are much more aware of the disruptive changes caused by 4IR than those from Ghana 65(67.7%). This finding suggests that academic libraries in South Africa have invested more in creating awareness of 4IR via various channels and incorporating them into the provision of library services. This finding implies that even though the study recorded significant awareness of the 4IR, the small percentage of respondents who noted their nonawareness of 4IR were experiencing digital transformation caused by 4IR technologies but were not privy to the fact that the phenomenon is an indication of the 4IR. Strengthening this implication, the academic library staff are much more knowledgeable about the general features of a smart library as found later in this section. It can therefore be inferred from the finding that education and training on the part of the academic library still need improvement. As emphasized by the model of the study, especially the GCI component, this conceptual model indicates that

education and training is the gateway to creating massive awareness and use of any adopted technologies (Lib 4.0 technologies). Also, on account of this, the people as one of the constructs of STT propose that workshops, conferences, and webinars are the quickest and easy way to engage library staff through training to increase awareness of emerging technologies. Hence, academic libraries can take a clue from this proposition to enhance awareness creation of the 4IR.

This finding is consistent with the work by Gaspar, Juliao and Cruz (2019) as well as Ahmat and Hanipah (2018) who established that the majority of the librarians were very much aware of the 4IR and heightened awareness and need to acquire Lib 4.0 skills. Some of the Lib 4.0 skills include emotional intelligence, negotiation abilities, intercultural and communicative, collaborative, and digital skills needed by a 21st-century librarian to survive amidst the unavoidable disruptive changes caused by the 4IR. Similarly, this finding is also in agreement with the study by Hussain (2019) who investigated the 4IR and its implication for libraries and librarians and concluded that librarians were not only aware of the impact of the 4IR on library services but saw the need for them to be proactive, and act swiftly and smartly to adjust themselves to face the inevitable disruptive changes to keep their jobs and to stay relevant in providing smart library services. This study's findings also support those of Tela (2020a) and Ntlotlang (2019) where high awareness of the 4IR was established and the need for aggressive and constant review of their resources and services was proffered for library staff to stay relevant. Studies by Mashiyane et al. (2020), Kennedy (2018), as well as Khan and Bhatti (2017), also revealed high awareness of the 4IR.

The internet was found the most utilized means or channel of awareness of the 4IR by academic library staff. They became aware of the 4IR through random web pages with algorithms matching their individual queries. These findings were confirmed by the library heads of Ghana and South Africa during interviews:

“I am somebody who reads a lot about emerging technology on the internet, by reading, my participation in conferences outside, my association with some experts on some technologies”.

“I became aware of the 4IR through literature and also through staff meetings, one of my colleagues is undertaking a study on references services under the 4IR so I got to know about it through conferences.”

These findings correspond with findings by Gleason (2018) as well as Ocholla and Ocholla (2020) that library professionals depend heavily on their web pages for articles published on the 4IR and other related topics rather than on the official university website or through information literacy skills and training programmes. However, the finding is contrary to what Catalano et al. (2018) and Zervoudi (2020) revealed. Their studies found that most information professionals utilize institutional websites to stay well-informed and up-to-date with programmes on 4IR.

This study determined that university websites were, after the internet, used as channels of awareness. This is consistent with findings by Appleton (2018) who established that academic university libraries usually publish information on emerging Lib4.0 technologies on their websites to inform staff and patrons to win new customers and maintain the interest of current customers. While scholars such as Catalano et al. (2018), Chiware and Becker (2018), as well as Sewell and Kingsley (2017), showed that information literacy and training programmes serve as a good

opportunity for library staff to learn about the 4IR, this study found training programmes at the tail end of the channel of awareness of the 4IR. Other channels include social media platforms, news items, information literacy training programmes, magazines, staff meetings, and unit heads.

The majority of library staff are knowledgeable about the 4IR in the general features of a smart library. Peculiarly, the majority of the respondents reacted positively to the following features of a smart library. For example, *Smart library services* can be accessed at anytime, anywhere, everywhere, and by everyone (52.8% of 57.5% Ghana; 42.6% of 42.6% South Africa), *Smart library spaces* are available at any time for everyone and everywhere (57 Ghana; 59 South Africa). Also, similar positive findings were reflected in the following: *Smart library staff* are qualified, competent, adaptive, innovative, critical thinkers, complex problem solvers, self-learners, and ethically upright. *Smart technology and applications* are ones which are effective, efficient, and innovative. *Smart users* are those who are information and smart technology literate, well-informed, adaptable, self-learners, and ethical. *Smart leaders* are visionary and innovative. *Smart library resources* are openly accessible at anytime, anywhere, and by everyone. *Smart policies* are adaptable, responsive, sensitive, and ethical/social justice aligned. *Smart library management* deals with the increasing transparency of the administration and management system, user participation in decision-making processes, automatic and optimized administration procedures, and real-time. *Smart library networking* is about library openness and embeddedness in its social and cultural environment.

These findings are consistent with the study by Sanjeeva (2018) who determined that library staff realized the best policy during the 4IR era is to provide smart services. Academic libraries are

steadily replacing their conventional library services with innovative Lib 4.0 technologies and applications that will give patrons the convenience and ease to access library materials digitally. The findings are also congruent with Khan and Bhatti (2017) who discovered that academic libraries provision digital platforms to make the library services look smart and have realized that technologically savvy patrons have varying information needs and the surest way to meet their current needs is to invest in Lib 4.0 technologies and applications. These novel Lib4.0 technologies will not only connect library staff to intelligent machines for smart services but also expand the scope of the library service, increase high visibility access and enhance the profile of the library, “expedite library operations, increase client satisfaction, and improve the technical performance of difficult library tasks” (Tella et al., 2022, p.1).

7.4 Lib4.0 technologies and applications

Several authors such as Ocholla and Ocholla (2020), Esew (2019), Ahmat and Hanipah (2018), as well as Frahm-Arp (2018), have affirmed that academic libraries will be able to stand tall amidst the disruptive changes caused by the 4IR if they invest in incorporating Lib 4.0 technologies and applications. In an attempt for academic libraries to respond to the demand of the 4IR, the following technologies, though not exhaustive, are being applied in information provisions, such as cloud computing, advanced robotics, artificial intelligence, complex sensors, Internet of Things, cognitive computing, virtual reality, big data, Makerspace, 3D printing and Geotagging (Labangon & Manabat, 2018; Schwab, 2016). Among these numerous Lib 4.0 technologies and applications, it is obvious that not all of these are needed by individual academic libraries but based on local needs and demand by patrons, staff, and top management of the libraries. So, the onus lies on which ones should be enlisted to spend the limited funds on to enhance library services.

7.4.1 Lib4.0 technologies and applications utilized

In the quest to meet the purpose of this study, the second objective of the study sought to find out the various Lib 4.0 technologies and applications that are being used in academic libraries in Ghana and South Africa as a step forward toward the preparation for the disruptive change of the 4IR. The study found that certain Lib 4.0 technologies are deployed by academic libraries in Ghana and South Africa.

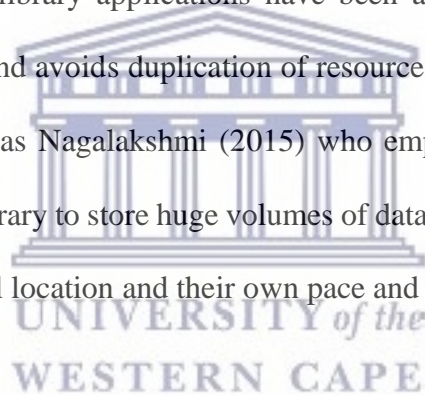
7.4.1.1 Artificial Intelligence (AI)

The findings show that Lib 4.0 technologies and applications such as Artificial Intelligence (AI), have been incorporated into the provision of library services by all the participating academic libraries. The fundamental focus of AI intelligent tasks is reasoning, learning new skills, and adapting to new situations and problems (Mogali, 2015). Its applications permeate all the other Lib 4.0 technologies and applications. It enhances activities such as visual perception, speech recognition, decision-making, and translation between languages. AI is known for contributing to the so called “intelligent society”. The finding is consistent with the study by Yu et al. (2019) who maintained that the application of AI has tremendously changed the nature of library services as it injects new vitality into the development of smart libraries making access to library resources easier, faster, and more convenient. The findings are also in agreement with Vijayakumar and Sheshadri (2019) who asserted that AI has made it possible for librarians and patrons to interact with intelligent machines in an attempt to meet the varying information needs of patrons. Providing intelligent services is also in line with Asemi and Asemi (2018) who established that when searching for information online, the search engine intelligently suggests other relevant

information that may be needed by the information seeker, corrects misspelled words, and ranks results.

7.4.1.2 Cloud computing

Findings show that cloud computing has been utilized by all academic libraries due to its phenomenal contribution to the provision of library services. This finding is in agreement with the study by Ireneo¹, Tijani, and Bakare (2018) which established that cloud computing is compelling in academic libraries for their survival and in their quest to embrace the disruptive change of the 4IR. The finding is also congruent with the study by Dutt (2015) who found that an estimated number of three million cloud library applications have been adopted by libraries worldwide because it helps minimize cost and avoids duplication of resources. The finding also supports the study by Tella (2020a) as well as Nagalakshmi (2015) who emphasized that cloud computing provides the platforms for the library to store huge volumes of data that can be assessed by patrons irrespective of their geographical location and their own pace and convenience.



7.4.1.3 Ask-a-librarian application

The Ask-a-librarian application is another Lib 4.0 application that the study found to be utilized by all the participating academic libraries allowing patrons constant, real-time, and easy communication with librarians to meet their information needs. Sankar and Kavitha (2016) emphasized that Ask-A-Librarian provides a chat window for patrons to access online reference services synchronously and asynchronously. Queries are answered in real-time or patrons leave a question to be answered by a librarian later (Ocholla & Ocholla, 2020). The need for the Ask-a-

librarian application was evident during the COVID-19 pandemic when patrons were forced to contact librarians virtually. This phenomenon was highlighted by one of the head librarians: “The COVID-19 challenges and the lockdowns and our inability to navigate between conditions etc have thought us to be proactive to leverage from online platforms”. Barton (2020), as well as Gesley (2020), emphasized that the COVID-19 pandemic has taught libraries to be proactive, dynamic, and flexible to embrace online platforms and to serve the 21st-century digital-savvy patrons at all times.

7.4.1.4 Virtual reality

Academic libraries in South Africa have incorporated virtual reality applications into library services, but none of the academic libraries in Ghana are utilizing these applications. The University of Pretoria in South Africa has created a world-class Virtual Reality Centre and in addition, the library has launched an application characterized as one-click access to its library resources popularly known as the University of Pretoria’s Boopsie mobile app (University of Pretoria, 2020). Wang et al. (2017) as well as Lessick and Kraft (2017) indicated how virtual reality was introduced successfully at the Ryerson University Library and Archives in Toronto, the University of Utah and the Library Claude Moore Health Sciences Library at the University of Virginia.

7.4.1.5 Big data tools

Big data tools (e.g Batch analysis tools, interactive tools, stream analysis tools) are used, according to Blummer and Kenton (2018), by librarians to analyze and synthesize their high volume of data

holdings, helping them obtain a clear picture of their users' statistics to upgrade and improve upon their services and the surrounding environments. This study found that all the South African academic libraries have incorporated big data tools into their library services while none in Ghana has utilized such Lib 4.0 tools. This corresponds with Sengupta (2019) who emphasized that, despite the phenomenal advantage of big data, it has been realized that only 15% of institutions have managed to implement them in their day-to-day activities. Metzler et al. (2016) attributed low implementation to insufficient qualified staff, legal uncertainties, and risks due to data protection issues.

7.4.1.6 Robot library assistant

Robot library assistant (e.g. Semi Humanoid robot for reference service) is another intelligent tool that is being utilized to replace the work of librarians (Mahalingam et al., 2017) to cut down costs and enhance library service. Libraries such as Harvard University Library (Kyle & Kilcer, 2016), the University of Pretoria Library (Ocholla & Ocholla, 2020), and the Pesisit Central Library where robots have been intelligently programmed to enhance their services and to perform tasks such as filing, sorting, and shelving (Tella, 2020a, Vysakh & Rajendra, 2020a).

The finding of this study shows that, only one (1) out of the four (4) participating libraries confirmed using robot library assistants to perform some library services. This can be attributed to the constraint of a limited budget for the initial purchasing, training of employees to operate it, experts to manage it, and for maintenance costs. Studies by Vysakh and Rajendra (2020b) as well

as Bomble et al. (2015) confirm the high costs of robotics and suggest that library management should acknowledge the value of smart services and the needs of the millennial generation and find funders to invest in robotics services. Some innovative use of robotics are the University of Pretoria's assistant, the Libby, a client service robot responsible for providing guidance, conducting surveys, displaying marketing videos, and answering questions (University of Pretoria, 2019). Chigwada and Nwaohiri (2021) reported on an advanced robotic conveyer system that transports books underground from Bryant Park's off-site storage area to New York Public Library. The University of Missouri Kansas City Miller Nichols Library has installed a robotic storage and retrieval system that holds library about 80 percent of the library's collection (University of Missouri Kansas City, 2018).



7.4.1.7 Internet of Things

The Internet of Things (electronic sensors, actuators, electronic devices as well as objects such as human beings or buildings) fits in with the data-driven 4IR (Evans, 2020) enabling libraries to provide smart services and integrate the Internet into digital devices to facilitate communication and to collect and exchange data (Bongomin et al., 2020).

The study found that three out of the four (75%) participating academic libraries acknowledged fully utilizing the Internet of Things to enhance their smart library services. This corresponds with Wojick (2016) who maintained that the use of the Internet of Things improves library services in numerous innovative ways including providing more tools and opportunities for sharing information, tracking, tracing services, and pushing notification services. This fact also

corroborates Liang (2018) and Fernandez (2015) who illustrated the use of the Internet of Things to organize, manage and control library collections. Abo-Seada, (2019) as well as Pujar and Satyanarayana (2015) concluded that the Internet of Things contributes to the security system of a library and ultimately reduces the workloads of librarians.

7.4.1.8 Makerspace

Creative spaces in libraries purposely earmarked to demonstrate creative ideas practically, learn, collaborate, share ideas, create new things or improve upon existing things were established by only the University of Johannesburg Library. The library head confirmed the use of Makerspace:

“Yeah, for 4IR technologies, we have a Makerspace where our patrons and other researchers come to learn, and it serves as an opportunity for them to create something innovative. So, it is a place for creativity. We also have UJ library checkout and 3D printing”.



Even though the findings reveal that out of the four libraries, only one from South Africa one which has implemented Makerspace, the literature reveals several advanced libraries that have implemented it and others planning to do so. For instance, At the University of Pretoria, Makerspace is available for the entire university community where users utilize it to think creatively and work on their conceptual ideas into objective reality. The University of Johannesburg in the Doornfontein Campus Library has also championed and leveraged a Makerspace by making it available to researchers and patrons. While the UJ libraries saw the need to implement a Makerspace to bring patrons closer as part of their vision for 4IR (University

of Johannesburg, 2017), the University of Pretoria saw it as a “creative laboratory that enables people with ideas to collaborate with people who have the technical ability to make these ideas become a reality.” (University of Pretoria Library Services, 2017).

The low creation of Makerspaces can be attributed to limited funds to purchase needed equipment and for experts to manage it. One of the head librarians indicated that university management perceived spending on the 4IR technologies such as Makerspace as a waste of money. This can be attributed to the fact that they are not privy to the value of these innovative technologies and their impact on the library in general. This finding is similar to Cao, Wu and Stvilia (2020) who compared public, academic, and school libraries in China and concluded that libraries’ inability to implement Makerspace can be attributed to limited funds, inadequate equipment, and low managerial interest. Gao et al. (2017) drew attention to the low numbers of Makerspace due to a lack of professional instructors and low interest and recommended the allocation of external funding as well as support from stakeholders. Li, Fan and Luo (2018), as well as Curry (2017), suggested innovative exhibition programmes to create awareness and interest in makerspaces.

7.4.1.9 3D modeling software

Printers with 3D modeling software are implemented in the academic library to promote creative thinking by converting conceptual art into a real object. The University of Toronto Libraries (University of Toronto Libraries, 2015), the University of Regina Library, Dalhousie University Libraries, and Thompson Rivers, University Library in British Columbia (Nowlan, 2015) have already operating 3D printers.

3D printing services are associated with Makerspaces as found in previous findings. This study shows that only one library from South Africa confirmed having 3D printing services. It can again be concluded that the lack of implementing 3D printing is a result of limited funds, a lack of managerial interest as well as a lack of experts to manage it. Nowlan (2015) also concluded that although Makerspaces coupled with 3D printing provides a welcoming environment for patrons to generate new knowledge through creative and critical thinking, inadequate funds and expertise have hindered many academic libraries from exploring these tools.

7.4.1.10 Chatbot

The advances of a chatbot are that it provides intelligent interactive conversations with library patrons and answers repetitive high-volume questions to reduce the work of human librarians (Indra & Narayan, 2019; Young, 2019; McAfee, 2018; Shelmerdine, 2018; Woods, 2018). The two South African libraries affirmed that their libraries have chatbots that enhance their reference service. One of the directors of libraries from South Africa declared:

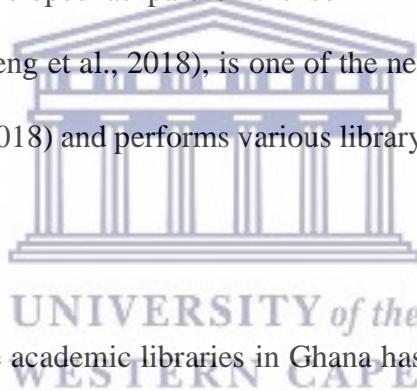
“Yes, so in the area of references services, we tried to go digital, and we were able to carry out reference services. We were able to do that because we had an intervention in which we were able to interact with our librarians virtually. For instance, we have the “chat the librarian” it was very well patronized, so we need such kind of services to be able to work everywhere, so whether we are in lockdown or not”.

This statement supports the study by Jameson, Natal and Napp (2018) who found that libraries deploy chatbots to assist patrons to access information, direct them to specific locations in the library, finding specific library material, and use plagiarism software. They also provide information on circulation, paying fines, new library requisitions, and upcoming events.

The reasons for the Ghanaian academic libraries' inability to leverage chatbots can be attributed to the lack of expertise, funds, and priority in Lib 4.0 technologies.

7.4.1.11 Blockchain technology

Blockchain technology was developed as part of the so called “cryptocurrency technology” (Vysakh & Rajendra, 2020b; Zheng et al., 2018), is one of the newest technologies in the area of academic libraries (Chen et al., 2018) and performs various library functions (Hirsh & Kim, 2019; Hoy, 2017, p.3).

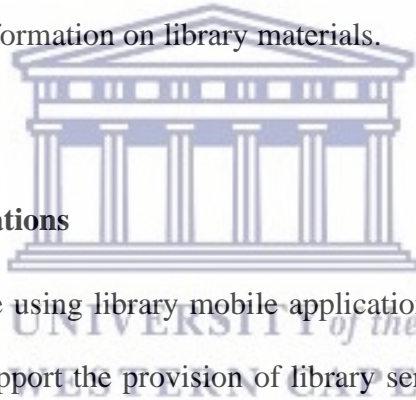


The study found that none of the academic libraries in Ghana has incorporated it into the library services while one of the libraries in South Africa responded in the affirmative. This finding can be attributed to the fact that Blockchain technology is still relatively new in the area of libraries and therefore there is a need to create awareness for academic libraries to learn about its functions and how they can be leveraged from.

7.4.1.12 Quick Response (QR) code

The prime reason for the application of the QR code is to promote the digital marketing of library resources and services as well as to provide quick access to information (Chigwada & Nwaohiri, 2020).

The finding of this study shows that all the academic libraries in South Africa and one from Ghana have deployed QR to enhance their services. This finding is consistent with those of Kim (2020) who found that QR code gives quick access to information to library users to make an informed decision about the available library materials. The finding also is in agreement with Chigwada and Nwaohiri (2020), Mishra et al. (2017) as well as Shettar (2016) who similarly found that information about library space, library catalogue, and the bibliographic list can be digitized using QR code for prompt access to information on library materials.



7.4.1.13 Library mobile applications

Most libraries internationally are using library mobile applications due to mobile devices being ubiquitous and compelling to support the provision of library services. Manjula (2016) asserted that academic libraries have reached a position where the need to use Library mobile apps is not an option. For example, the UP Mobile App was launched by the University of Pretoria to ensure easy access and good interaction among students, faculty, and librarians (Ocholla & Ocholla, 2020; University of Pretoria, 2020; Potgieter, 2015). The UJ mobile applications were introduced to pave the way for patrons to access prompt library services (Ocholla & Ocholla, 2020).

The findings of this study showed that all the participating academic libraries in South Africa and one from Ghana are using mobile applications to support and enhance library services. This high

level of usage is evidence that technologically oriented patrons prefer to access library resources in the comfort of their homes and anytime they wish to do so. In support of this finding, one of the participating library's directors indicated:

“The second thing is that we have got a library app and our app enables people to locate a particular resource, just as you would on a Google map system. But you can also pay your fines and take out books on the system. The advanced mobile app with the back slogan takes the University of UJ library everywhere you go help to search the library catalogue and reserve items, manage your checkouts, holds, fines, and reading history, and view upcoming events and news at our library and access learning tools and digital resources”.

These findings are similar to Okike (2020) who concluded that the library mobile application has a propensity of attracting new patrons, maintaining the interest of existing ones, and winning back the lost ones due to their smart nature. Manjula (2016) also emphasized that the library mobile application assists to reach a large audience, is cost-effective, supplies 24/7 personalized access, provides user-friendly library service, and encourages reading habits.

7.4.1.14 Others

Library bookmark applications are being used by one of the participating libraries in South Africa, Scheduling and event management software, as well as a self-checkout machine, were found as part of services in all the two academic libraries in South Africa as indicated by the respondents but none was found in Ghana. One of the academic libraries in Ghana has intensified its security

measures by installing a biometric security sensor for check-in and check-out, while this service is already in place in all the academic libraries in South Africa.

The following technologies are being used by all the participating academic libraries in the study:

- Virtual library research guide,
 - Library tutorials (video) tool,
 - Circulation modules,
 - Digital library repositories (Dspace, Fedora commons),
 - Library social media platform,
 - E-newspapers,
 - Webinar digital library training service,
 - Reference management tools (e.g. Mendeley, endnote, Zotero).

Most of these technologies started operation during the third industrial revolution but enhanced versions are critical in the era of the 4IR to contribute to the agenda of obtaining a smart library.



7.4.2 Reasons for using Lib 4.0 technologies and applications

The study found several reasons for investing in Lib 4.0 technologies and applications by academic libraries:

- to make library services easier to use and access,
- to inspire patrons to patronize library services,
- to help patrons learn new skills,
- for the library to stay relevant in providing services,

- to attract new and maintain existing customers

Additionally, some of the library directors detailed the intent for investing in Lib 4.0 technologies and applications as they envisioned these modern technologies will enable them to become cutting-edge libraries and to stay active but relevant to provide smart services to 21st-century librarians.

One director, from South Africa for instance, mentioned:

“but from my side as the executive director, it's also being much more about enabling to upskill staff to keep us cutting edge libraries and relevant and to use technology to make the lives of members of our staff and patrons better with our services”.

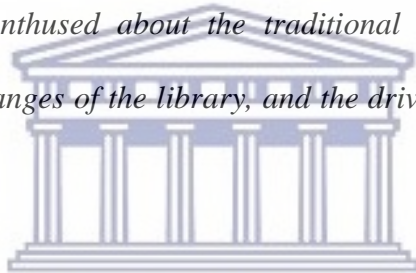
Other directors also emphasized that their motivation for investing in Lib 4.0 technologies and applications is to attract broader visibility and access:

“Lib 4.0 technologies allow greater access, greater discoverability, and greater levels of communication. It makes the staff think critically. It is also through mobile technologies etc that allows anytime access to library resources. It allows students from wherever they are; at home, off-site, on-site, in the country, and beyond the country, to access our resources. It goes beyond physical borders”.

Similar findings were recorded by Ocholla and Ocholla (2020), Du Toit (2019) as well as Lase (2019) who emphasized that academic libraries are redirecting their focus on creating a virtual space for patrons as their information needs keep changing as well as to protect their services from becoming redundant.

The academic libraries realized that to improve their effectiveness and high productivity, it is essential to focus on replacing Lib 4.0 technologies with some of the conventional tools to meet the current needs of users. This assertion is in line with a study by Chigwada and Nwaohiri (2021) who emphasized that the impact of 4IR has led to “the increasing digitization of products and services which is termed internet of everything. These tools and applications have the potential to boost productivity in libraries and can reduce costs as well as improve the quality of products and services.” Citing from one of the directors from Ghana:

“to improve services delivery to our client, to ensure efficiency and productivity, to cut down the cost of operation with these advanced technologies”. It is user driven., current users are not enthused about the traditional library. So, the global initiatives, the global changes of the library, and the drive for our library to stay relevant is part of it”.



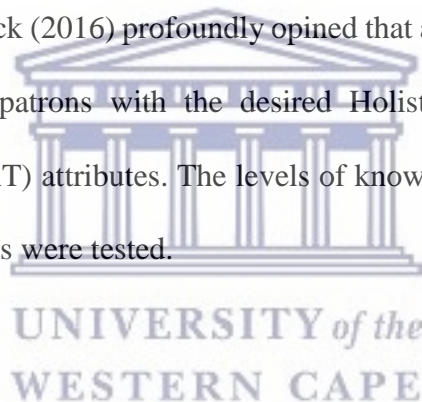
Okike (2020) concurred that current patrons are more attracted to new smart ways of accessing the library such as using library mobile applications.

In general, it can be realized that academic libraries are fairly equipped with Lib 4.0 technologies relevant to the 4IR. It can be understood that inferring from the model of the study, there is an inadequacy in technological readiness which is a compelling construct for an academic library to thrive significantly. This can be attributed to inadequate funding which the model emphasized as a chief leading cause of difficulties in embracing Lib 4.0 technologies. It is incumbent on the part

of the management and stakeholders of the library to devise strategies to score high in financial readiness in order to have a high score in technological readiness.

7.5 Librarian knowledge, skills, and abilities needed

For academic libraries to succeed in implementing and utilizing Lib 4.0 technologies and applications, librarians need to possess the right knowledge, right skillset, and competencies. Many people anticipate the relevancy of academic libraries as the 4IR makes it possible to use artificial intelligence applications for all data and information to be managed and shared in real-time. For academic libraries to stay relevant, complete transformational changes must be done necessitating reskilling and upskilling of librarians to meet the needs of 21st-century patrons. Dempsey and Malpas (2018) as well as Frederick (2016) profoundly opined that academic libraries must provide value-added services to serve patrons with the desired Holistic, Entrepreneurial, Balanced, Articulate, and Thinking (HEBAT) attributes. The levels of knowledge, skills, and competencies toward the 4IR of the respondents were tested.



7.5.1 Knowledge abilities of academic librarians needed for 4IR

The finding of this study was based on the summary of the assessment of knowledge abilities of academic librarians using the variables; library management software, programming skills, library automation, knowledge taxonomy, information search strategy, online registration of patrons, users' interfaces of library webpages, virtual help desk, and web-based tutorials. The study found that while South Africa respondents have high levels of knowledge (64.8%) of the aforementioned variables, those from Ghana had a moderate level of knowledge (47.9%). It can be concluded that academic libraries need to reconsider the content of their training programmes

that are focused on the 4IR if they want to stay relevant and justify their value of existence. Librarians should work sedulously to improve upon their competencies as they approach the 4IR (Nashihuddin & Suryono, 2018) with greater knowledge in e-resources management, coding, programming, library automation, digital literacy, managerial leadership, and research literacy to thrive well during the 4IR.

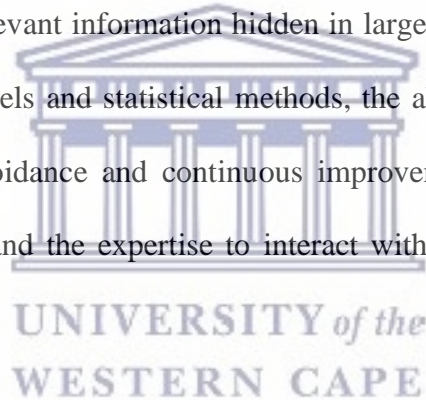
7.5.2 IT Skills and competence of academic librarians needed for 4IR

Several authors such as Kolle and Parmeshwar (2014) as well as Tella (2020b) have confirmed that the 4IR needs a new breed of librarians who are ready to re-skill, upskill, and possess the attitude of embracing change. There are myriads of skills and competence needed for 4IR; mainly technological, programming, digital, analytical, and critical thinking as well as personal skills. Data scientist talent, digital content development, and digital user advising talent capabilities are also needed. Additional skills are formation curation, technology design, system analysis, and evaluation, innovation, creativity and originality, complex problem-solving, in-depth research, active learning as well as emotional intelligence (Ocholla & Ocholla, 2020; Tella, 2020a; Tella, 2020b).

The study assessed the *Technical/hard IT skills* of respondents using the following items: fault and error recovery skills, understanding of digitization processing, and ability to work with advanced technologies e.g. 3D printing, autonomous robots, and understanding of digitization processing. It also assessed their *digital skills* which encapsulate the following items: cloud computing skills, data analytics/data processing, creativity /innovation, and digital content creation skills. Again, the *thinking skills* of respondents were evaluated using the following items which comprise; critical

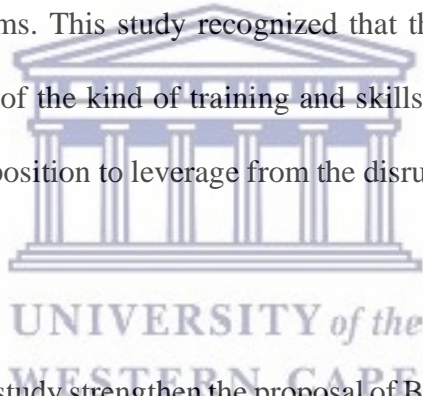
thinking and logical reasons, complex problem solving, troubleshooting, analytical thinking skills, and creativity /innovation.

In the quest to assess the readiness of academic librarians, the *personal skills* of respondents were also evaluated capturing; lifelong learning skills, communicating technologically, leadership skills/people management, emotional intelligence, negotiation skills, embracing and adaptability skills, active learning with a growth mindset, judgmental and decision making. Additionally, the *data science talent capabilities* of respondents were assessed using the following sub variables; the ability to identify patterns of data; the ability to apply context and intelligence; demonstrating the ability to evaluate complex data and document findings, draw conclusions and take appropriate actions, the ability to extract relevant information hidden in large volumes of data, the ability to design and implement data models and statistical methods, the ability to integrate research and best practices into problem avoidance and continuous improvement; demonstrates the expert ability to apply trend analysis and the expertise to interact with values of digital content user interaction.



Putting all these abovementioned variables together, the total scores were grouped into three classes of levels which comprised “low level”, “moderate level”, and “high level”. The finding of this study shows that academic libraries in Ghana have a low level of 60 (62.5%) of knowledge in IT skills and competencies needed for the 4IR whiles South Africa had a score of 48 (67.6%) which represents a moderate level.

Comparing both results, it is realized that academic libraries from both Ghana and South Africa need to organize relevant continuous intensive education and training programmes for their library staff with the prime intent of helping them gain the new skillsets needed to stay relevant in the 4IR era. This finding supports the study by Tella (2020) who investigated repackaging professionals towards the 4IR concluding that a mismatch of skills and the lack of required IT skills and competencies negatively impacted the growth of the libraries. The study then further recommended that it is essential for library professionals as well as patrons to be continuously exposed to the 4IR skills needed and this approach should be accorded the highest priority. The finding is also in line with the Digital Blindspot (2019) indicating that most libraries lack the required skills needed for the era of 4IR, given that library staff should be exposed to IT skills including coding skills, spreadsheets, and digital platforms. This study recognized that there is a need for an academic library to take a cognizant view of the kind of training and skills they are enrolling library staff and patrons in to secure a better position to leverage from the disruptive changes of the 4IR and to stay relevant.



Additionally, the findings of this study strengthen the proposal of Butler-Adam (2018) and Hussain (2019) that to prepare adequately for the 4IR, information professionals, as well as patrons, need to acquire the right skillset therefore, there is the need to review academic curriculum to incorporate more of the 4IR innovative and technological skills to minimize additional training initiatives. This is also supported by Tembe and Mkhathali (2021) who maintained that academic libraries must be futurists on the new skill-sets needed for the 4IR, adjust their training programmes, and review job descriptions to accommodate the current demands of using ICTs as well as communication, marketing, public relations, and research skills.

7.5.3 Level of computer proficiency skills of respondents

The level of computer proficiency skills influences the person's willingness to embrace new technologies and effectively utilize them (Darko-Adjei, 2018; Tegoe, 2012). Since technology is exponentially changing, it is creating continuous demands for library professionals to acquire new knowledge, skills, and competencies. This study found it imperative to assess their computer proficiency skills to determine their level of preparedness for Lib 4.0 technologies and applications.

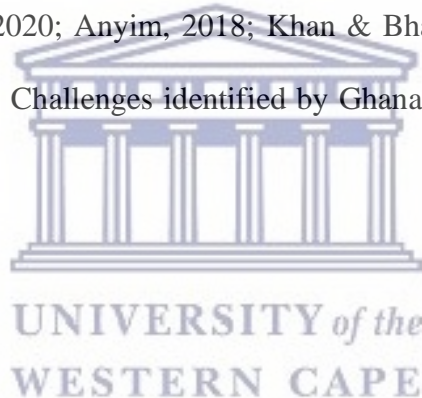
Through ranking of computer proficiency skills of respondents, the study found that information professionals from academic libraries in Ghana 42(25.2%) had an “Intermediate level” of computer proficiency skills while those from South Africa 31(18.6%) had an “Advanced level” of computer proficiency skills. These findings correspond with the findings of the Global Business Coalition for Education (2020) report which indicated that information professionals in Ghana didn't possess advanced skills. Viik et al. (2020) are of the view that information professionals in Africa are trying to upgrade themselves, but the development and drastic changes in technologies are moving at a faster pace. To provide vital library services meeting the needs of patrons, all librarians need to obtain the required new skills and competencies.

All in all, deducing from the finding, a low level of 4IR IT skills and competencies is evident in responses from Ghana and a moderate level from South Africa. According to the model of the study, from the STT perspective, structure, technology, and tasks cannot function without people (Valdez et al., 2016). In this context, without the right skill-sets, library staff will not be in a good position to utilize the implemented Lib 4.0 technologies, perform the required tasks, and operate

effectively within the structured environment. This finding also implies that academic libraries have not scored the required marks in terms of, high education and training focusing on 4IR technologies as emphasized by the GCI. Schwab (2019) asserted that the 4.0 will need workers with 4IR skillsets to stand tall in global competitiveness.

7.6 Challenges to incorporating the 4IR in academic libraries

Several scholars have indicated that academic libraries are facing unprecedented challenges to implement new ICTs with the main challenges being limited funds and the lack of library management to recognize the need for Lib 4.0 technology (Antwi, Ankrah & Frimpong, 2020; Schonfeld & Wolff-Eisenberg, 2020; Anyim, 2018; Khan & Bhatti, 2017; Acheampong, 2016; Mishra, Thakur & Singh, 2015). Challenges identified by Ghanaian and South African libraries are discussed below.



7.6.1 Insufficient budget

Warren (2020) found that insufficient budgets have become an ordinary phenomenon in academic libraries forcing them to constantly fight for a portion of the limited institutional funds to deploy relevant Lib4.0 technologies to render quality library services.

The finding of the study shows that both Ghanaian and South African academic libraries have insufficient and limited budgets for new ICTs. Financial handicaps have deprived academic libraries of deploying modern technologies such as robotics, Blockchain technology, Makerspace,

big data, and virtual reality. Statistically, academic libraries in Ghana (37.8% out of 57.5%) are more affected than in South Africa (21.6% out of 42.6%). One of the library heads acknowledged:

“We have a lot of funding issues. These new technologies are quite expensive getting money to acquire some of these latest technologies has not been easy. Budgetary allocation for such technology has been tough”.

This trend is consistent with Opele (2018) as well as Abban (2018), Acheampong (2016), and Ahenkora-Marfo and Osei-Bonsu (2013) who reported inadequate funding in academic libraries in Nigeria and Ghana respectively as the fundamental obstacle to the advancement in modern technology. Cronje (2019a) Hussain (2019), as well as Penprase (2018), concluded that most academics are currently ill-prepared for the disruptive changes of the 4IR. Even though South Africa is known for championing the incorporation of 4IR technologies in Africa, the work of Oke and Fernandes (2020) confirmed that they are weighed down by limited funding in their effort to implement innovation strategies toward 4IR. By extension, this finding implies that as academic libraries are already saddled with financial constraints, they are also not able to implement innovative strategies which could help attract funds from stakeholders.

This finding connotes that academic libraries do not have effective mechanisms to mobilize funds to support the incorporation of 4IR technologies into library services. In effect, it will impact library staff since there will be insufficient funds to motivate them, as well as education and training, and technological readiness from both GCI and STT perspectives will also be affected.

7.6.2 Inadequate ICT infrastructure and network facility

For academic libraries to thrive positively in the epoch of the 4IR, there is the need to have adequate ICT infrastructure and network facilities such as high broadband for internet connectivity, Hi-tech devices, and high digital connectivity preventing the smooth transition to smart library societies and high specification computers to embrace emerging technologies. Noh and Chang (2020) as well as Hussain (2019) asserted that libraries with dated technology and slow internet connectivity can't render smart library services.

This study's findings show that academic libraries in Ghana (39.6%) are laden with the issue of inadequate ICT infrastructure and network facilities. Reports from South Africa representing the majority indicated otherwise (40.9%), but still not highly positive. One of the library heads from South Africa lamented that: *"the second challenge is having adequate and right sort of hardware and software to be able to incorporate 4IR technologies and stable Wi-Fi connectivity with adequate bandwidth"*. Another one of the library heads from Ghana highlights the need for support from IT suppliers: *"Lack of IT support from suppliers is another issue"*.

These findings are consistent with Manda and Backhouse (2019), Darko-Adjei (2018), as well as Khan and Bhatti (2017), who foresaw that many academic libraries will not be able to materialize their plan of implementing Lib 4.0 technologies due to poor ICT infrastructure. Antwi, Ankrah, and Frimpong (2020), Mashiyane et al. (2020) as well as Ocholla and Ocholla (2019) all agree that due to insufficient ICT infrastructure, some academic libraries in Ghana, South Africa, and Malaysia had to borrow ICTs and devices to render some smart services to patrons.

With the GCI infrastructure in mind, Noh (2015), as well as Adarkwah (2020) stressed that infrastructure is a key element for academic libraries to survive amidst disruptive changes caused by 4IR. This finding implies that as emphasized in GCI, if academic libraries do not strive hard to score high in terms of infrastructure including internet, telecommunication gadget, computers, and accessories the vision of academic libraries championing 4IR will be a mirage.

7.6.3 Inadequate training

Training programmes are fundamental for implementing and utilizing new ICTs and reducing the fear of embracing new technologies.

This study found that both academic libraries in Ghana (39%) and South Africa (31.2%) do not have adequate training on ICT applications and emerging technologies. This finding is consistent with Ankrah and Atuase (2018) who concluded that numerous academic libraries in Africa, due to inadequate funds, do not prioritize training and retraining of library staff to attain the necessary skillsets demanded by the 4IR.

The finding is also in line with the research by Ocholla and Ocholla (2019), Manda and Dhaou (2019) as well as Ghosh (2017) who concluded that without continuous local or international training and retraining, academic libraries will see disruptive changes in the 4IR as a big hurdle leading to a negative impact on the growth of the library. Given this challenge, academic libraries need to work assiduously to deploy alternative but moderate modalities such as online conferences, webinars, online information literacy programs, and workshops as training initiatives.

By implication, inferring from the GCI perspectives, academic libraries are lumbered with inadequate funds to organize enough training 4IR training programmes. It also suggests that leaders of the library are not innovative or do not have an interest in 4IR technologies. Again, individual libraries are not showing interest in taking advantage of available training programmes germane to 4IR.

7.6.4 Lack of ICT Skillset

One of the challenges faced by most academic libraries attempting to utilize Lib 4.0 technologies and applications is the lack of the right ICT skillset. In Africa especially, the digital divide makes it difficult for most libraries to act on their vision of becoming cutting-edge libraries with smart services. ETDP SETA (2020) explored the library and archive skill plan for South Africa and realized that skill gaps such as programming, web design, data management skills, and social media management are lacking among library professionals. In addition, the Global Coalition of Education (2020, p.16) found that “the speed of technological updates often surpasses the speed at which current and future talent can be upskilled and trained, leaving a gap between skills needed and skills available”.

The findings of this study show a lack of the right ICT skillset to utilize Lib 4.0 technologies in both Ghanaian (38.3%) and South African (22.5%) libraries. One of the library heads from South Africa said:

“There is a skillset gap and if we want to function in this environment, then librarians need to increase their technical skills in areas such as information

systems and programming skills because it is a natural progression. If we are going to be embracing these new tools in this environment, we need to have a new skill-set.”

Another library head from South Africa confirmed this by stating:

“We definitely have a lack of skills because people lack the underlying skills. Very often, skills of the third industrial revolution. It makes it more difficult to upskill people to be able to use 4IR technologies.”

These issues must be reduced as, consequently, competitors such as Google and other search engines will take over the work of professional librarians. This finding corresponds with Ayinde and Kirkwood (2020) who found that there is a mismatch between 4IR and the skills needed by information professionals to survive. Mashiyane et al. (2020), Khan and Raad (2020), as well as Anyim (2018), also found that insufficient skills are a critical challenge stifling academic libraries to keep pace with Lib 4.0 disruptive technologies even if innovative strategies are in place and management is ready to incorporate them. These are more reasons for academic libraries to train and retrain staff in relevant skills needed for the 4IR (Ocholla & Ocholla, 2020; Hussain, 2019; Manda & Dhaou, 2019; Ocholla, 2019; Ahmat & Hanipah, 2018). It is also crucial for academic libraries to conduct library staff skills audits to identify each individual’s strengths, abilities, and skills gap to have an in-depth understanding of library staff competencies (Ntlotlang, 2019).

The 4.0 skills gap is a compelling issue that will affect academic libraries’ ability to thrive in the 4IR. Both the STT and GCI explain that no matter how prepared the academic libraries may be in terms of technology, infrastructure, and funds, without the right skill sets possessed by librarians,

the incorporation and use of Lib 4.0 technologies will be highly difficult. This finding implies that the academic library needs to re-channel its focus to training library staff in areas demanded by the 4IR.

7.6.5 Lack of support from authorities

The academic libraries work under the broader supervision of the university. Therefore, the onus lies on the library management to showcase its values so it can receive funding to run its day-to-day activities. As already mentioned, academic institutions are battling with financial constraints, consequently, it affects the library's plans of implementing emerging technologies that will keep them abreast with new trends in order to stay relevant.

From the findings, it was revealed that academic libraries from Ghana (66 out of 96) are facing limited support from authorities to implement ICT applications while those from South Africa (40 out of 71) did not show much evidence of facing a similar issue. One of the directors from Ghana said:



“management support is another challenge. Some of the management thinks these 4IR technologies are a waste of money. They do not understand the value. Given constant training and alignment of these emerging 4IR technologies will be relevant.”


This finding that, suggests academic libraries in Ghana need support to implement Lib 4.0 technologies and applications.

This is consistent with the study by Mashiyane et al. (2020) who established that lack of institutional support has become a big issue for academic libraries. Acheampong and Dei (2020)

also emphasized that the lack of institutional support has made it difficult for academic libraries to materialize their goals towards the 4IR. Ntlotlang (2019), as well as Davis (2015), proffer that academic librarians should be proactive and continue to lobby and solicit support from the top management and other potential sources of funds.

This finding signalizes that, academic libraries do not have a proper structure, policies, good negotiation skills, and effective fund mobilization strategies that will compel funders to support them. Perhaps as STT explained, academic libraries need to show the value of what they have been funded for to be able to attract interest funders to support 4IR technologies in the future.

7.6.6 Lack of staff motivation

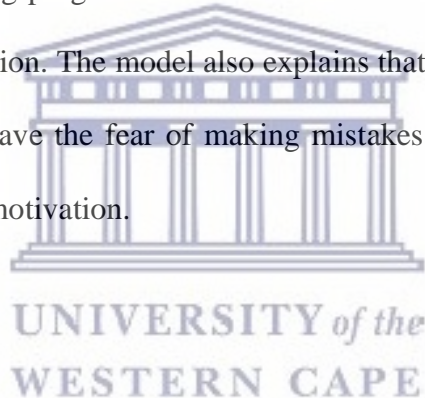


Staff motivation is one of the contributing factors that influence librarians' willingness to embrace Lib 4.0 technologies and change (Ntlotlang, 2019). Dube (2021) explored library staff support for 4IR applications to provide information resources to remote clients during the COVID-19 pandemic and found that a lack of staff motivation slowed down the incorporation of Lib 4.0 technologies to access smart libraries virtually. Library management needs to ascertain what motivational factors, including job security, increase in wages and salary, good relationships with colleagues, staff training, staff promotion, financial incentives, and rewards will encourage staff to work towards the incorporation of Lib 4.0 and applications.

Findings from this study show that academic library staff in Ghana (38.4%) lack the motivation to embrace Lib 4.0 technologies even though those from South Africa (10%) indicated otherwise. There is therefore room for improvement for all to thrive smoothly amidst the disruptive changes

caused by the 4IR. This finding supports Machara and Jain (2018) who found that library staff in Botswana were highly de-motivated and discontented with their jobs as a result, staff were not exhibiting the needed enthusiasm to embrace any initiative that will keep the library at pace with the ongoing trends. The finding is also in line with the study by Lawson (2018) who explored employee motivation and job satisfaction in Ghanaian academic libraries and found that staff motivation highly contributes to the change process, especially at a point of embracing emerging technologies.

The model both from GCI and STT theorized that motivation directly affects the willingness of academic libraries to support, embrace and use 4IR technologies. This finding suggests that inadequate education and training programmes as earlier confirmed in the study are the leading cause of the lack of staff motivation. The model also explains that if staff lack the required skills, the aftermath is that they will have the fear of making mistakes with new technologies and or losing their jobs leading to low motivation.



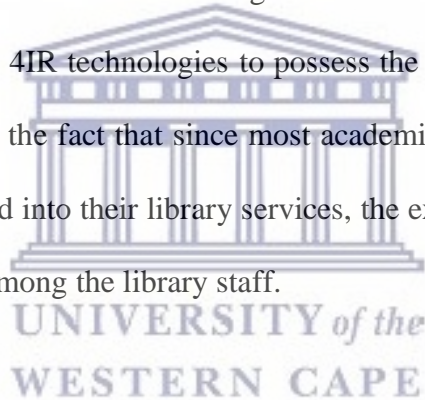
7.6.7 Fear of losing jobs

During the World Economic Forum (2016) a projection was made signaling that the 4IR will lead to job displacement and increase the skills gap which will heighten the fear of employees losing their jobs. Academic librarians are experiencing anxiety, and fear of not keeping abreast with the technology in change which might eventually replace them.

The finding of this study shows that despite speculation in the literature, library staff did not show significant fear of losing their jobs due to emerging technologies. Evidently, 53% out of 57.5%

and 31.2% out of 42.6% respectively, representing Ghana and South Africa disagree. This contradicts the conclusions made by Zervoudi (2020) and Hussain (2019) that information professionals felt unrest and anxiety due to fear that 4IR technologies such as robots and artificial intelligence would replace humans leading to so-called “technological unemployment”. Hussain (2019) and Tella (2020a), however, recommended that librarians should see 4IR as an opportunity to upgrade themselves to take over new roles due to 4IR technologies and to be able to provide smart services to satisfy the expectations of a technologically savvy clientele. On the account of this, Academic libraries must channel more efforts to change their staff’s thinking patterns and to cause a paradigm shift in technological change (Botha, 2021, p.4).

The model of the study suggests that staff exhibiting the fear of losing their jobs is a result of a lack of education and training in 4IR technologies to possess the right skill-sets to stay relevant. This finding can be attributed to the fact that since most academic libraries do not have most of the 4IR technologies incorporated into their library services, the existing library technologies and applications do not trigger fear among the library staff.



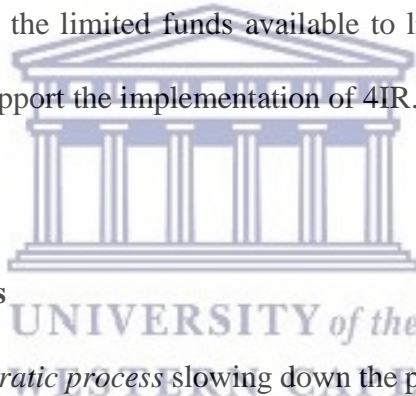
7.6.8 Data infrastructure and incompatibility

Data infrastructure or integrity issues as well as data incompatibility may transpire during the migration of data from manual to digital, between software and hardware from different companies, from one system to another, or from replacing old information technologies. “

The finding of this study shows that academic libraries in Ghana (52.3%) have high data infrastructure and incompatibility issues while those from South Africa (18.2%) showed moderate

outcomes. This is an indication that it is incumbent on the IT team to conduct a thorough analysis of data and infrastructure compatibility before implementing Lib 4.0 technologies to avert extra costs. Gelernter and Maheshwari (2019) found that data incompatibility has negatively affected data integration and migration, leading to data loss, inefficiency, and low productivity. The authors proffer minimizing infrastructure incompatibilities if a formidable library consortium enforces regulating standardization of new emerging technologies and standard policies.

Not scoring high in terms of technological infrastructure according to the GCI for instance is a worrying situation. In the era of 4IR, almost all technologies are interconnective hence, there will be a need to provide supporting infrastructure such as computers, and strong internet connectivity. This finding can be attributed to the limited funds available to library management to invest in technological infrastructure to support the implementation of 4IR.



7.6.9 Slow bureaucratic process

Another challenge is *the bureaucratic process* slowing down the procurement of new applications and equipment. One of the directors from Ghana bewailed that sometimes by the time management issues approval, the technology would have become obsolete:

“The issue of bureaucracy, it takes a very long time for technology to get approved”. Another concurred by stating “Bureaucracy of procurement. Sometimes you will buy a system but by the time the items get to procurement, it is already obsolete. It is also an issue worth mentioning”

This big issue if not arrested will hamper most libraries from losing their limited financial resources to support Lib 4.0 technologies. This is because since Information technologies change rapidly, therefore it is expedient for library management and the mother institution to cut down the procurement process to expeditiously implement needed 4IR technologies to support library services.

This finding suggests that the academic library does not have a good structure in terms of a procurement process that meets the demand of the 4IR (Valdez et al., 2016). The STT, for instance, emphasized technological obsolescence adversely affects most technologies, and to reduce the issues to the barest least, academic library management ought to reduce its bureaucracy process to expeditiously embrace needed 4IR for patrons to utilize them.



7.6.10 Lack of interest.

Having an interest in IT tools highly influences the extent of embracing and utilizing them. The finding from this study shows that library staff has an interest in newly incorporated technologies to support library services whereby 24.6% and 22.22% of library staff from Ghana and South Africa respectively, opposed the assertion of “lack of interest in newly adopted technologies”. This finding suggests that, if academic libraries are able to incorporate 4IR technologies in the library services there is a high propensity that library staff will support them for the betterment of the library. This finding collaborates with the study by Ocholla and Ocholla (2017) where the changing library and information research landscape in South Africa was explored. It was revealed that librarians exhibited a tremendous interest in supporting new technologies implemented by the

library. It is also consistent with the study by Onyancha (2018) and Raju (2017) in which staff exhibited the behavioral intention to continue utilizing new technologies.

7.6.11 Non-availability of IT consultation services

In the case of the non-availability of consultation services, both countries (34.2%) felt ambivalent. This finding suggests that library staff from both countries are not sure whether IT consultation services exist to assist in the implementation of Lib 4.0 technologies to support smart library services. The findings can also be attributed to the fact that determining the availability of IT consulting services is usually done by small units of the library. For instance, activities such as difficulties to diagnose technical problems, replacing faulty machines or parts, or repairing equipment are not core duties of the librarians except the technical units. Hence, they do not bother to find out about such problems. This finding is inconsistent with the study by Hussain and Parveen (2021); Rafi et al. (2016) as well as Taufiq et al. (2020) where the non-availability of IT consulting services was noted to have contributed to the challenges in the implementations of new technologies.

7.7 Responsive structures needed and policies

The section covers the responsive structures needed as well as policies for 4IR.

7.7.1 Responsive structures needed

The responsive strategies employed by academic libraries are centered on the four constructs of the socio-technical perspectives which comprise people, technology, tasks, and structure. The

theory states that before incorporating any new technology, it is germane to assess these factors or indices.

7.7.1.1 People

The preparedness of people and the human factor towards the 4IR was assessed using questions on recruiting well-skilled and experienced staff, constant training in newly adopted and emerging technologies to re-skill staff, good incentives to motivate staff to embrace new technologies and applications, periodic evaluation of staff attitude towards the usage of new technologies and applications, creating mutual understanding statements to deal with 4IR challenges, empowering staff and users to embrace new technology and applications. The study found that academic libraries in Ghana 67 (70%) are focusing on developing their human resources for the 4IR likewise in South Africa 49 (69%). This positive finding implies that academic libraries are investing more in human resources as part of their preparedness for 4IR. It can also be inferred that library staff are reconsidering “change as not a bad thing” and “to change is to survive” (Ahmat & Hanipah, 2017) and the only way to experience growth is to embrace change. This positive finding can be attributed to the fact that academic libraries are investing in human capital development to embrace change and emerging technologies, and this is a sign of good leadership. Similarly, Tella (2020a) as well as Ocholla and Ocholla (2020) asserted, that to succeed in changing the mindset of information professionals, good leadership has a pivotal role in preparing library staff for the 4IR.

From the STT perspective, this positive finding suggests that academic libraries are putting plans in place to invest in their working force which is a pillar to drive the vision of making library services stand tall amidst the disruption caused by 4IR. That is by considering what 4IR skills and

abilities are needed, what technology and applications are required, strategies to reduce resistance to change, and motivational factors germane to inspire library staff to embrace the new era with enthusiasm.

7.7.1.2 Structure

The academic library cannot continue to operate successfully with its conventional structure as changes are needed to meet the demand of the 4IR (Ahmat & Hanipah, 2017). The structure of the academic library was assessed using the variable the library structure motivates staff to participate in decision-making regarding the implementation of Lib 4.0 technologies and applications, the library structure provides an avenue to encourage staff in innovation/creativity and the library structure creates a good interpersonal relationship between managers and subordinate.

The study found that while academic libraries in Ghana 58(60.0 %) have positive responses on the structure of the library by scoring high, likewise, the scores of South Africa 58 (81.7%) fall on the high-level ranking. This implies academic libraries from both countries are using a modern approach that is apt for change in technology (Morgan, 2014, p.1). To strengthen the library structure towards the 4IR, the flatarchies structure should be employed as it will pave the way for library staff to bring out innovative ideas when introducing new systems or technologies and this motivates them to work harder and develop the sense of being involved in the decision-making process (Ahmat et al., 2016).

Structure as a critical construct of the STT states that it serves as a navigation compass/roadmap for the academic library to succeed in the 4IR. Generally, this finding suggests that academic

libraries have begun to create a favourable structure that supports the digital transformation agenda. Now the onus lies on the library to continue updating elements of its structure to keep pace with the changing demand of emerging technologies.

7.7.1.3 Technologies

To measure the preparedness of the academic libraries in terms of technologies for the 4IR, the factors investigated were fewer technologies are underutilized and undervalued, less difficulty in resolving technical glitches, library staff have less difficulty in keeping up with new technologies spend less time familiarizing themselves with technologies using new technologies to minimize library business inefficiency and decrease maintenance cost.

Ghana and South Africa libraries had total scores of 46 (48%) and 32 (52%) respectively which indicate moderate levels after computing responses under technologies and ranking them. This finding shows that the academic libraries are not prepared enough in terms of available technologies for the 4IR. Based on this finding, academic libraries should focus on bringing in Lib 4.0 technologies that are less difficult in resolving technical glitches and making available technical experts (Tucker & Kimbrell, 2013, p.1).

This finding implies that the nature of technologies at the disposal of academic libraries is not in good standing for 4IR. It suggests that the libraries do not have the relevant technologies as well as the right skill-sets, abilities, and competence possessed by librarians necessary for the 4IR as asserted by the STT standpoint.

7.7.1.4 Tasks

In the context of this study, tasks refer to the activities that are undertaken to achieve the goal of the library. The factors used to evaluate the preparedness for tasks towards 4IR were library tasks are less complex, good familiarity with library tasks, good coordination and collaboration with other staff, appropriate work schedule, good work location, and up-to-date job descriptions.

The finding of this study shows that the greater number of responses were skewed towards positive (72.9% Ghana; 69.8% South Africa) and a couple of responses shows indifference with a score of 25.0% and 4.2% representing Ghana and South Africa respectively.

This is an indication of a positive perception of the actual tasks being performed by academic libraries toward 4IR. This finding can be attributed to the conclusions by Ocholla and Ocholla (2020) as well as Ahmat and Hanipah (2017) that a positive response to a task is an indication that library staff are performing tasks and operating within an environment where they can thrive. This finding implies that academic libraries must assess the environment in which their employees operate considering the internal and external factors, reviving opportunities as well as threats from an organization (Tella, 2020a; Ahmat & Hanipah, 2017; Noh, 2015).


From the STT point of view, it can be deduced from this finding that academic library staff operates with favourable tasks within the technological subs. Thus, there are well-defined tasks that will support the implementation of 4IR technologies. However, it is pertinent to note that the 4IR is characterized by new tasks that will demand librarians to perform. In view of this, the library

should anticipate specific tasks and ascertain if its staff will be in good standing to effectively operate with the 4IR technologies they plan will incorporate in the future.

7.7.2 Library Policies

Library policies regulate the directions, procedures, and decisions of the library. Academic libraries need to have policies including Lib 4.0 technologies and applications. With this, it will not be hard for the library to invest in Lib 4.0 technologies and applications if the policy directs them to do so.

The study found that not all the participating academic libraries have general library policies where sections specifically capture Lib 4.0 technologies and applications or have special policies. This was also confirmed by the library director from South Africa stating:



“...we don't have a particular policy on 4.0 but we've got policies around. Only policy in line with Lib 4.0 is in line with circulating policies. We used to take cash. Now we do not take any cash. Everything is on the app, so in that way, our policy has changed”.

In terms of IT policies, it was realized that academic libraries do not have effective IT security policies to protect Lib 4.0 technologies. With the future possibility of the inclusion of Lib technologies in mind, the extent of the review of the general policy was further assessed. The study found that academic libraries have attempted to periodically review their general policies to include 4IR. This was also confirmed by one of the directors from Ghana who said:

“Fortunately, we have the opportunity to develop a library policy or say revised policy for the library. We are trying to incorporate some of these technologies into the library policies and let the library board and academic board understand the need to adapt and spend on these 4IR technologies. We are waiting for approval and one advantage is that when we have 4IR technologies incorporated into the library policies, it is easy to get support from the management”.

Despite this positive signal, the data shows academic libraries need to fuse Lib 4.0 technologies and applications if they want to stay relevant and thrive productively during the 4IR. Advisedly, academic libraries must reconstruct their policies to capture new attributes of skills that match with skills needed in this digital transformation era, a good financial budget for 4IR technologies, new business models, and new job descriptions (Ahmat & Hanipah, 2017).

Even though the study earlier found a good structure, it will be difficult for the academic library to smoothly implement its plans to incorporate 4IR technologies to enhance its library service without well-defined Lib 4.0 policies. It is, for this reason, the study later proposed the incorporation of Lib 4.0 policies as part of the variables apropos to measure the readiness of academic libraries towards the 4IR.

7.8 Actions toward disruptions

This sub-section assesses the available actions put in place by academic libraries toward the 4IR. It was evaluated based on the constructs of the Global Competitiveness Index (GCI) index that

was chosen to underpin this study. The index covers, infrastructure, technological readiness, education, and training as well as finance. Extrapolating the proposition of GCI into this study, academic libraries need to score high in the index to be able to prepare adequately for the 4IR. Given this, respondents were asked to respond to items on the following variables: ICT infrastructure and emerging technologies toward 4IR, education and training programme organized by the library towards 4IR, a fusion of innovation by academic libraries towards 4IR, and allocation of adequate funds for the library.

7.8.1 ICT infrastructure and emerging technologies toward 4IR

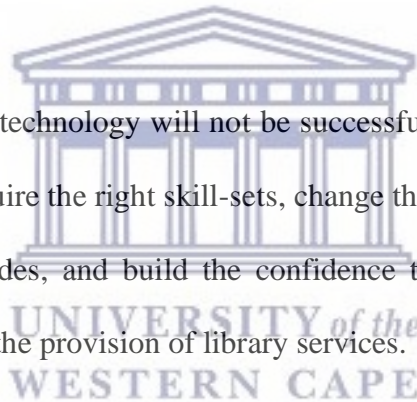
Assessing the ICT infrastructure and emerging technologies made available by the library toward 4IR, the following variables were assessed which comprises: there is a virtual gateway to the library and it has been well-designed with valuable content and strong visibility, and customer orientation, there is enough broadband and other internet technologies that provide digital connectivity for effective communication, there are available high specs computers to render enhanced services, there is an adequate power supply, there is constant maintenance of ICT infrastructure, there are available effective automated library cards/biometric sensor for patrons to access smart services: checkpoint for learning (research and knowledge) commons in the library.

In summary, the study found that all the responses were skewed towards positive (virtual gateway 82.6%; enough broadband and internet technologies 82.1%; high specification of computers 59.4%; adequate power supply 76.0%, Constant maintenance of ICT infrastructure 61.7% and effective automated library cards for patrons to access the library services (62.3%). The finding

resonates with the study by the European Commission (2016) in which it was found that institutions that have started investing in emerging technologies should invest more into the provision of ICT infrastructures including internet broadband with high bandwidth, and other related internet facilities because the disruptive changes of the 4IR are evidence that the library will have to amend its services and to meet the demand of the 21st-century patrons. This finding is also in agreement with Ocholla and Ocholla (2019) in which it was revealed that the disruptive change caused by 4IR has awakened the interest of the library by investing immensely in the provision of emerging ICT infrastructure.

7.8.2 Training

The implementation of any new technology will not be successful without adequate training and information professionals to acquire the right skill-sets, change their thinking patterns to embrace change, develop the right attitudes, and build the confidence to use any newly implemented technologies that will transform the provision of library services.



The overall assessment of these variables shows that most of the responses were skewed towards “Agree” and “Strongly agreed”. Combing all the responses from both countries, the positive results obtained are as follows; use of emerging technologies (54.8%); critical thinking (69.0%); creativity and innovation (78%); people management (75.6%); coordinating with others (83.4%); emotional intelligence (71.%); judgment and decision making (69.5%); service orientation (84.4%); Influencing and negotiation (69.5%); cognitive flexibility (74.9%); online learning (83.2%);

Aggregated data gathering (60.5%); digital information management (80.3%); collaboration and partnership (76.0%).

It can be inferred from this report that, the academic libraries have made efforts by investing in the right education and training content that is apropos for the 4IR. This finding was also confirmed by one of the library directors from South Africa:

“I have done a lot of the research that was originally around change management and helping people overcome fears and anxieties around the 4IR and that is why we have so many training programs and workshops, etc”. Another director avowed *“When you talk about educational training programs, we cannot do without; it is the surest way to motivate staff to embrace Lib 4.0 technologies and tools”.*

Another comment from one of the library directors is worth mentioning:

“Fear of people losing their job. So, we have to assure them that even though they will be affected by disruptive technologies, there will be opportunities for them to upgrade themselves. Given this, continuous training and education is the surest way to get them oriented and embrace Lib 4.0 technologies. We also send our staff to conferences and take part in seminars and Webinars to acquire knowledge about what is happening towards the 4IR for knowledge acquisition. In the past, only a few people partake in conferences, this time around we have a lot more of our staff

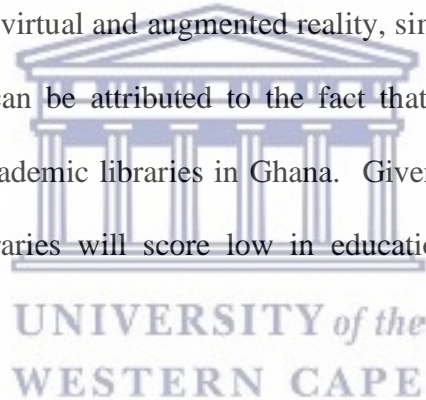
attending conferences and taking advantage of webinars which are relatively not expensive.”

This finding implies that when there is the right training content and the academic library makes a conscious effort to organize training programmes regularly, information professionals will obtain the right skills essential to improving the sustainability of future technologies (Yusuf, Walters & Sailin, 2020). Frahm-Arp (2018) agreed by indicating that myriads of management of academic libraries are using training to get their members reskilled and upskilled to meet the demand of the 4IR.

This study also found that academic librarians have not received training in the following Lib 4.0 technologies and applications putting the responses from both countries together: artificial intelligence applications (56.9% No), advanced robotics (90.4% No), virtual and augmented reality (97.0% No), simulation (90.4%), cloud computing (96.0%) and blockchain technologies (72.5%). A look at South Africa revealed that they have been engaged in training in 3D printing, cloud computing, and Makerspace. However, none of the respondents from Ghana confirmed having received training in these technologies. This shows how academic libraries in Ghana are lagging behind. This finding can be attributed to the fundamental issues of the limited fund and lack of institutional/managerial support. The study further confirmed that library staff in Ghana do not have enough training to better position themselves to embrace 4IR technologies and applications as compared to those from South Africa.

Putting all the responses together, even though the training programmes have been impactful for instance by building confidence in library staff to embrace new technologies relevant to the 4IR and they can now assist patrons on advanced search techniques with ease, taking a closer look at the aforementioned advanced technologies the overall impression shows that academic libraries in Africa do not have enough education and training programmes that the 4IR will demand.

It can be deduced from these findings that, even though academic libraries have invested in training their staff in creativity and innovation, people management, coordinating with others, emotional intelligence, judgment and decision-making, and service orientation, the underlying issue here is that they do not have training in the necessary 4IR technologies such as artificial intelligence applications, advanced robotics, virtual and augmented reality, simulation, cloud computing, and blockchain technologies. This can be attributed to the fact that they lack these technologies, especially as is the case with academic libraries in Ghana. Given this finding, according to the GCI proposition, academic libraries will score low in education and training as well as in technologies.



7.8.3 Innovation

Good innovation actions are needed to better reposition academic libraries for the inexorable disruptive changes caused by the 4IR and to stay relevant in the global competitive market (Mckinsey Global Institute, 2016). The report generated on the seven (7) items that were used to ascertain the innovation actions that the academic libraries have in place were positive as follows: Effective instant messaging (82.6% Yes), effective mobile library services (73.7% Yes), (*Periodic exhibition programmes*, (80.2% Yes), delivery of digital knowledge (87.4% Yes), constant updates

on new collections (63.5% Yes), periodic live online library instruction (79.0% Yes). This implies academic libraries have attempted to employ innovative actions such as effective instant messaging, availability of effective mobile library services for patrons, periodic exhibition programmes on new services and technologies, the delivery of low-cost digital knowledge, relevant library products and systems that attract customers to continue to use library services virtually, a constant update on new collections in the library to users through the use of e-alert, periodic live online library instruction programmes through webinars and social media platforms. In support of this finding, one of the library directors from Ghana acknowledged this point saying: *“We are taking advantage of webinars, and conferences to learn more about new trends that are necessary for us to implement”*. This finding agrees with the studies by Jong, Munnik, and Will (2019) as well as Ntlotlang (2019) establish that despite challenges, academic libraries are making efforts to implement innovative actions to offer attractive and enhanced services to their valuable customers. For instance, some academic libraries are using the “Open Access information highway” and “research collaboration” to leverage expertise and resources they lack in their libraries or are incapable of providing. Some academic libraries are also conducting “library staff skills audit exercises” (Ntlotlang, 2019; Sanjeeva, 2018) to make sure information professionals are equipped with the right skills to embrace innovative actions.

This finding suggests that should academic libraries according to GCI obtain the necessary funding and library staff who are technology enthusiasts and with Lib 4.0 skill-sets, the academic libraries will grow astronomically in the competitive market to attract more library customers.

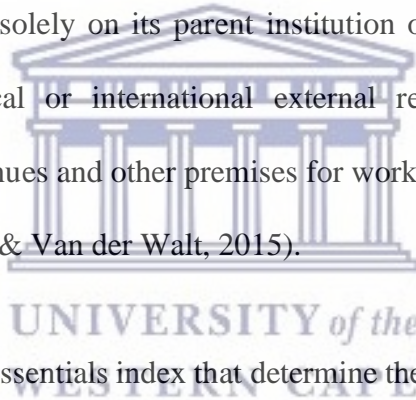
7.8.4 Funding

No matter the extent of preparation the academic library makes towards the 4IR, without adequate funds their plans cannot materialize or will be difficult to implement. Dadzie and Van der Walt (2015) maintained that “financial strength” is the lifeblood of every library, therefore it is essential for an academic library to have access to adequate funds to prepare adequately for emerging technologies to compete strongly in the global market.

From the findings, the various library heads highlighted some strategies to generate funding to support their vision of incorporating 4IR technologies. One is to substantiate the value of the new technology. For instance, one of the respondents from South Africa had say: *“I think it would be budgeting, ensuring that we get the budget required for the new technologies. We have a substantial budget, which is very fairly contained, we do make provisions for a fund that will help acquire what will enable the library to function effectively, to advance and enhance our services. If we are able to substantiate the value of the new technology, we can always apply for central funding.”* Another strategy mentioned was getting funding directly from the government as one of the library heads in Ghana indicated: *We get our main funding directly from the government that is the university.* Deducing from these strategies it can be inferred that the academic libraries do not have striking actions that will aid them to mobilize funds to support the 4IR vision.

These above findings justify why academic libraries are encumbered with financial constraints. To determine the extent to which academic libraries face financial constraints, responses assessed indicate that all the participating academic libraries have been hugely impacted by limited budgets. Thus, the study found that those in Ghana (63.6%) are lumbered with high financial constraints

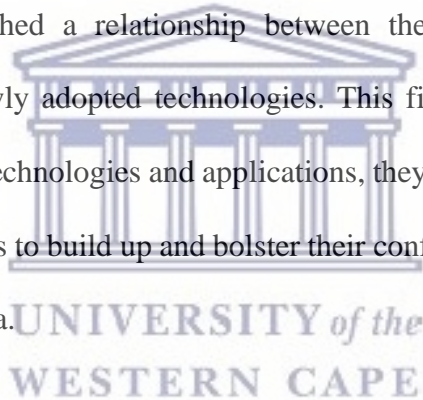
indicating that it will be a big hurdle to implement Lib 4.0 applications and technologies they may have in the pipeline. Also, academic libraries in South Africa (64.7%) are moderately saddled with financial difficulty which has incapacitated them from investing more in emerging technologies. This finding corroborates the studies by Amarteifio (2018) as well as Ubogu and Okiy (2011) where it was emphasized that financial constraint has made it difficult for most libraries to implement Lib 4.0 technologies and applications. Since embracing emerging technologies in academic libraries are not an option, an academic library needs to have a strong lobbying mechanism and constantly show value for investment to justify the need to receive support for new technologies. Separate policies that are earmarked for the allocation of funds for Lib 4.0 technologies and applications should be considered (Amarteifio, 2018). It is also important for the academic library not to depend solely on its parent institution or the government for financial support, but rather exploit local or international external resources such as sponsorship, exhibitions, or leasing library venues and other premises for workshops, exhibitions, conferences, seminars, and symposia (Dadzie & Van der Walt, 2015).



Funding affects almost all other essentials index that determine the readiness of academic libraries towards the 4IR as the proposed model underlined. The finding betokens that, it will be an incredibly difficult task for the library to actualize its plan of updating its services with 4IR technologies and services. Without adequate funds, academic libraries cannot invest in 4IR technologies, build their human capital with modern education and training contents, enhance their structure, and position themselves to work towards tasks demanded by the 4IR. Given this, it is pertinent on the part of leaders and stakeholders of the academic library to work assiduously to use all available avenues strategically to mobilize funds.

7.9 Hypothesis Testing

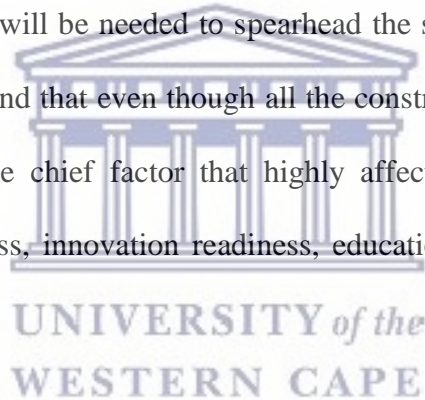
As a complement to the findings, using the chi-square test, the study sought to ascertain the association between selected variables of technological readiness and innovation readiness for 4IR as well as the extent of training and interest in adopting 4IR technologies. The study found that the technological readiness of academic libraries affects innovation readiness. It can be deduced from this finding that academic libraries need to be technologically prepared before they can effectively implement the right innovation to stay active and relevant in the epoch of the 4IR. However, serially, as earlier found in the study, for the academic library to prepare technologically to be able to implement innovative actions, then there should be adequate funding. This implies that adequate funding affects technological readiness and technological readiness will in turn affect innovation readiness. Results also established a relationship between the amount of training on new technologies and interest in newly adopted technologies. This finding implies that to motivate library staff to embrace Lib 4.0 technologies and applications, they should be engaged in adequate and relevant training programmes to build up and bolster their confidence to accept the demand of this digital transformation agenda.



7.10 Proposed conceptual model

The study was underpinned by a conceptual model which combines the constructs of the Global Competitiveness Index (GCI) as well as Socio-Technical Theory (STT). The GCI theorized that to assess an entity's readiness for digital transformation, the following variables should be assessed; infrastructure, technology, innovation, education, and training as well as funds should be considered. The STT considers the *social system* (structure and people) and the *technical system*

(technology and the tasks to perform). Considering the preposition of the STT, the academic libraries should be well prepared in all these constructs in order to stay relevant amidst the disruptive changes of the 4IR. The findings of the study confirm that all variables of the proposed model are essential to be considered as the academic library is preparing for the 4IR, however, it was revealed that, if academic libraries will be able to succeed in all the proposed constructs, there should be a special Lib 4.0 policy, and which should be enforced by the leadership and management of the library. This implies that the Lib 4.0 policies will help regulate all the constructs in the proposed model for a successful implementation of Lib 4.0 technologies and applications. In addition, the findings brought to light that leadership plays pivotal role in determining the readiness of the digital transformation agenda. Leaders with a growth mindset and belief in emerging technologies will be needed to spearhead the successful incorporation of Lib 4.0 technologies. It was also found that even though all the constructs influence the readiness of 4IR, finance appeared to be the chief factor that highly affects other factors: technological readiness, infrastructure readiness, innovation readiness, education and training readiness, and people.



Given the above background, as shown in Figure 7.1, Lib 4.0 policies as well as leadership should be added to the constructs of the proposed conceptual model to measure the readiness for digital transformation. These extra constructs which comprise Lib 4.0 policies and innovative leadership will help underpin further studies in 4IR and other digital transformation research expeditions.

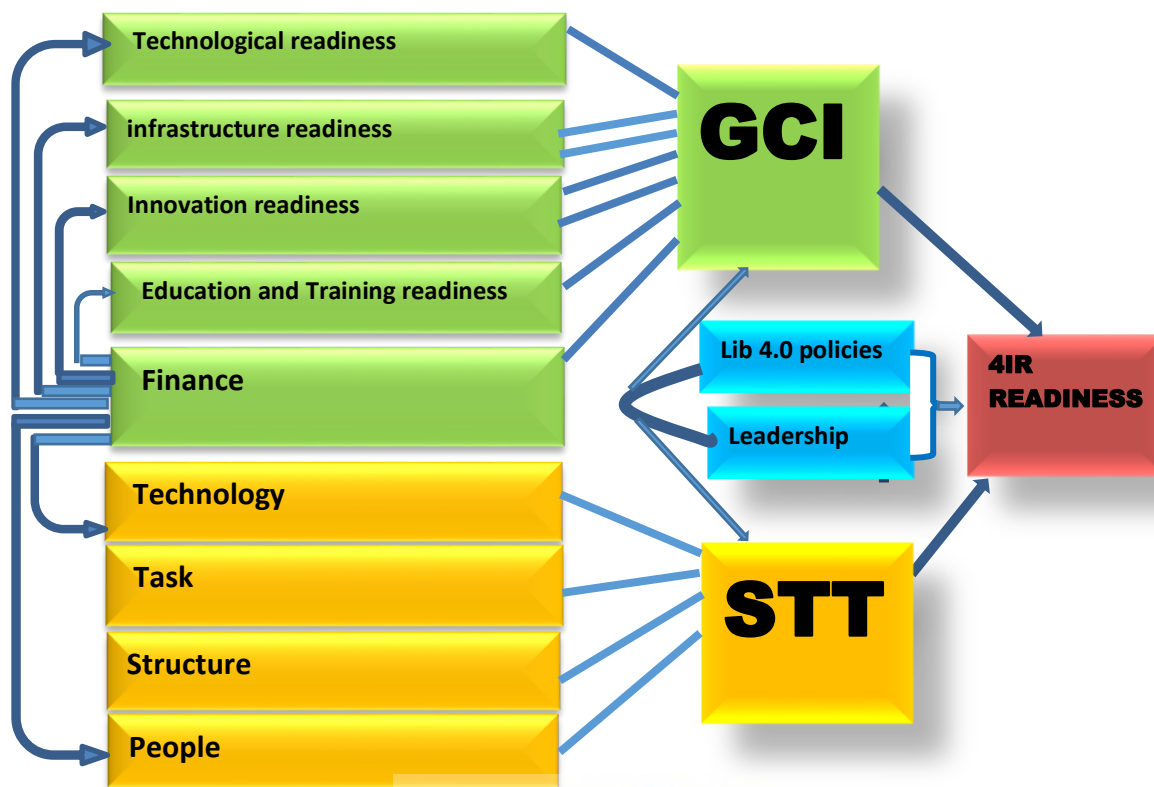


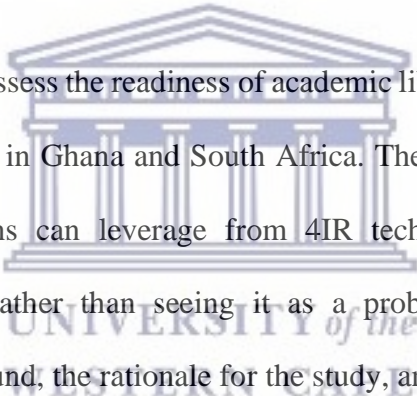
Figure 7.1 Proposed model to measure the readiness of the 4IR.
(Darko-Adjei, 2023)



CHAPTER EIGHT: CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This last chapter encapsulates a summary of key findings and concludes the study by answering the research questions. It then draws a critical conclusion guided by major findings, hypotheses tested, and proposed model to inform information practitioners, researchers, and stakeholders of 4IR. It also highlighted the value and contributions to the knowledge and originality of the study. It makes recommendations to address the research problem. Lastly, it proposes opportunities for further research to strengthen the findings of this study.



The purpose of the study was to assess the readiness of academic libraries in the 4IR by comparing two advanced academic libraries in Ghana and South Africa. The study shares light on the core opportunities academic librarians can leverage from 4IR technologies and applications by employing working strategies rather than seeing it as a problem to overcome. The study commences with a brief background, the rationale for the study, and a detailed problem statement that necessitated the study to be conducted. The researcher critically analyzed and synthesized extant literature to fathom the ongoing dialogue about the preparation of academic libraries for the digital transformation of the 4IR. The study combined the Socio-Technical theory as a theoretical perspective as well as the Global Competitiveness Index (GCI) as a conceptual framework. They were then amalgamated as a conceptual model with vital additional constructs that underpin and elucidate the findings of the study. Convergent parallel mixed methods was used which influenced data collection and procedure and subscribed to the post-positivists' tenets of research.

The study was guided by the following research questions which served as a roadmap for the entire research expedition:

- i. What are academic librarians' awareness and knowledge about the 4IR?
- ii. Which Lib4.0 technologies and applications are used in Ghana and South Africa?
- iii. What is the level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies?
- iv. What challenges do academic libraries face in incorporating 4IR technologies?
- v. Which responsive structure is needed and what policies are in place for disruptive changes?
- vi. What are the available actions toward the disruptive changes?

8.3 Academic librarians' awareness and knowledge of the 4IR

It is always apropos to ascertain users' awareness before any other factors can be assessed in the adoption, accessibility, and usage of new technologies. Given this, the initial research question of the study was to establish the level of academic library staff's awareness and general knowledge about the 4IR.

Results indicated that academic libraries from both countries were much aware of the 4IR and its potentially disruptive impact on the services of the library. Library staff became aware of the 4IR mostly through internet browsing, followed by institutional websites and local or international conferences/seminars/symposiums. Other channels of awareness included social media platforms, news items, information literacy training programmes, journals, staff meetings, and from the Heads of units.

General knowledge measured using the general features of a smart library, of 4IR was assessed and results reflect that the knowledge of academic librarians in both Ghana and South Africa about 4IR was above average. The findings draw attention to the fact that 4IR is not only about incorporating 4IR technologies and applications as emphasized in the literature. None of the following “360 factors” should be absent in the quest to assess how academic libraries are prepared for the disruption change of the 4IR. They are as follows:

- i. Smart library services
- ii. Smart library staff
- iii. Smart technology and applications
- iv. Smart users
- v. Smart leaders
- vi. Smart library resources
- vii. Smart policies
- viii. Smart library management
- ix. Smart library networking



It should be noted that even though all participating librarians were quite knowledgeable in 4IR and its impact on the provision of library services, information professionals from South Africa were more knowledgeable than those from Ghana. Results signify individual inquisitiveness into new technologies through research and programmes organized by library professional bodies like the Ghana Library Association (GLA), Library and Information Association of South Africa (LIASA), and American Library Association (ALA) have broadened the knowledge base of librarians resulting in them connecting not only to smart library attributes and the intelligent library industry, but also to improved technical tasks, increased visibility, expanded library services, increased library profile, ensured quality customer satisfaction, and ultimately increased numbers of library customers.

8.4 Lib4.0 technologies and applications

The 4IR technologies and applications are vastly changing how libraries operate to meet the demand of 21st-century technologically savvy library customers. Not all 4IR technologies can be embraced, but those reshaping the nature of library services include cloud computing, artificial intelligence, advanced assistant robotics, complex sensors, Internet of Things, cognitive computing, virtual reality, big data, Makerspace, 3D printing, and Geotagging. These smart technologies are gradually being introduced mostly in advanced libraries in the developed world and some advanced libraries in Africa.

The second research question of the study sought to find out the Lib 4.0 technologies and applications that academic libraries in Ghana and South Africa have begun or already incorporated. The study found that all the participating libraries have incorporated AI applications in their services. This was evident in several components of technologically supported services such as OPAC which, amongst others, intelligently suggests related search results, correct spellings, faceted navigation, related search queries as well as relevancy and ranking of results. Similarly, Ask-a-librarian, which enables patrons to have live chat or leave queries for librarians to respond to later is commonly used by all libraries. Results reflect that cloud computing, which amongst others provides off-campus access to library resources, widening access, and leveraging new digital services, is being utilized by all the libraries. To further library access, three libraries, two from South Africa and one from Ghana provide library mobile applications. Also, the two South Africa libraries have incorporated self-checkout machines to ensure easy entry and exit of the

library and additionally contribute to a security check by preventing unauthorized access to library materials.

Other tools used by all four academic libraries in support of 4IR include the following:

- Library tutorials (video) tool
- Circulation modules
- Digital library repositories
- Library social media platforms
- Electronic newspapers
- Webinar digital library training service
- Reference management tools

While both South African libraries have incorporated virtual reality, chatbot applications, Makerspace, 3D modeling software, blockchain technology, the Internet of Things, robot library assistants, Quick Response codes, and big data tools to enhance library services, these Lib 4.0 tools have not been introduced in Ghanaian libraries. The overall assessment, therefore, reveals that academic libraries from South Africa were better equipped with Lib 4.0 technologies and applications as compared to those in Ghana.

To further answer the second research question, the reasons that necessitated the incorporation of Lib 4.0 technologies and applications were explored. The following reasons were identified:

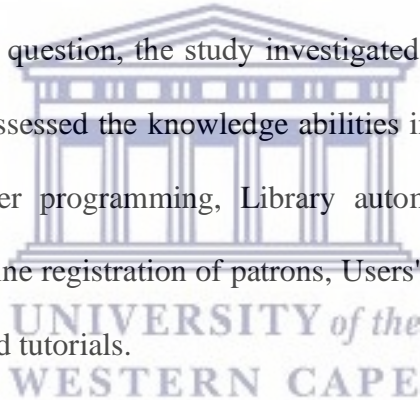
- To make library services easier to use and access
- To inspire patrons to patronize library services
- To help patrons learn new skills, attract new ones, and maintain existing customers
- To enable them to become cutting-edge libraries

- To stay active and relevant to provide smart library services to 21st-century patrons
- To improve upon service effectiveness and high productivity

8.5 Librarian knowledge, skills, and abilities needed

The 4IR disruptions require academic librarians to acquire new knowledge, skills, and abilities to operate seamlessly. They need to continuously learn, relearn, get skilled, reskill, and upskill to stay relevant. It is practical and worthy to realize that regardless of the technological readiness of academic libraries for the disruptions, the skillset gap hampers academic libraries' progress.

To respond to the third research question, the study investigated librarians' knowledge abilities needed for the 4IR. The study assessed the knowledge abilities in the germane areas of Library management software, Computer programming, Library automation, Knowledge taxonomy, Information search strategy, Online registration of patrons, Users' interfaces of library webpages, Virtual help desk, and Web-based tutorials.




A summation score revealed that academic library staff from South Africa have high knowledge in the mentioned facets of 4IR as compared to those from Ghana with a moderate level. This result suggests that there is more room for improvement as far as training is concerned to bridge the skills gap since it is indispensable for academic libraries to succeed in the epoch of the 4IR.

Skills and competencies demanded by academic libraries were evaluated using the dimensions relevant to disruptions of 4IR Technical/hard IT skills, digital skills, thinking skills, personal skills, and data science talent capabilities.

When all the variables were assessed and ranked, the results showed that librarians from Ghana have a low level of 4IR IT skills and competencies, while South Africa demonstrated a moderate level. This implies a need for training in the mentioned skills. After gauging the level of computer proficiency skills of respondents, the findings exposed that information professionals from academic libraries in Ghana rated themselves as intermediate while those from South Africa rated themselves as advanced. Librarians from Ghana, therefore, had a low level of IT skills and competencies than those from South Africa

8.6 Challenges to incorporating the 4IR in academic libraries.

Since the inception of the information technology revolution, myriads of challenges have become a common phenomenon that obstructs the implementation of new technologies. Results identified the following challenges saddling academic libraries in their quest to invest in 4IR technologies and applications:

- 
- Insufficient budget allocation
 - Inadequate training
 - Lack of new skillset
 - Inadequate ICT infrastructure & network facility
 - Lack of support from authorities/leaders
 - Lack of staff motivation
 - Fear of losing jobs
 - Data infrastructure and incompatibility
 - Lack of coordination
 - Non-availability of consultation services on IT technical issues
 - Library staff lack interest in newly adopted technologies
 - Low priority in modern ICT applications and technologies

- Long bureaucratic process

Therefore, the onus lies on the individual academic library to decipher the best approach to minimize these challenges to the barest least and strategically prepare for inherent emerging challenges in the pursuit of embracing 4IR technologies and applications.

8.7 The responsive structures needed and policies

The fifth research question of the study sought to investigate the responsive structure needed for the 4IR in the academic library to succeed as well as policies earmarked for 4IR technologies in academic libraries.

8.7.1 Responsive structures needed

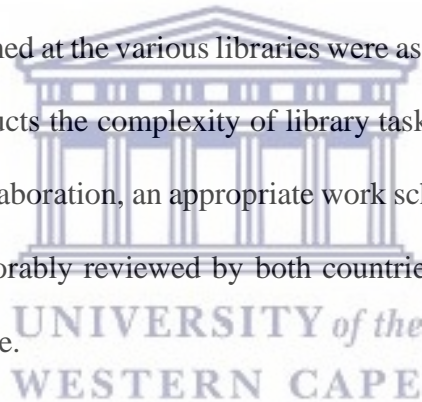
The study assessed the four responsive structures needed people, structure, technologies, and tasks. Concerning the preparedness of the human force (*people*), the study found that librarians from Ghana rated themselves favorably more than those from South Africa even though both countries placed themselves on a high level. Noteworthy is that even though academic libraries from Ghana are not well advanced with sophisticated Lib 4.0 technologies and applications as compared to those in South Africa, they are better skilled to use their available technologies and applications. In general, results reflect that academic librarians from both countries need new skills-sets, competencies, knowledge, and attitudes to succeed in the 4IR age.

Structure is characterized by attracting new talent, building better leaders, and creating a competitive organization. Results reflect that academic libraries in both countries have a good structure for the incorporation of the 4IR applications and technologies to yield good results by

ranking themselves on a high level. If the workflow of an organization is not well appreciated by employees to operate, the aftermath will be a repercussion of slowing down productivity.

Academic libraries in Ghana and South Africa demonstrated average scores on *technology* with 46 (48%) and 32 (45%) respectively. However, another set of 32 (45%) respondents from South Africa rated their library high which indicates that South Africa libraries are a bit more advanced than those in Ghana. The assessment was done based on their perception of the nature of the available technologies. Library management needs to take forethought actions in choosing the best among available options during the process of buying or subscribing to multiple types of hardware and software for the 4IR disruption.

The nature of *tasks* being performed at the various libraries were assessed with respect to the nature and complexity using the constructs the complexity of library tasks, good familiarity with library tasks, good coordination and collaboration, an appropriate work schedule, good work location, and job description. These were favorably reviewed by both countries (72.9% Ghana; 69.8% South Africa) giving a positive response.



8.7.2 Policies

Results revealed that not all academic libraries have policies specially earmarked for 4IR and that general policies don't include capturing 4IR. Findings also revealed that these academic libraries do not have effective IT security policies, separate or part of the general library policies, to ensure the protection of current and future Lib 4.0 technologies. There was, however, an indication that these academic libraries are attempting to review their general policy to include 4IR demands.

8.8 Actions toward disruptions

The last research question sought to determine the actions toward disruptions put in place by academic libraries. The actions ICT infrastructure and emerging technologies, training programmes, a fusion of innovations, and the allocation of adequate funds for the library.

The study found actions initiated and practiced by the academic libraries regarding ICT infrastructure and emerging technologies toward 4IR were favourably reviewed. General training was positive, but enough training in Lib 4.0 technologies is lacking as artificial intelligence applications, advanced robotics, virtual and augmented reality, simulation, blockchain technologies, 3D printing, cloud computing, and Makerspace are not yet available in especially Ghana. Results reflect that although academic libraries have some innovative ideas such as effective instant messaging, a periodic exhibition of programmes, constant updates on a new collection, periodic live online library instruction, collaboration and partnership, good influencing and negotiation, judgment, and decision-making which will when effectively incorporated will enhance service delivery, limited funding prevents the implementation of innovative technologies. No financial plans to supplement the budget in place. On account of this, limited funding has had a colossal negative impact on ICT infrastructure and emerging technologies, training programmes, and innovation.

Hypothesis testing reveals that technological readiness affects innovation readiness for 4IR. This implies that innovation which is one of the core actions for academic libraries to thrive in 4IR cannot be embarked on if they do not have adequate technologies. This finding, therefore, confirms financial constraints have negatively impacted technological readiness, which is in turn affecting

innovation readiness. Thereupon, it is compelling for academic libraries to devise mechanisms to mobilize additional funds. Another hypothesis testing also brought to bear that, the extent of training for library staff affects their interest in newly adopted technologies, giving a clue that, it is pertinent for academic libraries to invest in diverse innovative training programmes to constantly revive their staff's competence, skills, and abilities essential for the 4IR.

8.9 Concluding the study

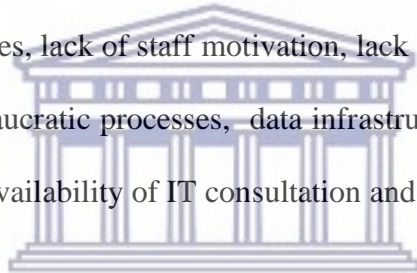
The concept of 4IR is characterized by a fusion of technologies blurring the lines between the physical, digital, and biological spheres. The study unveiled the need for academic libraries to embrace digital transformation to offer valuable services and stay active and relevant in the 4IR. The study aimed to compare the readiness of academic libraries in Ghana and South Africa for the 4IR and to develop responsive strategies toward disruptive changes.

Even though a universal positive awareness of the 4IR by academic libraries in Ghana and South Africa was determined, knowledge of the general features of a smart library that characterized 4IR was average. Librarians from South Africa, however, were more knowledgeable than their colleagues in Ghana. This is attributed to the fact that South African academic libraries have implemented and embraced quite sophisticated 4IR technologies and applications as compared to Ghana. All the participating libraries demonstrated plans to embrace 4IR technologies and applications based on their capacities and local needs. The study exposed a 4.0 skills gap among all the participating library staff. These skills need to be acquired to cope and thrive in the 4IR environment. This finding was also confirmed by the hypothesis tested, where training

programmes influence the extent to which library staff show interest in newly adopted technology and use them to support the digital transformation agenda.

All the academic libraries have begun to leverage educational programmes on 4IR organized by local and international library professional organizations through conferences, workshops, colloquia, symposiums, and seminars.

Attempts to incorporate Lib 4.0 technologies and applications to address the disruptions 4IR have been chiefly obstructed first by insufficient budget allocation, followed by inadequate ICT infrastructure and network facilities, lack of new skillset, inadequate training, lack of support from authorities, lack of Lib 4.0 policies, lack of staff motivation, lack of library staff interest in newly adopted technologies, long bureaucratic processes, data infrastructure, and incompatibility, lack of coordination, as well as non-availability of IT consultation and technical services.

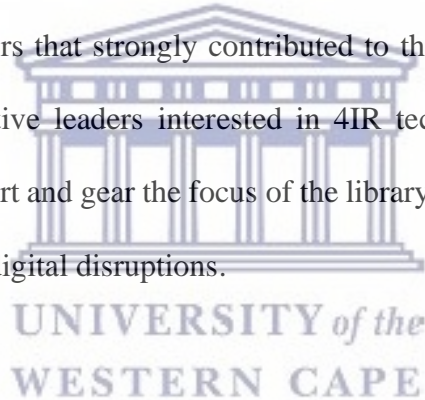


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Preparation regarding the human force shows academic libraries are not well prepared in terms of new skill-sets, mindsets, interest in new technology, and change. The organizational flow, working environment as well as tasks as perceived were favourably remarked for the academic library to operate with 4IR technologies and applications that they have been able to incorporate within their capacity. Academic libraries need innovative leaders with an interest in 4IR technologies, reducing procurement processes, and seeing 4IR as an opportunity to add value to services and uplift the librarian profession. The 4IR must be used to create smart libraries and enhanced services rather than anticipating the potential replacement of jobs. The reality is human-machine collaboration adjusting some of the duties of librarians. Human skills are becoming more unique therefore

librarians need to continue learning, relearning, reskilling, and upskilling. It is suggested that library schools review their curricula to incorporate 4IR technologies and applications and their effect on library services to prepare students for the job market. Academic libraries must also adequately prepare patrons through digital literacy programmes to utilize the Lib 4.0 technology, applications, and services.

The initial theory of the study established that Global Competitiveness Index (GCI) and Socio-Technical Theory (STT) determine the 4IR readiness of academic libraries. The findings revealed that the constructs of GCI and STT are germane as a criterion to gauge how prepared an academic library is for 4IR, however, the study brought to the fore that, Lib 4.0 policies and innovative leaderships are compelling factors that strongly contributed to the readiness of 4IR. Given this, academic libraries need innovative leaders interested in 4IR technologies and design Lib 4.0 policies to attract financial support and gear the focus of the library towards the demand of 4IR for them to succeed in the midst of digital disruptions.



8.10 Contributions and originality of the study

4IR in academic libraries aims to create an intelligent library and actions towards the disruption changes. Results from this study as well as from the literature accentuates the critical incorporation of Technoware (4IR technologies and applications and innovation), Financeware (source of funds, allocation of fund for 4IR), Humanware (library staff's skills-set, knowledge, and attitude, and innovative leaders), Patronware (digital literacy programmes and 4IR curriculum), Orgaware (structure, tasks, Lib 4.0 policies, procedure, steps, and environment, collaboration and network

and change management) and Infoware (information access, usage, and interconnectivity) in creating a holistic preparation towards the 4IR. Figure 8.1 represents a guide and proposes strategies created by the researcher for academic libraries to explore 4IR and the subsequent further anticipated developments. generation.

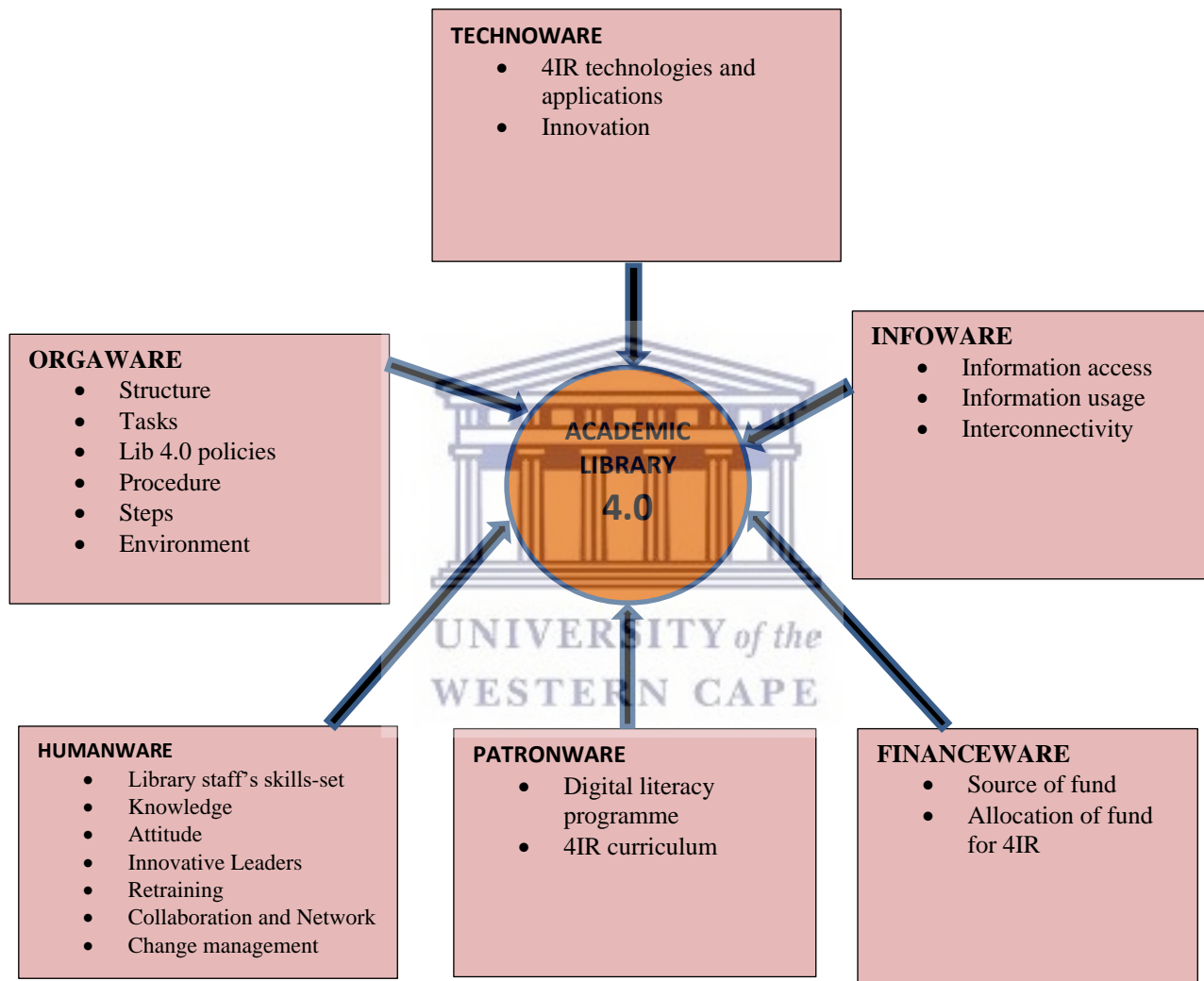


Figure 8.1 Guidelines to assess the readiness of academic libraries for 4IR disruption

The study also confirmed through hypothesis testing that training affects academic librarians' interest to embrace 4IR disruptive technologies and adequate technologies affect implementations of innovation strategies for academic libraries to thrive.

8.5 Recommendations

In their 4IR transition to the 4IR, academic libraries need to adopt relevant strategies that suit the local settings and needs. The following strategies in the form of recommendations are suggested:

8.5.1 Training

The 4IR operates in a digital environment therefore there is a demand for the rapid acquiring of new skill-sets for academic libraries to survive. Resistance to change usually occurs among library staff members and patrons who are not digitally literate. To keep pace with technological changes in the library profession refresher courses and retraining staff in the soft and technical skills of 4IR to be able to use Lib 4.0 technologies and applications at regular intervals are needed. By extension, this novel epoch will need technologically savvy librarians who are proficient in the skillset of 4IR including technological, programming, digital, critical thinking, digital content development, and digital user advisory skills. As 4IR will continue to cause change, this signifies lifelong learning, hence, it will be imperative for the library to anticipate future skill-sets, adjust training programmes, and review job descriptions to embrace change. Libraries should gain new knowledge and working styles in line with the 4IR trends. If libraries will not be able to provide the necessary training programmes in-house, they should be outsourced.

8.5.2 Development Library 4.0 policies

Academic libraries should develop an innovative library policy that specifically captures budget allocation towards procurement of major 4IR technologies and applications. This can be achieved by having clear structured guidelines to adopt and implement needed technologies and applications. This should be done progressively by incorporating them step by step based on local needs and capabilities. The policies should also capture human requirements such as Lib 4.0 skills and management strategies.

This strategy can be supported by legislative reforms spearheaded by institutions, and government to support the digital transformation agenda. The policy should guide library management, stakeholders, and policymakers to focus on the demands and needs to re-channel resources to support the 4IR. This will lessen the issues of rechanneling money meant for 4IR technologies and applications for other activities. A structured policy with clear guidelines and budget allocations will prevent library workers and leaders not showing much interest in incorporating 4IR and emerging technologies as well as minimize bureaucratic processes that elongate the time frame to embrace 4IR technology.

8.5.3 Funding

Academic libraries should devise strategies to mobilize funds and become financially grounded in the quest to take action towards the disruption. The following strategies can be considered to generate funds to complement the direct source(s) of funds from traditional sources.

8.5.3.1 Lobbying and Advocacy

The leaders of academic libraries should work sedulously by lobbying and advocacy to influence the decision-making process through diplomacy and personal contact with people like the chairperson of the library committee, head of the institution, finance officer, registrar, student leadership, and faculty representatives. They should develop various methods, strategies, and tactics to gain access, inform, influence, and pressure policymakers' decisions to invest in Lib 4.0 technologies and applications. In addition, librarians and other professionals should unite to work together on specific issues, and on tactics to deal with government departments for efficiency and effectiveness to achieve greater influence for funds.

8.5.3.2 Income generation/fundraising

Even though the ultimate goal of academic libraries is not to make a profit, they cannot achieve their vision and mission without adequate financial support to thrive – especially in the 4IR era.

Generating funds internally can be attempted through:

- Printing and photocopying services
- Late fees and book fines
- Donation and gifts (*“Fundraising is judged to be successful when it results in gifts that contribute to the strategic vision for the library; gifts should free a library to achieve its goals rather than hamper or distract from its mission”*)
- Grants
- Library endowments

- Renting spaces in the library for conferences, workshops, local businesses, entities, and school group activities.
- Host community-based events to raise from funds key sponsors.
- Library card fees

8.5.3.3 Proposal writing for funding

Academic libraries require sufficient funding to implement Lib 4.0 technologies and applications and prepare librarians as well as patrons to effectively utilize them. A carefully drafted convincing proposal presenting the library's vision, needs, and feasible solution to the disruption instigated by 4IR should be considered to galvanize investors and donors to support.

8.5.4 Collaboration and network

The collaboration and networking of academic libraries determine their “net worth” and whether they can provide better access, more relevant library resources, and easier usage. Both internal and external collaboration and networking should be considered. Internal collaboration and networking with IT and/or Computer Science and Engineering Departments of the parent institution may be used to tap colleagues' knowledge, experience, expertise, ideas, and skills as well as to share technology and application. Collaborating and networking with other libraries can be used to tap new ideas and knowledge as well as to share resources – especially if the libraries have mutual objectives and needs. It can also be cost-effective as consortium pricing, licensing, and standards can be negotiated.

8.5.5 Innovative leadership

Transformational library leadership with innovative thinking and a growth mindset are needed to survive and stay relevant in the 4IR. Library leaders determine the budget, spearhead the library vision and represent the library at higher-level meetings with institutional leaders. When leaders as drivers for the progress of the library envision and are enthusiastic about emerging technologies, colleagues and subordinates might be encouraged to share the vision of incorporating Lib 4.0 technologies. Innovative leaders who are strategic thinkers, effective communicators, problem solvers, and result oriented are needed to champion, facilitate, and prioritize pragmatic strategies for the academic library to thrive in the disruption precipitated by 4IR.

8.5.6 Investing in new ICT

The 4IR is characterized by the incorporation of technologies and applications to provide smart libraries and offer intelligent services. To stay relevant, academic libraries should invest in acquiring emerging technologies, ICTs, and effective Wi-Fi to ensure the digital connectivity necessary to deliver intelligent and smart library services. Academic libraries should prove return on investments by ensuring data infrastructure and compatibility, building integrated systems including all facets of the library, and using data analytics to determine the extent of usage, generating feedback on customer perception. This action will encourage donors, stakeholders, management, government, and other funders to support the library's digital transformation agenda without hesitation.

8.5.7 Developing Curriculum 4.0

While working assiduously to embrace the demands of the 4IR, library schools should review and adjust where needed their curricula to equip them with the necessary lib 4.0 knowledge and skills and reduce re-training future librarians. The academic institution should also offer innovative core courses to equip students with knowledge, skills, and competency to produce patron 4.0 utilizing Lib 4.0 services effectively. Partnering with local or international stakeholders might be needed to ensure that experts offer the courses.

8.5.8 Digital literacy 4.0 skill set for patrons

As mentioned already, smart 4IR services offered by academic libraries can only be successfully and effectively utilized by digital and technological literature patrons. Embedded digital and technological literacy programmes in the core modules of the academic institution and library literacy initiatives and library orientation should be offered.

Academic institutions should also focus on bridging digital inequalities by providing equipment and training especially to incoming students and to the wider community.

8.5.9 Promotion Library 4.0 services

Academic libraries should enhance their visibility and Lib 4.0 services using all the available promotional tools including exhibitions, information literacy programmes, outreach projects, displaying of new services on the library and the university's website, social media networking sites, current awareness services, library tours, newsletters, flyers, brochures, posters, and

bookmarks, webcasts, radio advertisements, events and activities like workshops, conferences, seminars, user education and orientation, one-to-one conversations, word of mouth, and classroom instruction.

8.5.10 Journal for 4IR researchers in libraries

Researchers, scholars, information professionals, and students should explore cutting-edge studies on the 4IR. To guide academic libraries, research should be published in academic journals, as book chapters, as monographs, or as technical reports, or shared at professional conferences, seminars, and webinars.

8.5.11 Establishment of a center for research and innovation for 4IR

Innovation has been noticed as instrumental for academic libraries to succeed in the 4IR. A center for research and innovation can be used to research the effects of the 4IR, share innovative ideas, prepare for the next IR and enhance the role of academic libraries. Only put academic libraries on their toes but also attract talents to share their innovative ideas to make the academic library stand out. This center should make a space for a Makerspace, where students, researchers, and librarians can exhibit their ideas and present prototypes for possible consideration using 3D printing.

8.6 Recommendation for further studies

To address the limitations and delimitations and to strengthen the findings of this study, further studies are suggested.

1. This study investigated the readiness of academic libraries towards 4IR by accentuating 4IR technologies and applications, therefore, further study should be conducted by capitalizing on the readiness of information professionals as well as patrons.
2. A further study should investigate the impact of 4IR on the digital divide – especially in academic libraries in Africa.
3. Change is constant and without change, there cannot be improvement. Change management is critical for transition, therefore, a further study should be conducted to look into the best change management practices for academic libraries to embrace change and grow during the next information revolution.
4. There is a need to explore how the incorporation of 4IR technologies and applications by academic libraries will contribute to the achievement of SDG4 which is quality education. This will interest researchers to explore to determine whether 4IR technologies which focus on smart library services will be to enhance quality education swiftly and effectively.
5. A further study should be conducted focusing on the provision made for people with digital and physical disabilities in academic libraries towards the 4IR disruption.

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APPENDIX A: QUESTIONNAIRE

Dear Participant,

You are invited to participate in a research study on THE READINESS IN SELECTED ACADEMIC LIBRARIES TOWARDS THE FOURTH INDUSTRIAL REVOLUTION: A COMPARATIVE STUDY BETWEEN GHANA AND SOUTH AFRICA conducted by Noah Darko-Adjei for the completion of a Ph.D. thesis at the Department of Library & Information Science, University of the Western Cape. Before you decide to participate, it is important for you to understand the purpose of the research and what the questionnaire would entail.

The purpose of the study is to compare the readiness in selected academic libraries in Ghana and South Africa for the 4IR and to develop responsive strategies toward disruptive changes. You were selected to share your experiences and knowledge on academic librarianship and new technological developments.

Completing the questionnaire will take about 15-20 minutes. Please be advised that your participation in this research is entirely voluntary, you will be compensated with 50 Rands for participating. There will be no risks involved if you participate.

Official approval for the study has been granted as found attached. You will be asked to provide informed consent before answering any questions or taking part in any tasks. All information that you provide will be kept strictly confidential and secure nor will details of the data be shared with others. If any aspect of the study makes you feel uncomfortable, you can withdraw from the study at any time.

If you require any further information, you may contact me by phone at (+233) 275799894 or by email: at noahdarkoadjei@gmail.com. You may also contact my supervisor, Dr. Lizette King at the Department of Library and Information Science, UWC, Private bag x17, Bellville, 7530, or phone 021 959 2535 or email lking@uwc.ac.za. In addition, you may contact the UWC Research Office at HSSREC, Research Development at telephone 021 9594111 or email research-ethics@uwc.ac.za.

CONSENT FORM:

I confirm that I have read and understood the information sheet explaining the above research project and I have had the opportunity to ask questions about the project.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline. (If I wish to withdraw, I may contact the lead researcher at any time).

I understand my responses and personal data will be kept strictly confidential. I permit members of the research team to have access to my anonymized responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the reports or publications that result from the research

I agree that the data collected from me may be used in future research.

I agree to take part in the above research project.

SECTION ONE: DEMOGRAPHIC DATA OF RESPONDENTS

Please, tick (✓) appropriately.

1. Gender: (I) Male (II) Female
2. Which of the following academic institutions do you work in as a library staff?
(I) University of Ghana (II) University of Cape Coast
(III) University of Pretoria (IV) University of Johannesburg
3. What is your educational level?
(I) Masters of Arts (MA) (II) Master of Philosophy (MPhil)
(III) Doctor of Philosophy (Ph.D.) (IV) Other
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4. Which of the following sections of the library do you work in?
(I) Reference services (II) Electronic resources (III) IT support unit
(IV) Cataloguing (V) Circulation (VI) Acquisition
(VII) Institutional repository (VIII) Other. Please state

SECTION 2.1: AWARENESS AND KNOWLEDGE ABOUT THE FOURTH INDUSTRIAL REVOLUTION IN LIBRARIES

1. Have you heard about the Fourth Industrial Revolution?
(I) Yes (II) No
2. If yes, how did you get to know about it? Tick (✓) all that apply
(I) During information literacy training programme
(II) Research work
(III) Internet
(IV) Social media platforms
(V) News items
(VI) Magazine

- (VII) University website []
- (VIII) Staff meeting []
- (IX) Conference / Seminar []
- (X) Unit head []
- (XI) Other. Please state

SECTION 2.2 GENERAL FEATURES OF A ‘SMART’ LIBRARY

A smart library is characterized as a type of library where library services and resources can quickly be accessed virtually and mainly regulated by the use of ICT in an innovative way.

Please, indicate your level of agreement with the following statements about your library

Please, tick (√) where appropriate.

Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), Strongly Agree (SA)

<i>Please, respond to the items below considering the current state of your library</i>	SD	D	N	A	SA
1. Smart services can be accessed at anytime, anywhere, everywhere, and by everyone.					
2. Smart spaces are available at any time, for everyone, and everywhere.					
3. Smart Staff are qualified, competent, adaptive, creative, innovative, critical thinkers, complex problem solvers, self-learners, and ethically upright.					
4. Smart technology and applications are effective, efficient, and innovative.					
5. Smart users are information and smart technology literate, well-informed, adaptable, self-learners, and ethical.					
6. Smart leadership is visionary and innovative					
7. Smart resources are openly accessible at anytime, anywhere, and by everyone.					
8. Smart policies are adaptable, responsive, sensitive, and ethical/social justice aligned.					
9. Smart management deals with the increasing transparency of the administration and management system, user participation in decision-making processes, automatic and optimized administration procedures, and real-time					
10. Smart networking is about library openness and embeddedness in its social and cultural environment.					

SECTION 3: WHAT NEW (LIB4.0) TECHNOLOGIES AND APPLICATIONS ARE AVAILABLE IN YOUR LIBRARY DUE TO THE 4IR? Tick (✓) all that apply

SN	NEW (LIB 4.0) TECHNOLOGIES AND APPLICATIONS AVAILABLE DUE TO 4IR	Tick
		✓
1	Artificial intelligence	
2	Big data tools (e.g. Batch analysis tools, interactive tools, stream analysis tools)	
3	Virtual reality	
4	Robot library assistant (e.g. Semi Humanoid robot for reference service)	
5	Clouding computing	
6	Blockchain technology	
7	Makerspace	
8	Chatbot	
9	3D modelling software	
10	Quick response (QR) code	
11	Ask-a-librarian app	
12	Library mobile apps	
13	Library bookmark apps	
14	Self-checkout machine	
15	Scheduling and event management software	
16	Biometric security sensor for check-in and check out	
17	Internet of Things (IoT)	
14	Virtual library research guide	
15	Library tutorials (video) tool	
16	Circulation module	
18	Digital library repositories (Dspace, Fedora commons)	
20	Library social media platform	
25	Electronic newspaper	
26	Webinar digital library training service	
27	Reference management tools (e.g. Mendeley, endnote, Zotero)	
28	Others	

SECTION 4: What are the reasons for using Lib 4.0 technologies and applications in your library? Tick all that apply.

- (I) To make library services easier to use and access []
- (II) To inspire and inform patrons to patronize library services []
- (III) To help patrons learn new skills []
- (IV) To stay relevant in providing library services []

(V) To attract new and maintain existing customers []

(VI) Other. Please state

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SECTION 5A: LEVEL OF ACADEMIC LIBRARIAN’S KNOWLEDGE, SKILLS, AND COMPETENCIES IN THE LIB 4.0 APPLICATION AND TECHNOLOGIES

Please, indicate your level of agreement with the following statements. Please, tick (√) where appropriate.

Very Low (VL), Low (L), Moderate (M), High (H), Very High (VH)

KNOWLEDGE ABILITIES	Please, indicate your level of knowledge in the following technologies and applications	VL	L	M	H	VH
	1. Library management software					
	2. Programming (JAVA, HTML, etc.)					
	4. Library automation					
	5. Knowledge taxonomy					
	6. Information search strategy					
	8. Online registration of patrons					
	9. User interfaces on library web pages					
	10. Virtual help desk					
	12. Web-based tutorial (YouTube, webinar)					
IT SKILLS and competencies						
Technical IT skills	13. Fault and error recovery skills					
	14. Understand digitalization processing					
	15. Ability to work with advanced technologies e.g. 3D printing, autonomous robots, and others.					
Digital skills	18. Cloud computing skills					
	19. Data analytics/data processing					

	21. Digital content creation skills					
Thinking skills	22. Critical thinking and logical reasoning					
	23. Complex problem-solving, trouble-shooting					
	24. Creativity and innovation					
	25. Analytical thinking skills					
Personal skills	26. Lifelong learning skills					
	27. interpersonal and Communicating technologically					
	28. Leadership skills/people management					
	29. Emotional intelligence (EQ)					
	30. Negotiation skills					
	31. Embracing and Adaptability					
	32. Active learning with a growth mindset					
	33. Judgmental and decision making					
Data scientist's talent capabilities	34. The ability to identify patterns of data					
	35. The ability to apply context and intelligence					
	36. Demonstrates ability to evaluate complex data and retrieve complex data, draw conclusions, and take appropriate actions.					
	37. The ability to extract relevant information hidden in large volumes of data					
	38. The ability to design and implement data models and statistical methods.					
	39. The ability to integrate research and best practices into problem avoidance and continuous improvement.					
	40. Demonstrates expert ability to apply trend analysis.					
Digital content developer and digital user advisor's talent capabilities.	38. The expertise to interact with values of digital content user interaction.					

5B. What is your level of computer proficiency?

(I) Beginner [] (II) Intermediate [] (III) Advanced [] (IV) Expert []

**SECTION 6: CHALLENGES ACADEMIC LIBRARIES FACE
INCORPORATING THE 4IR TECHNOLOGIES AND APPLICATIONS**

Please, indicate your level of agreement with the following statements. Please, tick (√) where appropriate.

Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), Strongly Agree (SA)

No.	Items	SD	D	N	A	SA
1	Inadequate training in ICT applications					
2	Inadequate infrastructure & network facility					
3	Lack of ICT skillset to utilize Library 4.0 technologies					
4	Lack of support from authorities for implementing ICT applications in the library.					
5	Insufficient budget for ICT					
6	Data infrastructure and incompatibility					
7	Fear of losing my job as new technology emerges					
8	Lack of coordination among library staff					
9	Non-availability of consultation services on IT technical issues –					
10	Fear of new ICT applications					
12	Not involving library staff in the implementation of new technologies in the library.					
13	Lack of interest in newly adopted technologies					
14	Low priority in modern ICT applications and technologies					
15	Lack of staff motivation					

SECTION 7: RESPONSIVE STRUCTURES AND POLICIES IN PLACE FOR THE 4IR

Please, indicate your level of agreement with the following statements. Please, tick (√) where appropriate.

Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), Strongly Agree (SA)

No.	Items	SD	D	N	A	SA
RESPONSIVE STRATEGIES						
People	1. Recruiting well-skilled and experienced staff					
	2. Constant training in newly adopted and emerging technologies to re-skill staff					
	3. Good incentives to motivate staff to embrace new technologies.					
	4. Periodic evaluation of staff attitude towards the usage of new technologies and applications					
	5. Creating mutual understanding statements to deal with 4IR challenges					
	6. Empowering staff and users.					
Organizational Structure	7. The library structure motivates staff to participate in decision-making regarding the implementation of library 4.0 technologies and applications.					
	8. The library provides an avenue to encourage staff in innovation/creativity.					
	9. The library structure creates a good interpersonal relationship between managers and subordinates.					
Tasks	10 Library tasks are less complex.					
	11. Good familiarity with library tasks.					
	12. Good coordination and collaboration with other staff.					
	13. Appropriate work schedule					
	14. Good work location.					
	15. Job description is up to date					
Technology	16. Fewer technologies are underutilized and undervalued.					
	17. Less difficulty in resolving technical glitches.					

	18. Library staff have less difficulty in keeping up with new technologies and spend less time familiarizing themselves with technologies.					
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SECTION 7: POLICIES

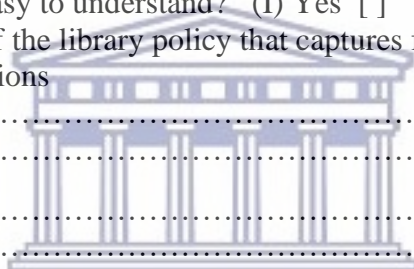
1. Do your library policies make room for library 4.0 technologies and applications?
 - (I) Yes []
 - (II) No []
2. Do the library policies cover any of the following issues?
 - (I) ICT Skills []
 - (II) ICT Infrastructure []
 - (III) Funding []
 - (IV) Regulation []
 - (V) Effective Security []
 - (VI) Training []
 - (VII) Frequent review of library policies to capture 4IR technologies and applications []
3. Are the library policies easy to understand? (I) Yes [] (II) No []
4. If yes, state an instance of the library policy that captures future emerging technologies and applications

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SECTION 8: AVAILABLE ACTIONS TOWARD THE DISRUPTIVE CHANGES

A. Information and Communication Technologies (ICT) infrastructure and emerging technologies	SD	D	N	A	SA
1. There is a virtual gateway to the library, and it has been well-designed with valuable content and strong visibility, and customer orientation.					
2. There is enough broadband and other internet technologies that provide digital connectivity for effective communication.					
3. There are available high specifications computers and accessories to render enhanced and advanced library services.					
4. There is the adequate power supply					
5. The library software is user-friendly.					
6. Constant maintenance of ICT infrastructure					
7. There are available automated library cards for patrons to access the library ICT infrastructure and services.					

8. There is an available automated entry checkpoint for learning (research and knowledge) commons in the library.					
9. There is an available automated sensor system at the entrance of the library to ensure the safeguarding of library materials (e.g. Reference materials).					

B. Education and training programmes organized by the library capture the following focus:					
1. Use of emerging technologies					
2. Complex problem solving					
3. Critical thinking					
4. Creativity and innovation					
5. People management					
6. Coordinating with others					
7. Emotional intelligence					
8. Judgment and decision making					
9. Service orientation					
10. Influencing and negotiation					
12. Online learning					
13. Aggregated data gathering					
14. Digital information management					
15. Collaboration and partnership					

16. How often does your library provide training on new technologies and applications for the staff?

- (I) Very often
- (II) Often
- (III) Once in a while
- (IV) Every six months
- (V) Every year
- (VI) Only when there is a new implementation of a system or product in the library
- (VII) (VII) Not sure

17. Which of the following Library 4.0 areas have you received education and training on?

Please, tick (√) all that apply

- (i) Big data
- (ii) Artificial intelligence
- (iii) Advanced robotics
- (iv) Internet of Things

- (v) Virtual and augmented reality
- (vi) Simulation
- (vii) Cloud computing
- (viii)Blockchain
- (ix) Makerspace
- (x) Other.....

18. Impact of library training programmes on the library staff

Please, indicate your level of agreement with the following statements. Please tick (√) where appropriate.

Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), Strongly Agree (SA)

Rate the impact of the training programmes on the library staff	SD	D	N	A	SA
19. It has helped library staff to be abreast of new technologies and applications.					
20. It has helped me to be efficient and effective in my work delivery.					
21. It has helped librarians to understand the varying information needs of the user.					
22. It has reduced the negative perception (E.g. fear of losing a job) towards the implementation of new technologies and applications.					
24. I have been able to build my confidence in complex systems and applications through library training programmes.					
25. I can now assist patrons with advanced search techniques with ease.					

26. I think that there are not enough training programmes on emerging technologies in libraries.

- (I) Yes (II) No

C. INNOVATION	Yes	No.
What are the innovation strategies implemented in your library?		
1. Effective Instant messaging (through SMS and emails to patrons)		
2. Availability of mobile library apps for patrons.		
4. The delivery of digital knowledge that is being supplied at a low cost to patrons.		
5. There are periodic live online library instruction programmes through a webinar and social media platforms.		
6. There are periodic live library instruction programmes through a webinar.		

7. Constant update on a new collection in the library to users through the use of e-alerts.		
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10. Indicate any other innovation strategies in your library

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ALLOCATION OF ADEQUATE FUNDS FOR THE LIBRARY

1. What are the sources of funding for managing the library? Tick all that apply.

- (I) Government
- (II) Library's internally generated revenue
- (III) Donations
- (IV) Tertiary education tax fund, library services
- (V) University coffers
- (VI) (VI) Scholarships
- (VII) Other

2. To what extent does your library face financial constraints?

- (I) Very High
- (II) High
- (III) Moderate
- (IV) Low
- (V) Very Low



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3. Give an instance where financial constraints incapacitated the library from adopting the most needed library 4.0 technology or application

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Thank You

APPENDIX B: INTERVIEW GUIDE

Section A: AWARENESS AND KNOWLEDGE ABOUT THE FOURTH INDUSTRIAL REVOLUTION

1. Are you aware of the 4IR technologies in your library?
2. How did you get to know about them?
3. What are some of the changes that the 4IR industry revolution has brought into your library?

SECTION B1: NEW (LIB4.0) TECHNOLOGIES AND APPLICATIONS

1. Mention new (Lib4.0) technologies and applications that are available in your library due to the 4IR.

SECTION B2: REASONS FOR USING LIB 4.0 TECHNOLOGIES AND APPLICATIONS

1. Mention reasons that have necessitated the use of these lib 4.0 technologies and applications in your library.

SECTION B3: CHANGES CAUSED BY 4IR TECHNOLOGIES.

1. What are some of the practical changes that you have witnessed in your library due to the implementation of 4IR technologies and applications?

SECTION 4: KNOWLEDGE, SKILLS, AND COMPETENCIES

1. Rate your knowledge in implemented lib 4.0 technologies and applications in your library (from 1-10)
2. How often does your library provide training on new technologies and applications to the staff?
3. What are some of the impacts of the training?

SECTION 6: CHALLENGES

1. What are some of the challenges that your library face in incorporating the 4IR technologies and application?

SECTION 7: RESPONSIVE STRUCTURE AND POLICIES

1. What are the responsive structure in place for the 4IR?
2. What are the policies in place for the 4IR?
3. What are some of the areas that the library policy cover?
4. Does the library policy include future emerging technologies and applications applicable to the library?
5. State instances of the library policy that captures future emerging technologies and applications.

SECTION8: AVAILABLE ACTIONS

1. What are the available actions the library has in place toward the disruptive changes of the 4IR?

Thank you for your time



UNIVERSITY *of the*
WESTERN CAPE

APPENDIX C: ETHICAL CLEARANCE - UNIVERSITY OF WESTERN CAPE



UNIVERSITY of the
WESTERN CAPE



16 September 2020

Mr. N Darko-Adjei
Library and Information Science
Faculty of Arts

Ethics Reference Number: HS20/6/34

Project Title: The readiness of academic libraries towards the fourth industrial revolution: A comparative study between Ghana and South Africa.

Approval Period: 12 September 2020 – 12 September 2023

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

The permission to conduct the study must be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

NHREC Registration Number: HSSREC-130416-049

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

APPENDIX D: LETTER OF PERMISSION TO THE UNIVERSITY OF GHANA BALME LIBRARY



UNIVERSITY of the
WESTERN CAPE



17th June 2021

Prof. Perpetua Sekyiwa Dadzie
The University Librarian
University of Ghana Balme Library
University of Ghana, Legon
psdadzie@ug.edu.gh

Dear Prof. Dadzie,

**REQUEST TO CONDUCT A RESEARCH STUDY AT THE UNIVERSITY OF GHANA
BALME LIBRARY**



I am undertaking a Ph.D. thesis in partial fulfillment of the requirements for a Doctor of Philosophy (Ph.D.) Degree in Library and Information Science, Department of Library and Information Science at the University of the Western Cape (UWC).

This study intends to assess the readiness in selected academic libraries in the Fourth Industrial Revolution (4IR) by comparing two advanced academic libraries in Ghana and South Africa. Limited studies on the readiness of African academic libraries exist. As this transition is critical for Ghana and South Africa academic libraries, it would be of great importance to know the level of their preparedness. If readiness (or lack thereof) towards the digital transformation in the 4IR can be determined and a holistic picture of the current situation can be projected, necessary actions to be taken might be identified. This move will enable academic libraries to prepare adequately in diverse ways to face the disruptive changes caused by the 4IR otherwise they will eventually fold up since their services will be redundant.

The study will seek to answer the following research questions:

1. What are academic librarians' awareness and knowledge about the 4IR?
2. Which Lib4.0 technologies and applications are used in Ghana and South Africa?
3. What is the level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies?
4. What challenges do academic libraries face in incorporating 4IR technologies?
5. Which structures and policies are in place towards disruptive changes?
6. What are the available actions toward disruptive changes?

As research demands, ethics clearance from UWC has been worked on and as the University of Ghana Balme Library will be part of my research site, I need permission from you to conduct the research. I hope that my request will receive your favourable consideration.

Yours faithfully,



Noah Darko-Adjei (Student number: 4015126).

4015126@myuwc.ac.za





17 June 2021

Dr. Mac-Anthony Cobblah

The University Librarian:
Sam Jona Library
University of Cape Coast
mac-anthony.cobblah@ucc.edu.gh

Dear Cobblah,

Request to conduct a research study at the University of Sam Jona Library

I am undertaking a Ph.D. thesis in partial fulfillment of the requirements for a Doctor of Philosophy (Ph.D.) Degree in Library and Information Science, Department of Library and Information Science at the University of the Western Cape (UWC).

This study intends to assess the readiness in selected academic libraries in the Fourth Industrial Revolution (4IR) by comparing two advanced academic libraries in Ghana and South Africa. Limited studies on the readiness of African academic libraries exist. As this transition is critical for Ghana and South Africa academic libraries, it would be important to know the level of their preparedness. If readiness (or lack thereof) towards the digital transformation in the 4IR can be determined and a holistic picture of the current situation can be projected, necessary actions to be taken might be identified. This move will enable academic libraries to prepare adequately in diverse ways to face the disruptive changes by the 4IR otherwise they will eventually fold up since their services will be redundant.

The study will seek to answer the following research questions:

1. What are academic librarians' awareness and knowledge about the 4IR?
2. Which Lib4.0 technologies and applications are used in Ghana and South Africa?
3. What is the level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies?
4. What challenges do academic libraries face in incorporating 4IR technologies?
5. Which structures and policies are in place towards disruptive changes?
6. What are the available actions towards disruptive changes?

As research demands, ethics clearance from UWC has been worked on and as Sam Jona Library will be part of my research site, I need permission from you to conduct the research. I hope that my request will receive your favourable consideration.

Yours faithfully,



Noah Darko-Adjei (Student number: 4015126).
4015126@myuwc.ac.za



APPENDIX F: LETTER OF PERMISSION TO THE UNIVERSITY OF JOHANNESBURG
LIBRARY



17 June 2021

Maria Frahm-Arp
The Director of Library:
University of Johannesburg Library
University of South Africa
mariafa@uj.ac.za

Dear Sir/Madam,

Request to conduct a research study at the University of Johannesburg Library

I am undertaking a Ph.D. thesis in partial fulfillment of the requirements for a Doctor of Philosophy (Ph.D.) Degree in Library and Information Science, Department of Library and Information Science at the University of the Western Cape (UWC).

This study intends to assess the readiness in selected academic libraries in the Fourth Industrial Revolution (4IR) by comparing two advanced academic libraries in Ghana and South Africa. Limited studies on the readiness of African academic libraries exist. As this transition is critical for Ghana and South Africa academic libraries, it would be important to know the level of their preparedness. If readiness (or lack thereof) towards the digital transformation in the 4IR can be determined and a holistic picture of the current situation can be projected, necessary actions to be taken might be identified. This move will enable academic libraries to prepare adequately in diverse ways to face the disruptive changes by the 4IR otherwise they will eventually fold up since their services will be redundant.

The study will seek to answer the following research questions:

1. What are academic librarians' awareness and knowledge about the 4IR?
2. Which Lib4.0 technologies and applications are used in Ghana and South Africa?
3. What is the level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies?
4. What challenges do academic libraries face in incorporating 4IR technologies?
5. Which structures and policies are in place towards disruptive changes?
6. What are the available actions towards disruptive changes?

As research demands, ethics clearance from UWC has been worked on and as the University of South Africa Library will be part of my research site, I need permission from you to conduct the research. I hope that my request will receive your favourable consideration.

Yours faithfully,



Noah Darko-Adjei (Student number: 4015126).
4015126@myuwc.ac.za



APPENDIX G: LETTER OF PERMISSION TO THE UNIVERSITY OF CAPE TOWN
LIBRARY



12th August 2021

Ms. Ujala Satgoor
The Executive Director UCT Libraries
University of Cape Town
Cape Town
ujala.satgoor@uct.ac.za

Dear Madam,

**REQUEST TO CONDUCT A RESEARCH STUDY AT THE UNIVERSITY OF
UNIVERSITY OF CAPE TOWN LIBRARY**

I am undertaking a Ph.D. thesis in partial fulfillment of the requirements for a Doctor of Philosophy (Ph.D.) Degree in Library and Information Science, Department of Library and Information Science at the University of the Western Cape (UWC).

This study intends to assess the readiness in selected academic libraries in the Fourth Industrial Revolution (4IR) by comparing two advanced academic libraries in Ghana and South Africa. Limited studies on the readiness of African academic libraries exist. As this transition is critical for Ghana and South Africa academic libraries, it would be important to know the level of their preparedness. If readiness (or lack thereof) towards the digital transformation in the 4IR can be determined and a holistic picture of the current situation can be projected, necessary actions to be taken might be identified. This move will enable academic libraries to prepare adequately in diverse ways to face the disruptive changes by the 4IR otherwise they will eventually fold up since their services will be redundant.

The study will seek to answer the following research questions:

1. What are academic librarians' awareness and knowledge about the 4IR?
2. Which Lib4.0 technologies and applications are used in Ghana and South Africa?
3. What is the level of academic librarian's knowledge, skills, and competencies in the application of the 4IR technologies?
4. What challenges do academic libraries face in incorporating 4IR technologies?
5. Which structures and policies are in place towards disruptive changes?
6. What are the available actions toward disruptive changes?

As research demand, ethics clearance was obtained from UWC and as the University of Cape Town Library will be part of my research site, I need permission from you to conduct the research. I hope that my request will receive your favorable consideration.

Please contact me if additional information is needed.

Yours faithfully,



Noah Darko-Adjei (Student number: 4015126),
4015126@myuwc.ac.za

