Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology

by

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ABSTRACT

Due to the proliferation of disruptive technologies that drive the fourth industrial revolution (4IR), academic libraries have undergone an evolution, which has also changed the role of academic librarians. With disruptive technologies, library services can be accessed from anywhere in the world, as long as a person is connected to the Internet of Things. For academic librarians to not be left behind, they need to skill themselves to be relevant in the 4IR. It is the thesis of this study that such upskilling can be done through continuous professional development. This explanatory mixed method research used a conceptual framework to explore how the evolving role of academic librarians can be shaped through continuous professional development at the Durban University of Technology (DUT). Quantitative data was collected first through online questionnaires due to the Covid-19 pandemic, followed by qualitative data through physical interviews with selected participants. Parallel sampling was used where different samples for qualitative and quantitative study phases were drawn from the same population. For the quantitative phase, all librarians at DUT were chosen, while for the qualitative study, participants were identified and chosen purposively to the level of saturation to augment the quantitative data. The key findings suggest that the advancement of disruptive technologies has impacted and transformed the customary ways of working in the DUT library. To counter the disruption, academic librarians at DUT have embraced continuous professional development in order to update their knowledge and skills to allow them to evolve and adapt accordingly to changes within their profession. The librarians acknowledged that whilst 4IR provided many advantages, there were still many challenges, such as learning new skills and keeping abreast with new innovations especially in an environment where budget cuts are common, to overcome in respect of changes in their roles and responsibilities. Librarians acknowledged that continuous learning and development provided an advantage that allowed them to understand the evolving changes and adapt accordingly. It is concluded that librarians are perceptive and open to learning new skills to ensure that users' needs are adequately met. The infrastructure at the DUT library is in place to embrace changes, and the institution is continuing to improve the existing infrastructure to accommodate future innovations. The study suggests a framework to align librarian roles and skills with 4IR

requirements. A further study on the user point of view and their current needs and how these needs are evolving with 4IR is recommended.

Key terms: Academic librarians; Fourth industrial revolution; Continuing professional development; Disruptive technologies; Evolving roles of librarians; Library services

DECLARATION

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Shaping the evolving role of academic librarians in the Fourth Industrial Revolution through Continuous Professional Development at the Durban University of Technology

I, Anushie Moonasar, declare that the above dissertation is my own work and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

22 March 2024

A. Moonasar — Date

DEDICATION

This thesis is wholeheartedly dedicated to my late parents, Mr Ramroop Maharaj and Mrs Jayanthi Maharaj. You both are missed everyday but remain a constant source of inspiration, motivation, and strength. I know you two would be proud and excited to celebrate this momentous milestone with me.

To my two daughters, Mishka and Keisha, I also dedicate this thesis to you as a reflection of hard work and dedication to show you that you can do what you love and achieve all your dreams no matter your age or phase in your life – never stop learning.

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LIST OF ACRONYMS AND ABBREVIATIONS

AACR2	Anglo-American Cataloguing Rules
AI	Artificial Intelligence
CPD	Continuing Professional Development
DUT	Durban University of Technology
FOLIO	Future of Libraries is Open
4IR	Fourth Industrial Revolution
ICT	Information and Communication Technology
IFLA	International Federation of Library Associations and Institutions
ILS	Integrated Library System
ITS	Information Technology Staff
ITSS	Information Technology Staff Services
IoT	Internet of Things
LIASA	Library and Information Association of South Africa
LMS	Library Management System
RDA	Resource Description and Access
RFID	Radio Frequency Identification

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CHAPTER ONE
INTRODUCTION: SETTING THE SCENE

1.1 Introduction and background to the study

Libraries and information sectors are caught up in a rapidly changing and dynamic environment. Throughout the years, this sector has seen and experienced many disruptive technological changes that are altering the role of librarians completely. Cox and Corrall (2013:1526) explain how librarians have reshaped their profession to keep up with the changing times, which evolved from the manual system to automation, and this is clear in the emergence of new jobs. Further clarification is explained in the creation of a systems librarian, institutional repository manager, digital librarian, research data manager to digital scholarship librarians. According to Chigwada and Chisita (2021:3), the impact the Fourth Industrial Revolution (4IR) had on different libraries varies. For academic libraries, it is even more so, as this sector supports researchers, students, lecturers, and administrators. As such, librarians are required to re-think and re-organise their skills to remain relevant and useful to their users. The new roles of academic librarians warrant them to provide information, services, and assistance with research regardless of time, place, or structure. An explanation of academic libraries by Momoh and Folorunso (2019:8) as 'agents of change' implies that it is expected to evolve with changes within the environment to keep up with the times.

According to Parahoo (2014:2), information technology (IT) is rapidly changing society's behaviour and the world one lives in and there are opportunities to develop and grow with the changes. Academic librarians today are very much involved in helping their users create an impact in the research field. They are aiding their researchers in fulfilling grant requirements and drawing attention to their institutional research impact, as well as ensuring the visibility of researchers (Stevens 2021). The library sector has embraced the changes and evolved with them. By continually updating their skills, librarians can stay abreast of the changes and evolution that the library world has undergone and experienced. The updating of skills is done through what is termed continuing professional development (CPD).

CPD is the ongoing ability to keep up to date in one's profession and it is a frequently practised activity (Pan & Hovde 2010:2). Librarians are now becoming more aware of how important CPD is to their professional capacity due to the rapidly changing technology. As explained by Parry (2008:41); Wong and Chan (2018:108); and Mohideen, Sheikh, Kaur and Sukmawatid (2022:522), it has been recognised that most librarians are very adaptable and can evolve with the changes within their environments. For example, if the transition from manual card catalogues to automation is studied, it is noted that librarians have found a way to survive and re-skill themselves. The changes in the sector have transformed over time from the manufacturing processes in the first industrial revolution and steam power to the advancement of computers, robots, and software in the current environment (Sutherland 2020:242). The latest technological convergence to impact the library sector is known as disruptive technology that drives 4IR. This technology is transforming the way in which the current environment and society operate. The 4IR embodies an extraordinary union "between and across digital, physical and biological technologies" and transforming how products are created and utilised (Maynard 2015:1005). According to Ahmat and Hanipah (2018:56), libraries are the main advocates and facilitators of the 4IR, and librarians are required to adapt accordingly. The 4IR technology is re-defining the future of work in all disciplines. Libraries are becoming the hubs of data capture, and the way in which the library is being used is transforming (Ahmat & Hanipah 2018:54-55). The internet, aligned with the digital revolution, is generating more efficient and automated systems via artificial intelligence (AI), cloud computing, the Internet of Things (IoT), virtual reality, and Big Data analytics, which have affected libraries and information services. The management of research data and big data is impacting on librarians and most of the traditional library works are being automated (Kashmir Observer 2017).

Academic librarians have continually played a fundamental role in research and information services to ensure that the needs of users are met. In an ever-changing technological environment, this is not an easy task. Today, academic librarians are more involved with their researchers and users. They need to ensure that their users are aware of and understand the scholarly communication and the open resources that are available. As observed by Wong and Chan (2018:110), many librarians

restructure and develop their daily processes to accommodate changes.

Academic librarians are helping their users to create their researcher profile identifiers such as Google Scholar, Scopus, Publons, and ORCID accounts to bring visibility and awareness to their research work and build institutional repositories. This is conforming to the Durban University of Technology (DUT) librarians as they even go a step further by assisting academics to link these research profile identifiers. This ensures that their work is accessible and enhances their citation indexes. Academic librarians are more involved in engaging researchers, understanding research analytics, becoming familiar with various open access resources, promoting library publishing, and educating their researchers on the importance of research data (Stevens 2021).

With the rapid spread of the coronavirus, which had affected the entire world and on the way people operated in all sectors, it has become more apparent that drastic measures must be implemented in academic libraries. Although libraries had been affected by technological changes before the pandemic, the spread of COVID-19 accelerated the transition of libraries to virtual information sharing platforms (Oladokun & Mooko 2022:2). According to the International Federation of Library Associations and Institutions (IFLA 2020), libraries around the world have been affected by the spread of the virus and faced difficult choices around which services to offer and how to offer the services to their users, and decisions on whether to restrict opening hours or to shut down services during the lockdown period had to be made. The spread of the COVID-19 virus had influenced the way in which libraries and other businesses operated and continued with their daily activities. Due to the total closure during the COVID-19 lockdown, libraries were faced with challenges around on how to effectively manage remote work. Although COVID-19 impacted on CPD activities, it accelerated the 4IR. Librarians were forced out of their comfort zones and needed to update their skills and training needs to work from home and provide effective services to their users (IFLA 2020). A traditional librarian would be in a physical space and anticipate the users approaching them. With the new shift in IT, compounded by the lockdown regulations during the COVID-19 pandemic, librarians needed to move out of confined or traditional physical spaces and approach the users and ensure that they could satisfy their needs. Librarians are expected to be proactive by ensuring that they can

keep up with the changing needs of the users, as they serve as the main bridge to information access (Dakshinamurti, Satpathy & Chandra 2009:24).

IFLA (2020) encourages librarians to stay abreast of current trends and continuous changes in the world of information. IFLA (2020) developed guidelines that are designed to guide professional bodies in dealing with librarians and their CPD activities or initiatives. Each country is unique in its characteristics and the IFLA guidelines (2016) may or may not be suitable for the needs of every country. The guidelines are a guide for each country to work towards and adapt their guidelines to suit their unique needs. The professional body in South Africa, known as the Library and Information Association of South Africa (LIASA), has adopted and shaped the South African CPD guidelines according to the IFLA guidelines. The CPD guidelines for LIASA were announced in April 2018 (LIASA 2021). The guidelines are directed towards allowing librarians in South Africa an opportunity to remain relevant in the profession, as well as in the 4IR era. These guidelines have been tweaked and customised to suit the needs of librarians in South Africa. LIASA (2021) explains the need for the CPD, as library and information professionals are faced with a growing pressure to maintain and develop professional competence. In order to maintain competence and remain relevant, LIASA (2021) professes ensuring that registered members retain and continuously develop their:

- professional knowledge
- professional skills
- professional values, ethics and attitudes
- competence achieved during years of study.

Participating in CPD initiatives will enable “members to continue to perform competently within their professional environments and chosen roles” (LIASA 2021). It is necessary and important that librarians understand the new trends and can adapt to the changes in time accordingly. As Shilenge and Telukdarie (2021:458) elucidate, the 4IR is no longer a hype but an actual reality in all organisational sectors. The libraries are impacted by the 4IR which brought about a change in technological innovations and the re-organisation of library spaces. Therefore, libraries must evolve to fit into a world that is increasingly digital and innovative (Wenborn 2018). This study explored how academic librarians respond to their evolving role, which has been

exacerbated by the 4IR and the COVID-19 pandemic, through CPD, with the DUT as a study. This was done by studying the skills of current academic librarians and the effect of the 4IR and their ability to adapt and develop recommendations that suited the academic environment. CPD initiatives can be structured in various ways and add value to and enhance existing knowledge and skills. The enhancement of knowledge and skills alone is not important (Long & Applegate 2008:172), but the actual way in which it is utilised to advance and transfer skills to others is also an important factor for librarians. Hussain (2020:2-3) alludes to the replacement of librarians with robots and radio frequency identification (RFID) technology. Although not yet replacing librarians, the University of Pretoria library introduced a robot librarian in May 2019 dubbed Libby. This robot was officially introduced as “a new library employee” by the manager of Library Services: MakerSpace (Olivier 2019). This shows that librarians must combine their skills with technology to obtain the best results in satisfying user needs. This, according to Hussain (2020:3), can be accomplished when librarians change their mind-sets and focus on working with innovations rather than being intimidated by the inventions that have appeared in the library environment.

The purpose of this study was to explore how the evolving role of academic librarians in the 4IR is shaped through continuous professional development at the DUT. This study addressed the changes that academic librarians experienced while struggling to adapt and embrace the transformations the 4IR presents in the information environment. Librarians must keep their skills relevant to adapt to the changing environment. Although new technology is continuously introduced in the library environment, some librarians are resistant to embrace new ways of working, while others are adjusting and open to learning transformative ways, for example, adapting the roles of cataloguers’ transition from AACR2 to RDA. This change affected librarians in the cataloguing and meta-data sections. The cataloguers had to adapt to the new standards in RDA that accommodated the newer online versions of information, for example, e-books, audio books and webinars. The cataloguers had to embrace new technologies that are connected to an international shared catalogue. This meant that these librarians had to brace themselves for the new changes and new ways of continuing with their daily work (MacLennan & Walicka 2020:464).

1.1.1 Contextual settings

This research was carried out at the DUT, which is located within KwaZulu-Natal, one of the nine provinces in South Africa. The emergence of DUT was a result of a merger in 2002 between ML Sultan Technikon and Technikon Natal. It was first named the Durban Institute of Technology and later became the DUT in accordance with the government decision on universities of technology. The university serves a student population of approximately 33 000 students across six campuses. The DUT library is a multi-campus spread across Durban and Pietermaritzburg and comprises of six library sites. This research focused on staff employed at the six library sites. Traditional libraries, similar to the DUT library, are housed in a space where the focus is on the storage and preservation of the physical items, such as books, media items and periodicals. Essentially, the information is stored in one place and users need to visit the library for the required item. The DUT librarians' jobs have evolved over time. They are now forced out of their comfort zones (which is continuing with the traditional ways of helping users) to embrace new technologies and new ways of working and imparting their knowledge to users. The DUT librarians are expected to be skilled and knowledgeable about the tasks they undertake and ensure that quality services are available to their users at all times. Some librarians find it difficult to adapt to the changes, whilst others are more flexible. According to Mooko and Oladokun (2021:226), the academic librarians play an important role in the teaching and learning of users by providing information to support them. In addition, the DUT librarians are very involved with teaching information literacy skills to users in a face-to-face environment. This teaching has evolved over time, and the librarians are attempting to adapt to the changes of blended teaching. Although many of the DUT librarians have risen in an attempt to meet the new challenges of online user interactions, the introduction of a new, integrated library system and Discovery layer tool has proven challenging. Librarians must be adequately equipped to cope with the changing demands of the times and, therefore, require regular CPD initiatives to enable them to cope effectively with environmental changes and demands. The study focused on how librarians' jobs have evolved, the types of CPD activities they attended to make the transition easier and the innovations the library introduced to the environment.

1.2 Conceptual framework

According to Ngulube (2020:18), theories are important in the research process and help to explain how the researcher envisions the study unfolding. The conceptual framework illustrates how the different key concepts of a study are related and how the literature review of the study was influenced. The conceptual framework is a map of how the study will unfold (McGaghie, Bordage & Shea 2001:923). According to Ngulube (2020:29), there are five distinctive ways of expressing a conceptual theory in research as reflected in Figure 1.1.

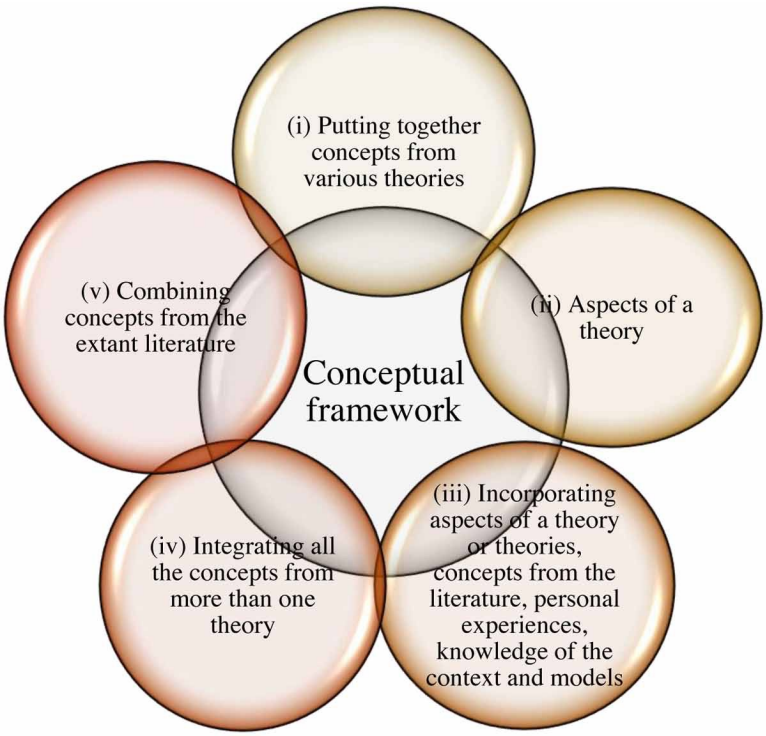

Figure 1.1: Five ways to formulate a conceptual framework for an empirical study (Ngulube 2020:30)

These five ways are as follows:

i) Placing together different concepts from different theories
ii) Aspects of a theory
iii) Incorporating aspects of a theory or theories, concepts from various literature, personal experiences, knowledge of the context and models
iv) Integrating all concepts from more than one theory
v) Combining concepts from the available literature (Ngulube 2020:29)

For the purpose of the current study, a combination of drawing from personal experiences and consulting existing literature contributed to the conceptual framework depicted in Figure 1.2. The researcher was guided mainly by the third aspect of Ngulube's (2020:29) five ways in determining the conceptual boundaries using one's thought process throughout this study. Svinicki (2010:5) points out that "everyone has a conceptual framework about how reality works that allows him or her to make predictions about how A is related to B and what will happen when the two intersect" and the researcher based the understanding of concepts and perceived outcomes of variables to conceptualise the framework for the study. The academic library in the current changing technological environment has been a challenge to the academic librarians and compels them to understand and adapt to the changes. These changes are reliant on the professional competencies and skills that librarians possess, as well as their behaviour and attitudes to embrace change. This study focused on the new technologies, 4IR, the information age, libraries, librarians, and their evolving roles. The 4IR has had a drastic impact on the library environment and this is confirmed by Mohideen et al (2022:521), as these authors explain that the 4IR with its disruptive changes in emerging technologies affects the library and information environment. The emergence of smart technology, AI, big data, robotics and many other technologies has changed the traditional ways of working for librarians. The shifting roles of academic librarians can be an extension of their existing roles and new emerging roles. The main objective of this research, and the attempt to address it in the conceptual map, was to explore the influence of the 4IR and the significant changes it created in the fluctuating roles of academic librarians.

The conceptual framework with the 4IR and the academic library as the main interrelated aspects in Figure 1.2 highlights the influence the 4IR has on libraries and what librarians must embrace and endure to remain relevant and competent in the face of the disruptive technological transformation. This conceptual framework in Figure 1.2 was influenced by the empirical study of Ngulube (2020:30), which included combining concepts from available literature and provided a guide to the investigation of CPD, how it helped academic librarians deal with the 4IR in the library world and examined whether the DUT library infrastructure supported 4IR and related innovations. The conceptual framework in Figure 1.2 defines the effect of the 4IR on libraries and librarians based on the digital transformation that impacted on the DUT

library. The automation of library service, smart technology, and IoT and the continuation of information literacy instruction caused the library to transform in the way it operated. Librarians need to embrace digital transformation to be better equipped to serve the users in the 4IR era. With new innovations such as AI and automation, librarians are able to evolve and transform the way that they engage with users. Instruction in information literacy will continue to be essential, as the amount of information is rapidly increasing within the university community with research and large datasets. Librarians can play an important role in helping users develop strong information literacy skills to search and evaluate databases and sources. Librarians need to be more open to various CPD activities and make a point of attending the activities and ensuring that they stay relevant in their profession. The arrows in Figure 1.2 indicate the direction of the data flow and how the academic library is the focus of the conceptual framework with the librarians' roles and responsibilities and CPD participation influenced by 4IR impacting on the library operational functions. The DUT librarians need to understand the new products and services that are part of the 4IR era. With the 4IR changing the landscape of libraries, academic librarians need to continue to learn to stay ahead of trends within their discipline. Librarians need to be equipped to adapt to technological changes and embrace the impact the 4IR will have on the library environment by adapting to changes and finding new ways to work. DUT librarians are forced into roles that require research skills, such as research data management and scholarly communication, that are being introduced to the DUT community, and the librarians need to take the lead in these areas. It is important to verify whether the existing DUT infrastructure is able to support the 4IR or if it needs to be upgraded.

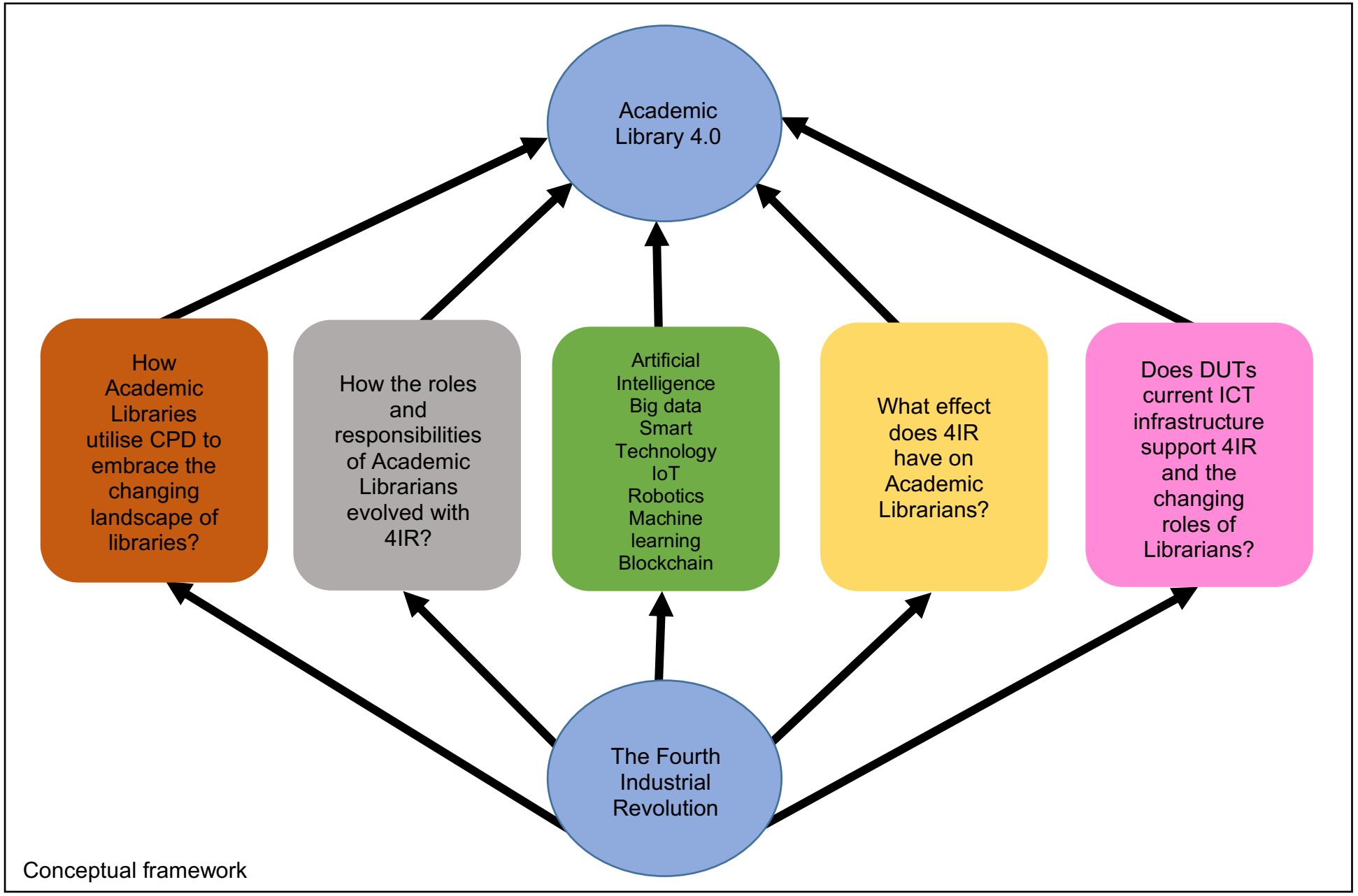

Figure 1.2: Conceptual framework based on the effect 4IR has on libraries and librarians (Researcher 2022)

Table 1.1 depicts the attributes that should complement academic librarians, the 4IR and CPD. These attributes captured in Table 1.1 are essential traits and qualities that are expected to help librarians navigate their way with new technological innovations. The literature review attempted to cover the extent to which the 4IR impacted the current roles and responsibilities of academic librarians. An analysis of what skills and proficiencies help ease academic librarians' path in navigating the 4IR and the change it brings with is the reason why continuous learning is important. The 4IR brings with it new challenges and opportunities that impact on the librarians' daily activities. Librarians need to be reskilled to embrace these changes and this can be achieved by attending CPD activities to keep librarians in line with new trends. The academic librarian, the 4IR, and CPD are linked to ensure that users' needs and requirements are always met. CPD includes both about formal and informal learning. Academic librarians need to be proactive in providing support for digital scholarship initiatives, manage research data, promote open access, and provide access to the various available digital resources. The changes the 4IR delivers need to be supported by the acceptance and willingness of academic librarians to learn new skills to embrace the changes. The academic librarians need to be adaptive and competent to advance and stay abreast of trends. The data collection instruments attempted to understand how the 4IR influences the current role of academic librarians and how they cope with changes in their environment. The librarians' attitudes and willingness to adapt to the changes in their environment will be measured by how they navigate their way by servicing the users whilst coping with disruptive technological innovations.

Table 1.1: Table of essential attributes required for professional associations (World Economic Forum 2020:105-108)

Academic Librarians	**4IR**	**CPD**
Qualification	Big Data	Ongoing learning
Competency	IOT	Formal learning
Adaptive	Smart Technology	Informal learning
Creative	Cyber physical systems	Benefits
Innovative	Interoperability	Challenges
Complex problem solvers	AI	
	Deep learning	

	Machine learning	
	Users	**Infrastructure**
	Informal and smart Technology literate Well informed Adaptable Self-learners	Software Cloud-based technology Good Wi-Fi connectivity Adequate ICT support Skilled ITS technicians

1.3 Statement of the problem

New technological changes impact on the access, evaluation, and dissemination of information. The fourth industrial revolution allows users to have much more flexibility with their access to information. The academic librarian plays an important role in promoting new ways of learning and accessing information. However, the way in which information is acquired and disseminated has changed, and this affected the roles and responsibilities of academic librarians, who are constantly faced with challenging ways to ensure that user needs are met. Information and communication technology (ICT) is rapidly changing and influencing traditional libraries (Wójcik 2016:404). Although the international and national professional library and information associations are more insistent that librarians understand the importance of continuing their professional development and being comfortable with the continuous changes in the sector, there is still a lack of commitment from librarians and information sectors to ensure that it is compulsory for librarians to enhance and develop their skills to suit the changing ICT environment (LIASA 2021). Librarians are constantly challenged to learn new skills and adapt to new technologies to satisfy user needs. If librarians are not flexible, it can be challenging to continue working with users to impart new teaching and learning skills (Pan & Hovde 2010:2). With the 4IR upon us and already changing the way that we operate and live, librarians need to ensure that they are fully equipped to handle the evolving changes, or they will be left behind in the new technological world of many disruptive technologies such as self-help service and AI, to name a few, that have impacted on the library world. The new technologies have affected the academic librarian's way of working and they need to brace themselves for a completely new way of operating. What seems to be lacking in many of the literature pieces is how the 4IR has affected the academic librarians and how continuous

professional learning has helped the librarians in adjusting and managing the changes in their daily activities (Ayinde & Kirkwood 2020; Sutherland 2020; Wong & Chan 2018).

1.4 Research purpose and objectives

The purpose of this study was to explore how to shape the evolving roles of academic librarians affected by emerging technologies at the DUT within the advancing environment on the cusp of the 4IR. The specific objectives were to:

- determine how the roles and responsibilities of academic librarians have evolved in view of current disruptive technologies that drive the 4IR;
- identify skills and competencies that can help academic librarians understand and transform with the impact of innovation and technologies;
- establish the effects of the 4IR on the roles of academic librarians in the changing information environment;
- determine how academic librarians utilise CPD to embrace the changing landscape of libraries;
- assess whether the current infrastructure of the DUT library supports the 4IR and the changing roles of librarians;
- suggest a model of aligning librarians' roles and skills with the 4IR.

1.5 Significance of the study

Research is seen as a contribution to existing discipline-based knowledge. Research is usually undertaken to supplement existing research or to provide another view on understanding a particular discipline. Research can influence policy makers and provide ways in which to simplify or address a particular issue (Wilkinson 2002:2-3). The study is significant in that it addresses the current challenges librarians face due to the constantly changing technological environment and the way their jobs evolve, specifically in the DUT library. Over time, there were significant changes in the librarian's job functions and DUT librarians are expected to work harder, perform new tasks and learn new systems and technologies as user demands increase. As ICTs are not static, new developments must be accommodated to meet changing internal technological innovations, such as changing ICT infrastructure, evolving job profiles that impact librarians' roles and responsibilities, and allowing librarians to continuously

update their professional competence (Gleason 2018:6-7). The study fills the gap in the current literature by providing new insights on the impact of 4IR on academic libraries and the importance of continuous development. It is hoped that this study can contribute to preparing librarians to be relevant in this information environment. By analysing the findings and data gathered, this study empirically tests and validates the applicability of CPD on 4IR and academic librarians at DUT. It is hoped that at the end of this study, contributions can be made to help librarians to cope with technological changes, with special attention given to CPD initiatives to include the new innovations. This study contributes to ongoing debates within the library and information landscape by critically examining and reconciling conflicting viewpoints on the importance of continuous development for academic librarians in the constantly evolving landscape. Furthermore, the recommendations of the study may be used as a guideline in future CPD activities in preparing librarians with their progressing roles.

1.6 Originality of the study

Scholarly research is usually undertaken to help support existing scholarly studies within the discipline and provide ways to improve existing knowledge. It adds value to the existing literature and can help to formulate new policies and add to existing practises (Creswell 2014:8-9). According to Wellington (2010:20), it is important that the research work undertaken has some degree of originality and it should not be a duplication of other studies that have already been initiated. Wellington (2010:82) highlights that originality may be evident in the finding of new facts, the study's design, the integration of knowledge, and the way that the study is presented. This study used an explanatory research design and a mixed methods research (MMR) approach, as it studied a specific sample population that formed the basis of this research (Babbie 2017:22). The MMR approach allowed the researcher to first analyse data quantitatively and then analyse the follow-up interviews as qualitative data. Myers (2009:6-7) affirms that research in a university setting is deemed an 'original investigation' as it contributes to knowledge in a particular discipline. The MMR approach to this study and the process by which the data were derived to support the study were original, as it was based on direct information from the participants. Due to COVID-19 protocols, an online questionnaire was sent to DUT library staff to receive direct data from participants. A further follow-up interview was conducted with a

sample of this population to correlate and delve further into pertinent issues. The study highlighted the changing roles of librarians and the loss of traditional librarianship roles. It is hoped that this study will prompt further studies on this topic within the academic library environment, including how traditional librarian roles have evolved, together with robots and AI impacting libraries. The effect of these technological changes impacted on the physical space of libraries, and further studies can be undertaken to determine how these traditional spaces are now being utilised.

1.7 Scope and delimitations of the study

This study is based on the DUT as a single study with the library presence at the six sites spread across KwaZulu-Natal. The study focused on academic librarians within the parameters of the DUT. This study engaged with the permanent librarians, which consisted of 70 staff members in the six sites libraries and excluded the part-time library assistants who assist during peak hours. This is so because the part-time staff members are not always available. At the time of conducting the study, the DUT library had 70 permanent full-time employees and 65 student assistant librarians who assist the evening librarians at the circulation desk for the part-time and after-hours students. The permanent employers comprise of the library managers, the subject librarians (specialists), postgraduate librarians, marketing librarian, training librarian, digital librarian, cataloguing staff, site coordinators, circulation staff (including stack attendants), Library Information Technology (LIT) staff, processing, acquisition, and periodicals staff. The DUT library is fortunate to have their own LIT department that consists of library staff providing technical services to library staff and students. With the new technological innovations, an internal technical department, consisting of librarians, is a valuable asset in dealing with new infrastructure and bandwidth concerns.

1.8 Preliminary literature review

The literature review allows the researcher to explore the available literature and provides a new perspective and approach to the study. The literature review reveals sources and ideas that the researcher may not have been aware of prior to the study (Leedy, Ormrod & Johnson 2019:58). The study of literature attempts to provide direction and clarification of what the undertaking of the study covers, as all research

studies are directed and informed by existing knowledge. According to Cheung and Waldeck (2016:10), the literature is guided by the research objectives and the research questions. The research covered within this study was derived and evaluated from a wide range of secondary literature studies, such as journal articles, books and various web resources. The literature for this study is based on a thematic analysis in that the literature is arranged according to themes. The related literature for this study is reviewed under the following themes, which were informed by the research objectives of the study:

- the evolving roles and responsibilities of academic librarians;
- skills and competencies for academic librarians in the new role;
- effects of the 4IR on the roles of academic librarians in the changing information environment;
- utilisation of CPD to embrace the changing landscape of libraries;
- library infrastructure for the 4IR;
- a model to align librarian roles and skills with the 4IR.

Chapter Two of this study provides a more detailed and comprehensive review of the literature on the themes mentioned above.

1.9 Definitions of key words

This section identifies and defines key concepts that are used for and relevant to this study. The definition of key terms eliminates ambiguity, as terms can vary in meaning according to the context in which they are used. The key terms that are relevant to this study are defined below to provide an understanding of the study.

1.9.1 Academic librarians

'Academic librarian' refers to a library or information professional that is employed within an academic institution's library to provide support to learners, staff, and various academics within the academic community (Levy & Roberts 2005:xiv). Academic librarians are an integral part of the academic library's functions, and they contribute to the success of many research outputs. The academic library depends on its ability

to use the information and skills of its librarians to serve the academic community (Maponya 2005:2).

1.9.2 Skills

According to the Merriam-Webster (2023) dictionary, a skill is defined as the ability of a person to use their knowledge constructively in the execution of a duty. This is a learned way of performing competently at something.

1.9.3 Fourth industrial revolution

The 4IR is based on the concept of smart technology where machines and people are connected through cyber-physical systems. Digitisation, which was part of the third industrial revolution, supports 4IR as it connects people to technology (Petrillo, De Felice, Cioffi & Zomparelli 2018:1). The 4IR is different from the previous industrial revolutions in that the earlier revolutions witnessed technology replacing skilled workers such as factory workers replaced by machinery, and complemented low-skilled workers, such as the invention of the steam engine. With the 4IR, lower-skilled workers are replaced with technology and automated innovations, while higher-skilled workers are complemented by the new inventions and are required to support the innovations with their digital skills (Naudé 2017:4).

1.9.4 Continuing professional development

CPD refers to the formal practices intended to develop existing professional knowledge and experience which supports learning initiatives (Collin, Van der Heijden & Lewis 2012:155). Engelbrecht, Ankiewicz and De Swardt (2007:581) define CPD as an ongoing education and training for librarians with the intention of assisting them to keep up to date with the constant changes in their profession.

1.10 Research methodology

Research methodology is the detailed process or method used to identify, select, process, and analyse information about a topic or subject. The methodology prescribes the specific tools the researcher used to conduct the research (Best 2012:3). Myers (2009:28) describes the research methodology as a 'strategy of inquiry' that advances from the underlying philosophical assumptions to

the research design and data collection methods. This research was an explanatory study, based on an MMR approach and data were collected from participants to explore the implications of the 4IR on the librarians at the DUT library and the importance of continuing their professional development. The research approach focused on the responses of the participants with the use of an online questionnaire for quantitative data and the follow up interviews for qualitative data. The explanatory sequential mixed methods study focused on analysing the quantitative strand of data gathered from the online questionnaire and thereafter began to analyse the qualitative data that was derived from the face-to-face/virtual interviews for further clarification. The data were scanned for identical patterns and similarities in order to illustrate the generality of the patterns attained (Khaldi 2017:17).

The study population comprised 70 library staff members and the online questionnaire was sent to all of them. Ten librarians (from the sample population of 70 participants) were further identified and selected to participate in face-to-face interview sessions, while others opted for virtual sessions due to COVID-19. The follow-up interview sessions allowed the researcher to engage directly with the selected participants during the data retrieval process. The questionnaire was administered online using the DUT subscribed software, namely QuestionPro, which is an online research method survey tool used in collecting data for research purposes. An online link was emailed to all participants to access and complete. A thematic analysis was used to analyse, identify, and transcribe similar patterns within the data. The data were analysed and categorised thematically. A comprehensive research methodology is discussed in Chapter 3 of the study.

1.11 Ethical considerations

Ethical considerations are important for any research process and apply to qualitative, quantitative, and MMR approaches. It is necessary to seek permission from the participants involved in the study, as well as from the institutions through which the research is conducted (Creswell 2014:92). Babbie (2016:65) emphasises the concern for anonymity and confidentiality in conducting the study. The participants' interest should be protected at all times. Ethical approval for the conduct of this study was obtained from the Higher Degree's Committee as stipulated in the 2016 Unisa Ethics

Policy. As soon as approval was received and all changes to the research instruments, such as the online questionnaire and face-to-face/virtual interview questions, were finalised, permission from the institution where the research was to be undertaken was pursued. Turnitin, a similarity tool, was used to check for similarities to other research works. All sources consulted were referenced accordingly. This research was carried out with participants employed at the DUT; therefore, permission was required before the participants were contacted. As recommended by Wilson (2014:99), all participants received all relevant information regarding the scope of this particular study. Participation was voluntary and participants were assured of confidentiality and anonymity. The assurance, confidentiality, and anonymity of all participants were explained and communicated to them before they participated in the study. The researcher explained the study and permission from each participant was sought and recorded through a signed consent form before any information was recorded.

1.12 Structure of the dissertation

This study is divided into six chapters as follows:

Chapter One: Introduction

This chapter provides an overview of the study, including the aims and objectives, research questions, data collection instruments, the population sample, the rationale for choosing the particular population, and the structure of the thesis. This chapter focused on setting the plan that the research followed.

Chapter Two: Literature review

The second chapter provides a review of scholarly articles and literature that highlight the importance of continuous updating of skills and the 4IR in relation to its impact on the library environment. The literature review highlighted the technological impact on the library and how the librarian's roles have evolved over time. It focused on understanding the 4IR, how academic librarians accepted the changes and evolved with them.

Chapter Three: Methodology

Chapter Three outlines the research design and methodology, including the target population and sampling, the data collection tools, and the data analysis techniques that were used. It also describes how the data were collected.

Chapter Four: Data analysis and presentation

This chapter outlines how the data were analysed. Findings are displayed using data analysis tools in the form of tables, figures, graphs, and descriptive analysis.

Chapter Five: Interpretation and discussion of results

The penultimate chapter discusses the full interpretation and results of the study. Findings / results were obtained from responses to the online questionnaire and the follow-up interviews that were conducted.

Chapter Six: Conclusion and recommendations

This chapter provides recommendations based on the findings and concluded on whether the aims and objectives of the study were achieved. It covered recommendations for future studies.

1.13 Summary

This chapter introduced the study and provided an overview of the study. It outlined the context within which the study was determined and carried out. The chapter presented the purpose and objectives of the study, research questions, justification of the study, scope, delimitations, definition of key terms, and an overview of the research methodology and design used for the study. The chapter provided a brief overview of what follows in the other chapters that form the study. The following chapter provides a review of the literature related to the evolving role of academic librarians in the fourth industrial revolution and continuous professional development.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The previous chapter put things into perspective by providing the introduction and background to the study, the problem statement, purpose and objectives of the study, significance of the study, the outline of the research approach adopted and stipulated the definition of key terms. This chapter presents an in-depth review of the literature based on different perspectives of researchers and creates an overall understanding of academic libraries and emerging technologies that causes libraries to constantly transcend with the changes. According to Babbie (2017:464), a literature review is important in laying the foundation for the way that the study should unfold. The literature review provides the researcher with an understanding of what relevant existing studies have already been conducted, thus preventing a duplication of ideas. A review of the literature can provide support in justifying the current study (Leedy et al 2019:59).

The information used in this study was derived primarily from secondary sources such as journal articles, books, online articles, and reports. It provides an overview of the existing published and unpublished research works from secondary sources and provides a background for new research that allows a researcher to identify gaps and to build on existing knowledge (Hempel 2019:3). The purpose of the review of the literature in this particular study was to provide the researcher with a comprehensive overview and analysis of the existing research literature relevant to the study on the evolving roles of academic librarians in the 4IR through continuous professional development. The literature covered in this chapter was centred on themes that emanated from the objectives of the study and helped the researcher to build on and contribute to the existing body of knowledge, while ensuring that this study is original and relevant. The literature review guided the researcher in situating her research within the context of previous work and providing a foundation for the development of a conceptual framework, research hypotheses, and research design that can align librarians to cope with rapidly changing technology and trends in their profession and help them deliver quality services to users. The following themes are covered: an

overview of the 4IR, the evolving roles and responsibilities of academic librarians, skills and competencies for academic librarians in the new role, effects of the 4IR on the roles of academic librarians in the changing information environment. utilisation of CPD to embrace the changing landscape of libraries, library infrastructure to support the 4IR, and attempts to create a model to align librarian roles and skills with the 4IR.

2.2 Overview of the fourth industrial revolution

According to Schwab (2017:28), the 4IR affects all disciplines, economies, and industries, and it will be driven by technological innovations. The new technologies impact vastly on and change the nature of work across disciplines and industries. As a result, the way we live, work, and socialise will be affected drastically in this era. Ghislieri, Molino and Cortese (2018:1) state that new technological changes affect the current way in which businesses 'create and capture value' and how people interact and continue to do their work. The 4IR is bringing about transformation, with its leaders being cloud and mobile computing, big data, advanced robotics and various machine-learning changes. The fact that robots and automated machines are integrated into the work environment affects the current way of working. The forced human-robot interaction within the workplace has created many changes and challenges within the industry and the information sectors (Ghislieri et al 2018:2). New technologies such as wearable computing, 3D printing, and augmented reality are forcing libraries to take note and making them re-think their services to keep up with evolving user behaviours.

The 4IR is actively changing the world one lives in. As Schwab (2017:8) endorses, the 4IR is about emerging technologies, smart and connected machines and systems connecting humans to machines and machines to machines. With the 4IR, data that are acquired can be shared in real time due to smart connection and intelligent sensors that are embedded within smart devices and gadgets. Robots, artificial intelligence, automations, connectivity, machine clones and bots are buzzwords in the 4IR era. The 4IR is unique in that it integrates many disciplines and allows for all types of interaction in various disciplines. Moreover, the 4IR represents an exceptional union “between and across digital, physical and biological technologies” and transforming how products are created and utilised (Maynard 2015:1005). The impact of the 4IR and technological advances shaped many academic libraries and influenced changes in

both the librarian and the user behaviours. The development in machine learning techniques in augmented reality and artificial intelligence has facilitated technology to replace people in various tasks. This technological 4IR is a combination of the digitisation, nanotechnology, renewable energy, and quantum computing of the third industrial revolution and the collaboration of the advanced 4IR innovations (Kim 2020:5). Whilst the third revolution focused on information technology and digitisation, the 4IR predominantly focuses on developing automation through machines and the focus is on artificial intelligence and the advancements of robotics (Nhede 2018:204). This means that society is changed by new innovations and impacts on people and organisations, with the academic sector being one of the many impacted sectors. Oke and Fernandes (2020:1) confirm that the technological innovations of the 4IR have influenced the service sectors and the academic sectors in the way that teaching, learning, and the searching for information have evolved. The 4IR has also affected academic libraries.

Indeed, academic libraries are the main advocates and facilitators of the 4IR, with various mobile technological advances, cloud computing, and wireless printing, to name just a few (Ahmat & Hanipah 2018:56). The 4IR changes the way many libraries and organisations operate and function. Jobs that can only be done on site will slowly phase out and, as the 4IR progresses, many academic librarians will be able to work autonomously from home or a remote office (Mpofu & Nicolaides 2019:17). This was exacerbated by the outbreak of COVID-19. For example, remote work was evident during the COVID-19 pandemic when many academic libraries were forced to close and allow their staff to work from home due to lockdown regulations. Figure 2.1 is an example of how users were notified via social networks about accessing library resources while the enforced lockdown was in effect. DUT librarians were tasked with continuing to provide information to their users from the comfort of their homes by using digitised collections and electronic resources and engaging with users through online platforms. The library users were notified of changes in accessing library resources via the website and DUT email notices. In keeping with the changes the 4IR generates, Ahmat and Hanipah (2018:57) state that libraries and information sectors are expected to observe the trend changes within their environment by examining the following factors: people, the organisational structure, the environment, and technology.

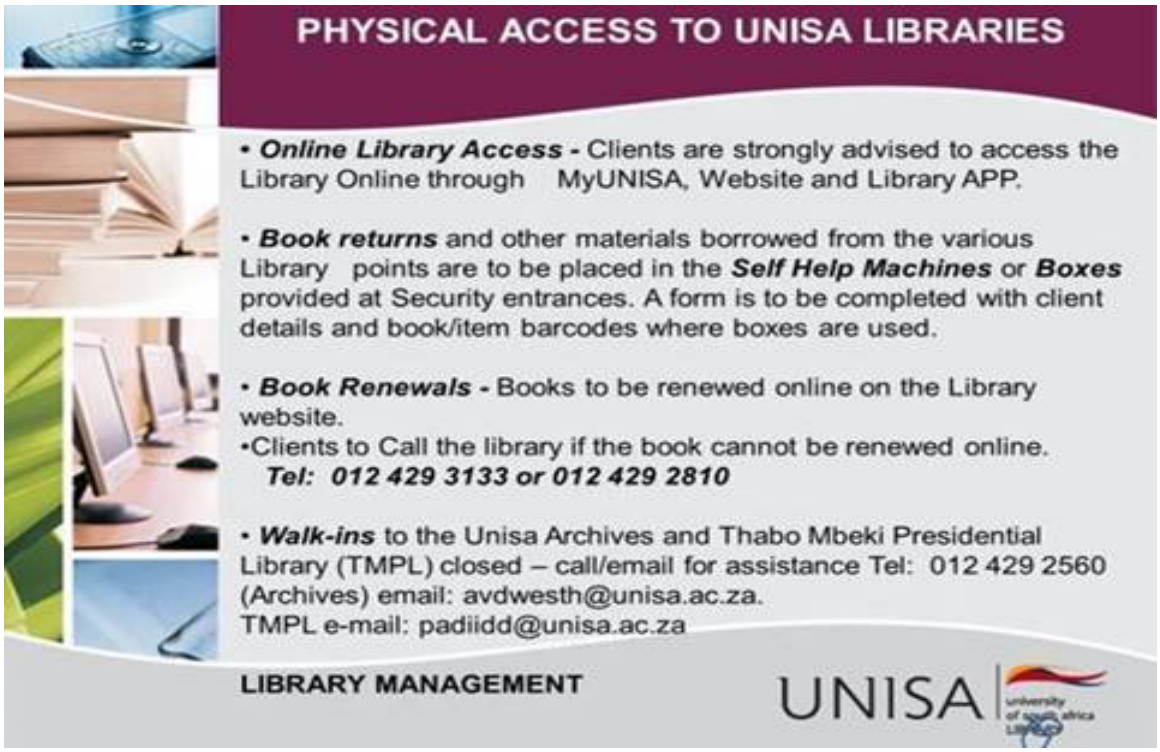

Figure 2.1: Physical access to the libraries during lockdown (Maluleke, Ngoepe & Marutha 2020)

2.2.1 People

It is a challenge for any employer to change the mind-set of employees. In the era of the 4IR, it is necessary that the employees (academic librarians) are amenable to change and learning new skills. Academic library managers must inculcate the belief that 'change is not bad' but embed the operational trend of the 4IR that 'changing is to survive' (Ahmat & Hanipah 2018:57). This ensures that employees are not left behind as technological development occurs and that they are prepared to learn new ways of working. People provide a certain level of soft skills and emotional intelligence that a machine cannot provide.

2.2.2 Organisational structure

Ahmat and Hanipah (2018:58) recommend that academic libraries consider the suitability of the current organogram and the traditional hierarchical structures. In the 4IR, all staff are expected and motivated to engage in decision-making processes. Drawing from the study by Ahmat and Hanipah (2018:58), it appears that holacratic and flatarchic structures are common in academic libraries. The holacratic structure is

a governance structural system that allows staff to participate in decision-making discussions and all the power is not held by the higher authorities (Ahmat & Hanipah 2018:58). The flatarchic structure allows for all levels of staff to be involved in decision-making processes and there are no hierarchical structures within the organisation (Ahmat & Hanipah 2018:58). Both these organisational structures enable equal participation from all levels of staff and open up avenues for more development and innovation amongst staff.

2.2.3 Environment

The fluctuating internal and external environment influences libraries and information sectors. The internal landscape would include the skills and qualification levels of the staff, the strengths and weaknesses within the library, and the infrastructure. The external environment should be evaluated for opportunities and threats that could prepare the library to use it to maximise its strengths (Ahmat & Hanipah 2018:59). Academic libraries have to evolve with the host academic institution and align its strategic plans, mission and vision to that of the academic institution.

2.2.4 Technology

Academic libraries are overcome by various technological innovations. The libraries are expected to evolve and grow with technology. Academic librarians are reaching out to users through mobile technology and various online platforms to engage and satisfy user needs. With the 4IR, academic libraries are engaging with artificial intelligence technologies, robots, makerspaces, context-aware technology, and augmented reality innovations (Ahmat & Hanipah 2018:59). Academic libraries have in part adopted many 4IR technologies such as mobile computing, wireless printing, cloud computing, and storage.

2.3 Academic librarians

Academic librarians are employed at academic libraries that are housed within educational institutions. Academic libraries are part of their institution's organisational culture, and the success of the library depends on its ability to use the information and skills of its librarians to serve the academic community (Maponya 2005:2). Academic

librarians are assessed for their knowledge in scholarship as well as librarianship, and the emphasis is on individual and institutional publishing output (Pan & Hovde 2010:2-4). Academic librarians have a large impact on the research and teaching activities of their universities. Librarians are expected to be multi-skilled, master data collection and analysis, be decision makers and provide solid research expertise for researchers (Shao, Li, Wu, Guo, Feng, Hui, Niu & Zheng 2018:805). Moreover, Bedi and Walde (2017:314) agree that academic librarians have a significant role in providing research services and research skills to their users. The active role of the academic librarian in the promotion of research and teaching (Shao et al 2018:805) improves the value and prestige of their home institution (Borrego, Ardanuy & Urbano 2018:663). By participating in research activities, collaboration with faculties helps to impart new skills to the librarians as well as develop various partnership roles with the library and the various departments within the campus (Borrego et al 2018:663). The DUT library is similar to what Momoh and Folorunso (2019:3) mention in their study regarding the library as a space that is used for knowledge creation and dissemination of information. This means that the academic librarians are at the forefront of providing information to users on a daily basis. At DUT, the librarians serve as the forerunners in helping the users search for the information and items that they require. These librarians work together with the faculties in building the collection of resources and in providing information literacy training to the users. This in line with the information resources policy and guidelines that are underpinned by the library's values, vision, and mission statement.

The main function of academic librarians is to acquire, organise, manage, and disseminate library resources to satisfy the user needs and to support the academic departments (Tella, Akande & Bamidele 2018:4). Librarians in academic institutions are expected to constantly ensure that they are able to adapt to the changing landscape of information needs and, as Awodoyin, Osisanwo, Adetoro and Adeyemo (2016:13) emphasise, that librarians need to be equipped with relevant tacit and explicit knowledge and share the knowledge between themselves to deal with the rapid changes in the library and information sectors. The librarians are faced with the task of redeveloping themselves to meet the fluctuating user needs. The librarians are

expected to be trustworthy and accountable for the information that they provide to users (Orick 2000:323).

2.4 Evolving roles and responsibilities of academic librarians

In abiding with Ranganathan's (as cited in Carr, 2014:153) fifth law "a library is a growing organism", it is clear that the libraries and librarianship have undergone a transformation over time due to the impact of technological innovations. Continuously changing technology has forced librarians to develop continuously to meet the ever-changing needs of users (Wójcik 2016:404-405). The changes in the workforce have forced employees to embrace change. Librarians are now required to upskill themselves to ensure that they are not left behind in this new era. Academic libraries are constantly identifying new roles and responsibilities for academic sector librarians by redeveloping existing posts and creating new jobs to meet the emerging new roles that involve different skill sets and mind sets (Goetsch 2008:157). Momoh and Folorunso (2019:2) concur that the roles and responsibilities of librarians have evolved due to the continual rapid changes in technologies over the years. The 21st century academic librarian jobs have evolved from simply providing information to users and fielding queries to become more involved in research and data analysis, information analysis, publishing, and social media experts, to list a few (Momoh & Folorunso 2019:6-7). The focus of academic libraries has changed from the ownership of information access to equipping themselves to evolve with the new needs of users. Libraries have surpassed the conventional functions of acquiring, processing, and making accessible information to users, but are now in the economy of knowledge data that are now fast becoming a commodity (Awodoyin et al 2016:13). Throughout the lifespan of a library, the way information was derived and disseminated has continuously changed and the librarians and libraries have used and will continue to use the changing technology to ensure that they provide the best service to their users (Orick 2000:323).

Academic librarians are increasingly pressured to align their profiles with the mission of the institution and engage whole-heartedly with collaboration and partnerships within the institution. As Shupe and Pung (2011:409) note, the academic librarian's role has experienced radical transformation in the recent era. The transformation in

the librarian's role is due to technological changes and the change in instructional models and institutional requirements (Shupe & Pung 2011:409). In the current environment, librarians have evolved to be more involved with academics and researchers as research partners collaborating with research works. Borrego et al (2018:663-664) suggest that managing research can improve the librarians' problem-solving and decision-making skills, which, in turn, contributes to their own development. Maponya (2005:1) iterates that the changing technological environment and information world have affected all institutions, and the academic librarians are also affected in providing a competitive and effective services to their parent institution and users. The librarians are now more involved and tasked with increasing the ratings of the research impact on their institutions and researchers affiliated to such institutions.

According to Atkins (cited in Force and Wiles 2020:196), academic librarians need to be advocates within their institutions and strive to be on par with the academics. The traditional roles of academic librarians have transitioned from focusing on collection development, bibliographic instruction, and referencing to a broader concept of teaching, learning, and imparting information literacy education to their users. The academic librarians' responsibilities are now more concerned with imparting scholarly communication through open access and open educational repositories collaboration and communicating the use of technology in order to link users to the desired information (Force & Wiles 2020:197). The role of academic librarians has progressed from being the custodian of books to that of an online system gatekeeper. In the current environment and circumstances, online teaching and online help from the librarians have become a commonality during the COVID-19 pandemic. Although Force and Wiles (2020:199) mention that the online interactions with users allowed the academic librarians to emerge with an additional skillset such as copyright knowledge, academic subject area and courseware advanced knowledge, it can be challenging to administer to the needs of all the users as users are unique with different needs and requirements. The changing landscape of librarianship has affected the current academic librarians' role in that it created the emergence of new specialties within the libraries. Some of these new posts that emerged over time include systems librarian, digital librarian, and research data manager librarian to

institutional repository librarian (Cox & Corrall 2013:1526). Many academic librarians found that they had to adjust the way they accessed information for users, as a considerable amount of the information was available online, which required thorough skills to sift for the correct information. The technological environment has changed the scene of academic library services and its daily activities. These changes affected the day-to-day roles of the academic librarians and there was a growing need to understand and manage the digital environment and the changes that emerged (Hamad, Al-Fadel & Fakhouri 2020:4).

According to Peiffer (2015:6), employees have undergone many changes due to digitisation and automation processes. Employees have experienced and conformed to too many disruptive technological changes, and in the 4IR, there are still many more changes to overcome. As the digital environment continues to grow and increase in volume and significance for libraries, the growing need for the different types of librarians and information professionals also gained momentum. Academic libraries have realised that their focus areas have changed and that there is now a need for records managers, archivists and data curator skills and other emerging skills for their librarians to collaborate and acquire new skills (Robinson 2021:151).

The new buzzword in academic libraries is research data services and data management. Many academic libraries had to rearrange their workflow to accommodate librarians' specialised skills in dealing with research data. The roles and responsibilities of cataloguing librarians have advanced in aligning with changes to both cataloguing systems and the resources to which libraries provide access. These librarians are required to work with repositories and various other open-source databases and use various standards that are compatible with these repositories. This means that cataloguers must constantly update their knowledge base and keep up to date with all new international standards that affect their work (Han & Hswe 2011:129). The cataloguers at the DUT library were identified as the most suitable librarians to be part of the research data services, and this altered the way cataloguers worked to accommodate various other roles and responsibilities. It appears that cataloguing librarians are well versed and more equipped to create metadata for research data

description and retrieval purposes, as the creation of metadata is similar to the cataloguing functions (Han & Hswe 2011:129).

Although times have changed, the structure and the traditional ways the academic librarians work have progressed with time, the core services of an academic library, which is essentially the access to information, remain unchanged. Information literacy instruction is still relevant and, in fact, increasingly significant as the amount of information continues to increase rapidly. As information influx increases, librarians play an important role in teaching information literacy skills to users, which includes the ability to evaluate sources for credibility and reliability (Koltay 2015:404). The provision of access to both traditional and online resources remains the core function of the academic librarians (Wójcik 2016:409). Regardless of how the information is distributed to the users, the retrieval methods or access points remain the same. The academic librarians' responsibilities in disseminating the information may be a bit different from the traditional face-to-face interactions. The days of face-to-face interaction have evolved. Librarians use technology in various forms to understand and respond to the needs of their users. Libraries are progressing from traditional library services to digital services. The shift in the way librarians interact with their users is changing and the librarians are forced to keep up with the changes, which require them to continuously update their skills (Lee Roberts 2007:803). Wójcik (2016:409) suggests that the academic librarian's role is no longer simply one of information sharing, but it is also established on partnerships and assisting users from the conception of data throughout the research process to the publication of the data. The academic library services are now offered in various online formats, such as online chat with subject-specific librarians, emails, social media interaction, and mobile applications. Librarians are now using various forms of communication to reach their users. This means that the academic librarians' roles and responsibilities are evolving with time and they are working on virtual platforms in response to user needs. Hussain (2020:4) believes that the 4IR will make librarians work much better and stronger, as it will not only enhance the library environment, but will also enrich librarians as they familiarise themselves with emerging technologies and adapt to new ways of working. It will be all about a mind-set shift and embracing the ease that comes with technological changes.

2.5 Skills and competencies for academic librarians in the new role

The past decade brought about many changes and skills requirements in the library and information sectors. Although it can be argued that the previous three industrial revolutions also required some skills development and training, the 4IR emerges with new ways of working and with an emphasis placed on data and virtual reality. Peiffer (2015:7) believes that in the Industry 4.0, the qualifications and skills of employees are important as well as the willingness to engage in continuous learning development.

According to Ayinde and Kirkwood (2020:148), customer services, searching and retrieving, referencing, leadership, and managerial skills are essential skills for academic librarians. Librarians are expected to be experts at navigating information searches to retrieve suitable and relevant information while sifting through vast amounts of information sources. They need to have a good understanding of information literacy and digital literacy skills. The academic librarian needs to keep up and ensure that current skills are relevant to provide a proper service to users. In the current environment, librarians are required to be adaptable and allow themselves to engage with all types of technological changes. Librarians need to equip themselves with digital and technical skills to be able to service users. Libraries are inundated with data collection and retrieval, and librarians need skills to implement, manage, and work with new technology and with one another. The cataloguing section of libraries was affected by the technological changes and these librarians had to ensure that their skills were on par with the international standards as globally all libraries were to follow international standards. Many cataloguers had to upgrade their skills and ensure that they were knowledgeable about various computer science and technology applications (Khurshid 2003:19; 21).

It is essential for librarians to develop and learn new skills to manage the digital environment. Hamad et al (2020:3) believe that digital competency skills for academic librarians are important, as they need to develop and manage digital content and understand digital software in order to prepare themselves for any technological challenges within their disciplines. Academic librarians are expected to have basic IT skills in order to understand the emerging technologies and web navigation. In this regard, they are expected to be IT literate not just computer literate. Academic

librarians in the technological era are required to have a portfolio of technology-related skills so that they are able to navigate their way in the high-tech environment. These skills allow librarians to manage the information and successfully transfer these skills to the users (Mathew & Baby 2012). Raju (2017:740) believes that libraries are guided by progressing technology and that it gained momentum, took over, and changed many areas of the traditional librarians' roles. This has impacted on the knowledge and skills that academic librarians require in order to continue with their roles and responsibilities in continuing to develop a sound collection of resources to satisfy the user requirements. The university libraries are the drivers in hosting and managing the various online portals for the host institution. Technical skills and knowledge are crucial in managing the various digital library services such as institutional repositories, digitisation, and curation of research data and various other online content (Raju 2017:751). DUT librarians had to embrace digital content and the university's vision of creating an institutional repository that would be able to store, preserve, organise, and share the university's knowledge content with the rest of the world.

As Tella et al (2018:4) point out, the role of academic librarians in their institution is to provide support to the academic department, and therefore it was only natural that librarians with their organisational and interpersonal skills take the lead in the dissemination and sharing of the institution's knowledge base. This meant that the librarians involved in this project had to sharpen their technical skills and learn about institutional repositories. Raju (2017:754) affirms that even though the system and tools have changed, the core aspect of organising and disseminating information are basically the same. The information is much more accessible via online platforms, and it can be argued, according to Raju (2017:754), that the academic librarians are gravitating towards becoming IT professionals. Tella et al (2018:6) mention that technology transformed the traditional academic library and the changes impacted on the knowledge and skills requirements for the current practising librarians. Academic librarians are expected to be easily adaptive to the ever-changing technological scenario. As Budd (2018:375) points out, all academic librarians must possess some sort of internet competency in order to understand the workings and needs of the users. It is also established that the knowledge and skills of the various academic librarians may differ in that a cataloguer and a reference librarian will have different

skills set (Budd 2018:356). Although the cataloguer would need metadata understanding and the knowledge about how to construct a bibliographic record, whilst the reference librarian would need to navigate commonly used electronic databases, both these librarians would need technical skills and an understanding of technology. The library integrated system (ILS) requires a fair set of technical skills and understanding to operate it effectively. Academic librarians must be critical thinkers and be able to exercise judgement when performing their professional duties, as they must be competent to deal with other structures and facilities within their institution (Budd 2018:381). Many library jobs require ICT-related skills such as information management, metadata management, curation, understanding of scholarly communication, research support, and the research process. Academic librarians should be well equipped to locate and identify various databases and be able to critically evaluate information accessed from websites and other sources on the internet (Chanetsa & Ngulube 2017:189). These are all crucial skills that are needed to understand and manage information. Academic librarians are expected to be resourceful, critical thinkers, and innovative in their job functions (Chanetsa & Ngulube 2017:195).

The need for academic librarians will not disappear in the 4IR era, but rather a demand for new knowledge and skills with continuous learning and retraining of employees to survive in the 4IR will be requested (Ayinde & Kirkwood 2020:145). As technology and the 4IR change the way academic librarians function, requiring new skills, the 4IR offers opportunities for librarians to learn new skills to pursue new job opportunities. The focus on data and the impact it has on society is one of the areas where academic libraries are expected to excel (Mpofu & Nicolaides 2019:7).

Shao et al (2018:805) observe that academic librarians are expected to understand data and the importance of it in the technological era. Academic librarians need to engage in decision-making, collection, analysing, and understanding data, as this is crucial in the research process at academic institutions. Once academic librarians understand the data conception process and master this skill, they provide an invaluable service to their researchers and become experts in their field.

Robinson (2021:149) notes that the fluctuating library environment impacts on the skills and characteristics that are required by academic librarians to meet the changing demands and needs of the users. Over time, the requirements and skills that were sought for academic librarian posts changed and the literature on the content analysis of various librarian job advertisements proves that technology impacted on the skills requirements evolving for librarians (Gerolimos, Malliari & Iakovidis 2015:22). The demand for qualified librarians with experience in various fields increased according to the shifting environment. The demand for librarians with computer skills and experience with various integrated library skills increased as libraries require librarians to be flexible and adaptable to the fluctuating environment (2015:31). The demand for academic librarians to be skilled and knowledgeable in current emerging technologies such as web design, internet searching skills, technical skills, and an understanding of scholarly communication has increased in the 4IR (Choi & Rasmussen 2009:458). The content analysis of job advertisements is one of the main informants that can be used to survey what the current requirements for specific jobs on the market are, and it is a useful aid for libraries that need to evolve with technological changes (Robinson 2021:149). It is without a doubt that technology has infiltrated all aspects of the library and information societies and, therefore, impacted on the roles, responsibilities, knowledge and skills of all academic librarians (Robinson 2021:151).

Gerolimos and Konsta (2008:691) believe that the modern academic librarian should be a professional that is able to adapt effectively to the technological requirements within a library. This professional should understand the conventional library practices, be able to develop and learn and possess adequate communication skills to manage a successful academic library driven by technology.

It should be noted that academic libraries prefer to recruit librarians in possession of a professional library and information science (LIS) qualification. Chanetsa and Ngulube (2017:189) note that many libraries expected the academic librarians to have an LIS qualification ranging between an LIS diploma to an honours degree. This has changed over the years and the qualification expectancy for academic librarians is a master's degree in the LIS field. Although it is necessary for academic librarians to have a formal qualification, many librarians require informal practical skills to satisfy

user requirements. This experience is gained over time by learning, emulating and observing the more seasoned librarians carry out their duties. Research conducted by Chanetsa and Ngulube (2017:189) showed that many academic librarian functions consisted of teaching information literacy and collection building with library-related competencies and technological-related skills. Over the past decade, DUT librarians have been engaged in teaching and imparting information literature skills to users. The level of competency of academic librarians can be seen as a combination of practical experience and theoretical knowledge gleaned through formal education. Some of the traditional competencies that academic librarians are expected to have are cataloguing standards, authority control, information retrieval knowledge, and the way that information is structured and organised (Chanetsa & Ngulube 2017:189). It has been observed by Tella et al (2018:5) that most academic libraries prefer to recruit librarians that have excellent organisational and interpersonal skills, with sound ICT skills, knowledge of databases, internet searching, verbal communication skills, subject-specific expertise, and a solid assessment of collection development to support curriculum development and user needs. As reported by Wong and Chan (2018:111), academic librarians need to be creative, adaptive and innovative to rise to meet challenges and changes that affect the librarians' skills gap, resources and service landscape. Authors Cao, Liang and Li (2018:820) maintain that an academic librarian should possess certain characteristics to be a smart librarian and to remain relevant in the information world. The main characteristics are the level of qualification, the affiliation to continuing education, flexibility, and complex problem solvers. The academic librarians need to be able to absorb knowledge rapidly and be fast learners in order to survive in the fluctuating technological climate.

Table 2.1 shows the difference between the set of skills required in 2018, 2020, and what is expected to be in demand in 2025, according to Despardes (2020). This is in agreement with what the World Economic Forum (2020:21) predicted in 2020. The focus on artificial intelligence and automation in the 4IR in 2020 highlights the skills that are more in demand in the workplace. In line with this, academic librarians need to ensure that their skills are aligned with what is required within the sector. Newly qualified LIS graduates should be exposed to these emerging skills during their formal training. These skills are similar to the skills that are expected in academic libraries.

The 10 skills requirements for 2025 evolve to suit the new emerging technologies and the areas of expertise that will be in demand. The 10 skills listed in Table 2.1 under 2025 are predicted to be the top rating skills required for the job market in 2025, according to Despardes (2020). It is noted that more than 40% of workers will need to be reskilled with the new trending skills, while 90% of workers will be expected to learn new skills on the job (World Economic Forum 2020:5). When studying this table, it is apparent that the 4IR challenges the workforce and academic librarians to think outside the box and be more creative in their approach to the challenges arising from 4IR.

Table 2.1: Top 10 skills requirements (Despardes 2020)

2025	**2020**	**2018**
Analytical thinking and innovation	Complex problem-solving	Complex problem-solving
Active learning and learning strategies	Critical thinking	Coordinating with others
Complex problem-solving	Creativity	People management skills
Critical thinking and analysis	People management skills	Critical thinking
Creativity, originality and initiative	Coordinating with others	Negotiation
Leadership and social influence	Emotional Intelligence	Quality control
Technology use, monitoring and control	Judgement and decision-making	Service orientation
Technology design and programming	Service orientation	Judgement and decision-making
Resilience, stress tolerance and flexibility	Negotiation	Active listening skills
Reasoning, problem-solving, and ideation.	Cognitive Flexibility	Creativity

2.6 Effects of 4IR on the roles of academic librarians in the changing information environment

Technology, globalisation, and the increasing competition for higher educational institutions have placed growing pressure on institutions to perform and deliver services in the 4IR environment. To meet the new and growing user needs, many libraries are expanding and creating new areas of expertise for librarians to meet the challenges of the 4IR (Yang & Cheng 2018:42). Hamad et al (2020:1) emphasise that technology is an important aspect of quality and efficiency in all library functions, such as the integrated library system, web-based catalogues, and online resources.

Ongoing technological innovations provide libraries and librarians with new opportunities and faster, seamless access to information resources. The academic librarians at DUT are creating digital content and organising and preserving many of the historical documents that have been uncovered within the institution, similar to what Hamad et al (2020:3) refer to as being an integral role for academic librarians to embrace. Academic librarians need to be familiar with ICT skills to be able to apply digital technology in their environment, as the user information-seeking and -retrieval behaviour is also shaped by the ICT environment (Hamad et al 2020:4). This means that the technological changes within the environment are reflected on users' behaviour and these users are flexible and adapt to the current environment in order to satisfy their needs.

In the digital era, libraries and information services use various types of technology to support the services they provide, and librarians have been affected by the changes. The impact of ICTs led to the reorganisation of workflows, the demand for new skills, and job retraining (Krubu & Osawaru 2011:3). During the digital era and impact on libraries, the DUT librarians affiliated themselves with understanding the searching and retrieval of information from the various online databases and adjusting to the shift from printed physical resources to online resources. In keeping with Wong and Chan (2018:110), the roles of academic librarians as gatekeepers and information providers have been constantly challenged by ICT advances, and librarians have always proactively responded to these challenges. Academic libraries are constantly developing new initiatives and reskilling staff in order to meet the challenges of

communication technology. Academic librarians redesign and expand the scope of current services by adapting to changes within the environment.

It is imperative that academic librarians ‘learn, unlearn, and relearn' the skills required to survive in their professional environment (Ayinde & Kirkwood 2020:145). The content analysis of 363 job advertisements for the desired competencies for academic librarians was carried out by Choi and Rasmussen (2009:461), which indicated that technical abilities and management skills were the preferred qualifications required in the ads. The experience and knowledge in technology-related competencies were the most desired and preferred categories for library-related posts, followed by experience in resource building. It was noted that current awareness and the experience in a digital library environment with the ability and familiarity in the conception, creation and management of digital information and metadata were significant in the academic library (2009:465).

Without a doubt, the current landscape of higher education and academic libraries is transformed by rapid advances in technology. Online platforms such as Massive Open Online Courses (MOOC) are transforming the way information is disseminated within the academic sectors, which in turn influences the academic libraries (Oke & Fernandes 2020:2). The future employment in academic libraries and other businesses are affected by trends like globalisation, aging population and urbanisation. These transformational changes, which include cloud and mobile computing, big data, advanced robotics, machine learning and intelligent manufacturing sensors, are leading elements of change in libraries (Ghislieri et al 2018:2). It should be noted that academic librarians are integral in the 4IR, as they have the set of knowledge and skills that include the critical thought process. The robots and machines are able to function up to a certain point and will continuously require upgrading to handle various transactions with users. Ghislieri et al (2018:4) note that soft skills that only humans possess, continuous learning, and the ability to work and deal with complex situations and multifunctional teams are crucial and will be lost in the sole reliance of robots and machine learning.

The 4IR has changed the way academic librarians engage with users. The shift from knowing your collection resources to knowing your online connection is dominant in the academic environment. Academic librarians need to focus on understanding the needs of the users rather than their collections. The use of robots and machines in the 4IR allows academic librarians to interconnect with their users, and these librarians need to make the most of the interconnectivity to reach out to more users and disseminate the right information to satisfy user requests (Hussain 2020:4). Currently, DUT librarians are using various online platforms to reach more users. With the online mobile services, more users can be reached and, hopefully, will be satisfied in their request for information.

The presence of the technological innovations within libraries is already visible in the machine-learning sensors, mobile technology, digital technologies, artificial intelligence, and robotics. Most academic libraries have already scrapped the printed newspaper subscriptions and replaced it with digital online sites. Academic libraries are now using the application and development of 'techno-human smart systems' that advance efficiency and productivity and improve the quality of information and life within communities (Lee, Yun, Pyka, Won, Kodama, Schiuma, Park, Jeon, Park, Jung & Yan 2018:3). The entire debate about how automation and technological changes impact on job losses should not be feared but rather embraced, as in the previous industrial revolutions, despite the fear of job losses, the automation and ICT changes created a boost for the economy. In each of the changes, productivity levels increased and more workers were skilled in specialised tasks (Fernandez 2020:24). It would be a great loss if the academic libraries refused to evolve with the changes. These libraries and librarians would be left behind in the world of information, without any opportunities and self-improvement. Therefore, libraries must progress and grow with changes to meet the needs of the user. Academic librarians are required to develop their skills and keep abreast of trends to meet the requirements of the ever-changing environment (Fernandez 2020:25). As Ocholla and Ocholla (2020:363) report, although there are hardly any studies related to the 4IR and academic libraries, academic libraries have already joined the revolution and adopted some of the 4IR components, such as big data, the IoT, cloud computing, embedded systems, and many other components.

2.6.1 Big data

With many various views on big data and what it entails, Al-Barashdi and Al-Karousi (2019:3) concur that the common way to describing big data is by the volume, velocity and variety of the datasets. The 4IR is characterised by the generation of large datasets, both structured, which can be organised and formatted, and unstructured, which is raw and unorganised, data. Essentially, data sets consisting of large and complex scientific data structures can be called big data, and libraries are usually tasked with collecting and managing vast amounts of data to gain insights and make informed decisions. Academic librarians are faced with big data and datasets when researchers proceed with their research process, and the acquired data need to be stored, preserved, and made accessible for future use. These research datasets need to be carefully analysed and preserved so that it does not lose its value over time due to interoperability. The storage of these types of data means that academic librarians need to update their knowledge base with specialised skills to be curators of these datasets. Academic librarians are the best people to handle and manage the data and datasets of researchers, as they understand information control better than researchers and academics (Al-Barashdi & Al-Karousi 2019:10). Since librarians play an important role in the collection, development and management of information, it makes sense that the librarians become the curators of the data. The academic librarians' role is clear in that they need to broaden their knowledge and learn how to manage the datasets for their researchers and understand the copyright implications attached to datasets and big data. Academic librarians are the ones with the aptitude and knowledge on how to arrange data and how to present it so that it is easily retrievable for further use and are more likely to understand all the aspects linked to data literacy. Data literacy refers to understanding how to work with large datasets, identify how they were produced, and how to connect the various datasets and interpret them (Koltay 2015:403).

The introduction of big data in the information world has changed the way academic librarians manage data in academic libraries. The academic librarians are tasked to revaluate the way they function and ensure that they are ready to preserve and work with researchers and their datasets. The academic librarians are expected to reassure the researchers that the datasets are safe and secure with the librarians at the helm

of its management. It is imperative that academic librarians receive adequate training to handle big data competently in their institutions. This is to ensure that the academic librarians are aware of the data-related analytics and techniques involved in preserving it (Ahmad, JianMing & Rafi 2019:204). Data collection is at the core of most businesses and has become a valuable commodity in 4IR (Balashova & Gromova 2018:1). The collection and use of data are a major topic of discussion in the 4IR as businesses and libraries can derive insights, patterns, and trends from data to assist them to understand user behaviour and make informed decisions in improving services to their users. Librarians are the most experienced people in handling and dealing with data and information, as this is part of their core functions. The various 4IR technologies rely on data to continue with technological inventions.

2.6.2 Internet of Things

The IoT is a system of interrelated computing devices and software that coordinates the transfer of data over systems and networks without any human-to-human or human-to-computer interaction (Wortmann & Flüchter 2015:221). The IoT is revolutionising libraries, is a step towards building a smart library and has the potential to improve the security and efficiency of academic libraries (Gupta & Singh 2018:71). The DUT library is working towards being a smart library and interconnecting its users with the information. Gupta and Singh (2018:72) mention the use of radio frequency identification (RFID) tags, which are embedded sensor chips that are placed in library resources, and these tags are able to link the items to the library systems. With these RFID tags, the academic libraries can connect their library resources to various devices. This is part of libraries' initiatives on the way to becoming smart libraries in a technologically innovative environment. The IoT allows libraries to conduct virtual tours of the academic space and continue with online library orientation. Most academic libraries have online catalogues to guide users in finding information. RFID tagging allows users to self-check in or check out library materials, and the benefit from this smart tagging is to trace lost or misfiled materials in the library collection. The DUT library began implementing RFID tags to the print library resources in 2021 and this project was successfully completed in December 2022.

2.6.3 Smart technology

According to Cao et al (2018:812), smart technology can refer to technology that is self-configured and self-optimised and that can control resources that are interconnected from one device. The technological innovations of the Internet, such as IoT, cloud computing, embedded devices, and big data technology, are used in many homes and organisations across multiple disciplines. IoT has provided opportunities for academic libraries to upgrade their infrastructure and adapt to smarter ways of operating. Traditional libraries can transform into smart libraries by strategic design and implementation of advanced technologies that exist and are available (Cao et al 2018:811). To some extent, the DUT library is on its way to being a smart library. The introduction of the RFID tagging system, the digital library platform, the use of mobile technology to access and retrieve information from any location, via on or off campus, cloud computing and wireless printing are all part of the drive towards the workings of a smart library.

As Cao et al (2018:817) point out, a smart library's ultimate goal is to evolve with the changing needs of the users in order to satisfy those needs. The user needs should be the focus when creating a smart library and the well-trained professional academic librarians are the main drivers in creating the smart library, as they best understand the needs of the users. A smart library is not just a smart technology structure, but it also provides a quality service and an exceptional user experience. It is important to note that the academic librarians form an integral part of a smart library and are key to the management and control of smart library technology (2018:818). As Ayinde and Kirkwood (2020:145) assert, there can be a symbiotic relationship between librarians and smart technologies. It is necessary that the academic librarians' mind-set be that of readiness to welcome new innovations, have the ability to learn quickly, and be able to adapt and respond to the 4IR. This type of mind-set will ensure that smart technologies and library professionals share a common ground and can work together to better meet the needs of the institution and its users.

2.6.4 Cloud computing

Cloud computing is a number of remote servers around the world that are connected to a network to provide faster internet access and a larger storage capacity for libraries and organisations (Wada 2018:17). Libraries are interested in accessing cloud

computing, as it reduces the cost of maintaining individual servers and energy costs. It also provides faster internet access and searching facilities across the web for users (Wada 2018:18). In line with the changes in the technological environment, the DUT library joined the cloud-computing environment and allowed the library to change from a server based library system to a cloud-based integrated management system.

2.6.5 Artificial intelligence

AI is the replication of human intelligence processes by computers and machines. AI can simulate human characteristics and perform human-like tasks (Harisanty, Anna, Putri, Firdaus & Noor Azizi 2022). Many academic libraries, according to Harisanty et al (2022), are using AI systems to support their services. Libraries perform various repetitive tasks that can be done easily by AI technologies, such as self-checkout kiosks, automated online access catalogues, which can recognise the users' needs based on previous searches and data logs. Many libraries use AI robots to help users with information retrieval, chatbots, provide assistance in shelving library resources and AI for cataloguing and classification systems (Harisanty et al 2022).

2.6.6 Robotics

Robotics in libraries refers to the integration of robotic technology within library settings to enhance services, engage patrons, and provide innovative learning experiences. Robotics is based on AI technology and is constructed on the design and operational use of robots (Harisanty et al 2022). Many academic libraries are using robots to help shelf books and help users with general information retrieval queries. Robots are designed to think and act in the same way as humans (Harisanty et al 2022). Although robots are built in simulation to humans, robots lack soft skills and emotional intelligence. As Harisanty et al (2020) explains that robots can be of great help to libraries in improving their performance, improving the image of the library and users' experience when visiting the library, promoting creativity and innovation within the library and allowing the librarians time to focus on continuing their professional development. Sutherland (2020:243) further explains that robots are at the core of automation and that cloud robotics are now used to enhance performance, processing and sharing of information from and between robots, machines, smart devices, and

humans. Tella (2020:4) mentions that robots are now co-workers in many libraries around the globe and these robots are created to complement library services in the 4IR. This is similar to the introduction of the University of Pretoria Library robot librarian, Libby, to assist users with information searches (Olivier 2019).

2.6.7 Blockchain

Another new terminology to look out for is blockchain, which is a decentralised digital ledger that is used to record transactions and transport information from one place to another in a safe and automated method (Tella 2020:4). According to Tella (2020:4), one party needs to initiate the transaction by creating a block, which, in turn, is verified by a vast number of computers, and the verified block is added to a chain, which is stored on the internet once it created a unique record with a unique history. Each of the created blocks of data are “bound and secured to each other using cryptographic principles” (Tella 2020:4). These blockchains are now being used by some libraries to store their information in a secured manner. Libraries can use blockchain technology to enhance security, transparency, and accessibility of various library-related services. For example, libraries can use blockchain to create permanent records for digital preservation of important historical documents, and research publications by storing these records on a decentralised blockchain network and ensure long-term preservation and easy accessibility of these records. Blockchain can support decentralised platforms for open access publishing by reducing costs and increasing accessibility. It can enable direct transactions between authors and readers, bypassing traditional publishing intermediaries. Blockchain can also be used to create secure digital identity for library users, and this can help to protect user information (Tella 2020:4).

2.7 Utilisation of CPD to embrace the changing landscape of libraries

Due to the rapid advancement of technology, librarians are forced to keep abreast of the new technological innovations to improve the quality of their services and products offered to users (Duncan 2021:10). It is essential that librarians are at the forefront and continuously expand their knowledge to provide the best quality service delivery to users. Duncan (2021:11) acknowledges that libraries need to continuously evolve with the changing needs of the users.

2.7.1 Continuing professional development

CPD is the ability of individuals to ensure that they remain relevant in their profession by continuously improving their professional knowledge and skill set (Moonasar & Underwood 2018:47). Campbell-Meier and Goulding (2021:2) describe CPD as providing librarians with skills and technical competencies to remain effective and relevant in their profession. Like most other professions, librarians are required to stay up to date with emerging trends within the discipline and ensure the survival of the profession (Moonasar & Underwood 2018:48). Brine (2005:131) states that CPD is crucial for librarians and information specialists to ensure that their skills and competencies remain up to date. This will enhance professionalism and the services they provide to their users. CPD is considered the link between the theoretical knowledge gained during formal education combined with the work experience gradually accumulated in the workplace (Postle, Edwards, Moon, Rumsey & Thomas 2002:167). This means that once the information professionals complete their formal education, continuous learning follows at the workplace as soon as they have secured a job.

According to Brine (2005:13), every professional in any discipline should be aware of their strengths and weaknesses, and this would include their skills and knowledge levels. In the library and information profession, there are varied skill sets amongst librarians depending on whether they operate within an academic library, public health or school information service. Individuals are required to update the skills to the appropriate level, and this can be done by continuing their professional development (Brine 2005:14). Campbell-Meier and Goulding (2021:3) question the acquired learning that librarians receive through CPD participation and whether the learning is carried back to the jobs or simply forgotten once the activity is concluded.

2.7.2 Importance of CPD

The main purpose of continuous learning is to add to existing knowledge and empower the individual to be competent and survive in their profession. Academic librarians are pushed to be proficient in many areas and serve as teachers, researchers, and information providers at their institutions (Engelbrecht et al 2007:580). Shupe and Pung (2011:411) note that the ever-changing roles of academic librarians result in the

continuous need for librarians to ensure that they remain relevant in their roles as information providers. By identifying the evolving roles of the librarians, the authors acknowledged the importance of both formal and informal training and development of librarians. With regard to the continuous development of academic librarians, DUT librarians are encouraged to remain relevant and participate in ongoing learning activities. Learning does not stop once the formal educational learning ends; it is the individual that would need to continue with remaining relevant and up to date within their specific disciplines (Gleason 2018:7). Academic librarians understand the need to remain relevant in their profession amidst the continuously changing landscape. This is supported by Oladokun and Mooko (2022:2) in that academic librarians need to understand that they cannot use old skills and old ways of doing things to meet the demands of a changing technological environment. Librarians attempt to upskill their knowledge base via online activities and attending various workshops and conferences, as well as by informal learning amongst their peers. The ongoing learning that is acquired via their peers and the electronic discussions have been effective in upskilling librarians in various libraries (Riley-Huff & Rholes 2011:138). As Moonasar and Underwood (2018:47) indicate, CPD is a fundamental element for all academic librarians to sustain their skills and expertise and remain relevant with trends and activities within the sector. According to Campbell-Meier and Goulding (2021:3), it is important for librarians to disseminate their learning to their jobs and peers, once they completed a CPD training.

The main challenge of 4IR within the South African environment is the implementation across the country. The South African demographic is based on inequality with wide socio-economic gaps within the country. The existing ICT infrastructure in South Africa is not very strong and mostly urban areas have access to a bit more advanced technology compared to most parts of the country. Most of the wealthy citizens can afford new technological developments whilst the poor are left behind. This inequality affects educational systems and academic libraries. The lack of financial backing and funding to implement new technological advancements (Kayembe & Nel 2019:89-90).

2.7.3 CPD participation and ongoing learning

The area of continuing professional development and ongoing learning that influences how a job is performed is an endless debate in many fields of employment. The need to understand how to perform a job to the best of one's ability is ongoing (Genoni & Graham 2005:12). According to Cheng (2017:446), fundamental encouragement for CPD activities is critical to nurturing a collaborative learning environment. Cheng also believes that supporting CPD is crucial to formulating a CPD policy and ensuring that all employees are aware of such initiatives within their workplace. An effective CPD policy should incorporate a structured mechanism to monitor and review CPD initiatives within workplaces (Cheng 2017:447). UNESCO (2023) created an ICT competency framework for teachers as a guide for in-service training to empower them to be competent in digital technologies. This is an excellent opportunity for people to empower and enrich their knowledge to be able to embrace new technologies and new ways of working comfortably. Librarians are in a similar position and need to embrace emerging technologies by learning how it functions and how it will assist in the functional areas of their disciplines. Employers need to encourage CPD participation among the employees, as it will benefit the organisation when the employees are well versed in their disciplines (Pan & Hovde 2010:2).

Eberhard, Podio, Alonso, Radovica, Avotina, Peiseniece, Caamaño Sendon, Gonzales Lozano and Solé-Pla (2017:48) mention that educational institutions need to react to newer trends by adapting their curriculum to provide their users with relevant skills to ensure that they are marketable for future employment. This means that future graduates need to be skilled and comfortable with the latest technological innovations. The task of the academic librarians in the 4IR is to ensure that the users are well equipped to retrieve information and satisfy their information needs. The users of today are used to technology and librarians need to keep up the pace to ensure that users' needs are always taken into consideration. The LIS curriculum needs to be developed to embody 4IR technological changes and ensure that LIS graduates are keeping pace with the developments and advancements in the library environment (Rahmah 2020:357; 361).

2.7.4 Impact of Information and communication technologies on libraries and librarians and continuing professional development

Chanetsa and Ngulube (2017:187) maintain that the impact of information and communication technologies on academic institutions forces academic librarians to ensure that their skills and services remain current to meet the needs of their users. Since LIS schools cannot keep up with constantly changing technology, newly qualified librarians are expected to continue developing their own learning and enter additional educational programmes to remain relevant in their field. Libraries usually have financial difficulties in ensuring that all their librarians are trained on a regular basis on current trends; therefore, librarians are also expected to pursue their own continuous educational learning (2017:190). As pointed out by Moonasar and Underwood (2018:48), academic librarians are at the epicentre of the academic institution, and they are expected to be leaders with information-searching skills and techniques that emerge with technological changes.

With the ongoing ICT impact on libraries and the new emerging knowledge and skill set required for certain specialised functions, Tenopir, Sandusky, Allard and Birch (2014:85) maintain that there are gaps in skills and a lack of confidence among librarians with regard to research data skills development. These authors suggest that various tools and recommendations have been developed online to help and guide librarians in upskilling their knowledge base and learning new competencies. According to Ghislieri et al (2018:4), newly graduated students need to realise the importance of soft skills and critical thinking in the employment arenas. The academic librarians need to ensure that they do not lose sight of the hard and soft skills that set them apart from machines and robots. The onus is on academic librarians to ensure that they regularly up-skill themselves to ensure they do not become obsolete in their areas of interest. Cao et al (2018:812) maintain that the diverse needs of the current academic library users require that the libraries provide updated information resources, services from knowledgeable and well-trained librarians, information skills workshop, professional service and current internet information. The users should not be disadvantaged due to the staff's lack of skills and training on the current trends and platforms.

With the 4IR and the different approach to working and social interaction, the rapid decrease in face-to-face interaction, and the reliance on technological innovations, there is a loss in various skills that only people can produce. This means that there will be a limit to the acquiring and developing soft skills such as communication, emotional intelligence, and interpersonal skills (Oke & Fernandes 2020:2). It should be noted that current academic library users are predominantly young users who are smart, literate, and adaptable to new technologies. These users are well informed and are self-learners. Users in the 4IR environment are fast learners and dynamic in accessing, exploring, and interpreting new technologies and devices (Oke & Fernandes 2020:3).

Ahmad et al (2019:208) emphasise the importance and value of training in the area of big data management. The authors believe that the competencies of the academic librarians are an integral requirement in any new undertakings within their environment. The academic librarians involved in the management of data need to be skilled and familiar with the management, acquisition, interoperability, metadata skills, data curation, data analysis and be able to identify and produce quality data. Lifelong learning and CPD are essential in the revolution of higher education and the influence on academic libraries. The academic librarians need to obtain an education that is qualitative and specialised that focuses on the current trends within the disciplines. Emerging trends in academic libraries require librarians to remain relevant in their profession. Many academic libraries are welcoming new trends such as makerspace, robotics, library as a publisher, and the management of research data (Ocholla & Ocholla 2020:358, 363). Newly qualified LIS graduates have the formal qualifications, but are still lacking practical on-the-job training that shapes a librarian. These new graduates enter a world transformed by technology where they will face various opportunities and challenges. This newly transformed world overtaken by artificial intelligence and social media requires certain skills that differ from the skills that were required in the third industrial revolution. This means that academic librarians and the new graduates need to be able to upgrade their critical thinking skills, manage people, possess emotional intelligence, have clear judgement, be flexible, have cognitive skills and manage knowledge. These skills are imperative in 4IR academic libraries (Xing & Marwala 2017). Academic librarians should make a

conscious effort to maintain lifelong learning activities. Continuous learning and adapting to newer ways of working should be second nature to librarians. In order become smarter and more effective librarians, we need to reflect on their personal learning development and self-improvement learning goals (Cao et al 2018:820). Academic librarians must ensure that they are regularly kept abreast of changes within their profession and constantly retrained in areas that have changed in order to avoid being completely replaced by technology. Nhede (2018:208) emphasises that the 4IR demands highly skilled personnel and these personnel must continuously improve their knowledge and abilities to remain relevant to changes within the sectors. Ayinde and Kirkwood (2020:144) claim that, usually, when new technologies are introduced into institutions, people are required to install and coordinate the tasks of the new technology so that it is set up to function correctly within the set environment. This is an area of expertise that only the employees can carry out and these employees should understand that they have the capacity to upgrade their skills to prove that when technology fails, they can continue with the process. This will reinforce the fact that people are vital to any organisation, regardless of technology. This is the same as in academic libraries. In times of power cuts and load shedding, academic librarians continue to help users with the traditional skills of tracing information. This reaffirms that academic librarians will not be outdated in the era of the 4IR, but rather require continuous education to keep them relevant (Ayinde & Kirkwood 2020:144).

2.7.5 National professional association

The recognition of continuous learning within the library and information sector has developed, and academic librarians are aware that improved knowledge and skills are vital to the survival of academic libraries. LIASA is the national professional association for South African librarians and information professionals. LIASA endeavours to empower and develop all library and information workers and provide a space for librarians to interact and transform with emerging trends (LIASA 2021). Mulvey (2013:268) believes that it is necessary that the professional body that oversees a particular profession needs to ensure that it provides proper governance. The rules and standards that one needs to adhere to should be communicated to members. The professional organisation is required to monitor the progress of individual members to ensure that the rules and standards are being followed. In the

case of librarians and information specialists, the governing body is LIASA, and this organisation is required to keep track of all CPD activities in which its members participate. DUT librarians are guided by a new CPD guide that was drafted to encourage librarians to ensure that they attend various CPD activities related to their duties.

2.8 Library infrastructure for the 4IR

The 4IR is actively changing the world as we know it. It is transforming and improving productivity through automation. Information technologies are believed to become an essential aspect of businesses. Libraries around the world have been touched by the changes in ICT. These changes have impacted library hardware and IT tools, including networks, cabling, servers, applications, bandwidth, and sources of information. With the introduction of concepts such as cloud computing, digital transformation and IoT, users, communities and academic institutions have been forced to make adjustments. Some of the changes are cost effective and can save libraries from additional costs if they choose the right software (Abo-Seada 2019:19).

There are many different hardware and software elements that a library needs to work smarter and adopt the new technological innovations. Abo-Seada (2019:19) reports that the core infrastructure that academic libraries should consist of is about ten basic elements. These consist of hardware such as computers, printers and other accessories; software programmes and applications; local area networks (LAN), which includes internal communication networks and devices; wide area network (WAN), including internet services and virtual private networks (VPN); integrated library system (ILS), including the collection catalogues and user accounts; various electronic tools, library websites, social media platforms; databases; electronic and digital resources; training resources for staff and user training; and an administration department to manage and monitor the system and its infrastructure. Academic libraries must align their strategic ICT goals with those of the parent institution and ensure that the institution has the infrastructure to support library innovations.

According to Marwala (2020), infrastructure that is required to support the 4IR is software-based, data-enabled and cloud-access foundations. Digital and online

structures improve access to information, promote transparency processes, and build interconnected and empowered communities. Data and computing technologies are highly reliant on energy and therefore a stable energy-powered source is necessary to support 4IR innovations. The country and the host institution need a solid maintenance strategic plan to complement and support 4IR initiatives. The institution and the academic library need to investigate ways in which they can set up cloud computing and sufficient storage space for big data initiatives and computing capabilities.

2.8.1 Computer hardware

Computer hardware refers to the physical components and devices that enable a computer system to perform various functions. These components work together to process data, execute instructions and provide an enabling platform for running software applications. The computer hardware encompasses both the internal and external components that are essential for the functioning of a computer system. The common and main components of any computer are generally the computer processing unit (CPU), the motherboard, which is the main circuit board that connects the power flow to the other components of the computer. Memory or RAM and storage space are also important aspects that form part of computer hardware. (Tanenbaum 2016:30-36). The 4IR is characterised by rapid technological innovations and is about the digitisation of library resources to allow easy access to information. The 4IR is focused on large data sets that comprise structured and unstructured complex data that require dedicated hardware storage space, as data are currently the new commodity (Kayembe & Nel 2019:84). Many organisations and libraries generate data on a daily basis and this requires adequate storage space. Computers, servers, and central processing units are required to continuously back up data and information. The challenge of many institutions in South Africa, including the DUT library, is the lack of funding and finances to procure these highly technical hardware (Kayembe & Nel 2019:90).

2.8.2 Computer software

As stated by Tella (2020:1), libraries must be equipped with relevant and updated software packages to remain relevant and functional in the 4IR. The libraries require

software and skilled staff to adopt and move with the changes that are driving the 4IR. Software that can control and connect users to their required information is the main area of need for many libraries. Libraries require software and management systems that can provide information to their users at their fingertips. Computer software is the programmes, instructions, and data that enable the computer system to perform various functions and tasks.

2.9 Aligning librarian roles and skills with 4IR

It is important that the librarians understand and embrace the changes that the 4IR and the changing ICT environment encompass. Librarians are information navigators and guide users through the vast digital landscape by assisting them in retrieving relevant information resources efficiently. Librarians are required to adapt and accommodate changes in their sectors. Librarians are seen as educators in teaching information literacy, imparting critical thinking and digital skills to help users evaluate, use and create information content responsibly. According to Maimela (2019), people will always be the driving force of systems and change. Systems, processes and technology affect the changing roles of librarians. AI, big data, block-chain, and the IoT are a few technologies that are affecting and impacting the roles of librarians.

Librarians play a critical role in adapting to and harnessing the technological advancements associated with big data, IoT, smart technology, cyber-physical systems, interoperability, deep learning and machine learning. There are many key roles that librarians need to identify with respect to the 4IR. To effectively navigate these changes, academic librarians need to have specific qualifications, competencies, adaptiveness, creativity, innovation, and complex problem-solving skills. Librarians must be flexible in embracing the changing structural environment that the 4IR brings with it and must be able to adapt to changes. Librarians are expected to be innovative in their thinking and have a holistic approach to change. The new technological innovation brings with it many emerging roles such as online publishing, digital library services, data curation and preservation, AI and machine learning specialists, and metadata librarians, to name just a few (Maimela 2019). As Ahmat and Hanipah (2018:60) indicate, it is necessary for libraries to align their structure to suit the changing needs of the environment and to meet the demands of

the 4IR on user needs. Academic libraries should review the roles of all levels of staff and determine the areas where there is a need for more staff and redeploy staff to those sections. Sections within the academic library that are automated and no longer require face-to-face interaction, will provide staff that can be allocated to other sections, like Makerspace. With the increasingly growing technological systems utilised within the academic libraries, there is a demand for ore technicians to assist with technical issues. The professional academic librarians need to combine their technical and professional skill sets to redefine and equip themselves to learn more about the new emerging trends (Ahmat & Hanipah 2018:61).

A study undertaken by Nkuebe and Raju (2020:198) confirm that there are gaps within the academic librarians' skill sets and the emerging technologies. Librarians should have a solid educational foundation in library and information science and ongoing professional development within the information discipline to ensure that they are abreast with the rapidly evolving technological landscape. Mooko and Oladokun (2021:217) clarifies that CPD needs will differ across libraries, as each library will identify and determine what activities are essential to meet the demands within their institutional mandates. It is important that the academic librarians align their skills and knowledge to keep up with the changing technologies and implement their projects in the information sectors. Librarians need to develop competency in various areas related to technology, data management, and information retrieval. Academic librarians need to understand the new emerging innovations within the digital environment and provide a seamless and integrated platform for users (Choi & Rasmussen 2009:461).

Technological innovations are characterised by rapidly evolving innovations, and librarians need to be adaptable and open to learning about new technologies and tools as they emerge. Being able to quickly adapt and integrate new ways of working in library services and resources is important. During the pandemic, it was evident that the demand for skills and infrastructure to support remote working in this era was crucial. The pandemic highlighted essential services jobs and jobs that could be done remotely. Within DUT, it was evident that only certain jobs could be performed remotely, whilst other jobs could not be accommodated by remote work. In order for the academic librarians to align their skills with the 4IR, skills, infrastructure, digitisation

of resources, adoption of cloud-based solutions and security are required to ensure data and network safety and protection (Oke & Fernandes 2020:3). The driving force of the 4IR on academic libraries has fast tracked the need for librarians to obtain skills that are aligned to the advancing innovations and technologies in order to cope with the user requirements. Mooko and Oladokun (2021:216) explain that participation in CPD allows librarians to show commitment to their profession and to up-skill their current knowledge and development. By aligning relevant skills with the 4IR, librarians will be able to determine what developmental skills they require to stay abreast of trends and technologies.

Hussain (2020:3) agrees that academic libraries are affected by the 4IR and that their continued survival depends on their ability to align with 4IR principles. Academic libraries are actively responding to the 4IR by aligning the resources and ensuring that the information collection is accessible, digitally or online. The responsiveness of academic libraries to adopt new technological innovations, such as cyber-physical systems, cloud computing, IoT, embedded systems and many other 4IR-related technologies proves that these libraries and librarians have the potential to align their roles and skills with the 4IR and its emerging systems (Ocholla & Ocholla 2020:363). The academic libraries need to integrate their collection of resources electronically so that the collection is visible and easily accessible online. Otike and Barát (2021:19) point out that academic libraries are mandated to transform to accommodate changes in the profession. Librarians are required to align their learning initiatives with the new tasks that affect them and to be able to support the teaching and learning of the university. Library staff should be skilled and reskilled in areas where they lack the ability to respond to the changing needs of users. This is part of the process of aligning with the 4IR and emerging changes.

2.10 Summary

It is clear from the literature review that the new era of information and communication technology brings with it risks and opportunities. It depends on how the 4IR is approached and accepted by the various stakeholders within the academic sectors. It is vital to remember that only people can embody soft skills, creativity, emotional intelligence, and critical thinking in the 4IR. As Xing, Marwala and Marwala (2018:173)

state, while the 4IR can benefit society, it can also challenge society by replacing the workforce of low-skilled workers with machines. Low-skilled workers are at a higher risk of being replaced by machines than highly skilled workers. The main challenge with te 4IR is to ensure that the academic librarians are continuously learning new skills to cope and keep up with the 4IR in order to provide efficient and effective service delivery to their users. Academic libraries and institutions are sceptical in embracing the 4IR due to the perception of high job losses associated with 4IR innovations. With the 4IR, there is also the unpredictability of infrastructure and the threat of cybercrimes. Education institutions must reassess the curriculum to accommodate the new training skills that require complex problem-solving skills, creativity, collaboration, and critical thinking skills (Nhede 2018:203, 211). As the world becomes more interconnected, large amounts of data are created on a daily basis from various devices and organisations. It is a challenge to manage and store this data for seamless retrieval. The use of robots in various industries and the threat of using robots to replace people is a challenge to soothe the workforce (Kayembe & Nel 2019:84). It is evident that academic librarians cannot be complacent but need to continuously update their knowledge and skills to remain relevant and respond to the growing needs and demands of the users. The next chapter presents the research methodology employed to conduct the study.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter was a review of the literature related to the evolving roles of academic librarians in the 4IR through continuous professional development. The literature review was guided by the objectives of the study. This chapter expands on the research methodology that underpins the study. Research is a systematic process of collecting, analysing and interpreting information that leads to the understanding of a knowledge idea that is of interest to the researcher (Leedy et al 2019:2). Research methodology is an important aspect in a study as it provides a background for discussions based on the research problem and objectives.

This chapter covers the philosophical paradigms that led to the study, the research approach, the research design, and the data collection instruments used to derive the data for the study. This chapter covers the target population, sampling methods used, data analysis, and ethical considerations. Research methodology is an essential element in underpinning the research process. Methodology refers to the study and analysis of data-creation techniques. It is more concerned with the process that shapes one's selection of a research design and defines how research should be undertaken (Rehman & Alharthi 2016:52). This is confirmed by Ngulube (2015:127) who highlights that methodology is fundamental to the research process. It is important because it provides the researcher with an understanding of how the process unfolds in identifying, selecting, and analysing information regarding a specific topic (May 2011:2).

Creswell and Creswell (2018:3) indicate that there are three main research approaches, namely quantitative, qualitative, and mixed-method research. Figure 3.1 describes the research design roadmap and methodology that underpins this study. It outlines the overall plan and approach to conduct this study. The roadmap served as a strategic guide for the researcher to navigate through the various stages of the research process, from defining the research problem and identifying the research design, methodology, collecting and analysing data, to ultimately drawing conclusions

and making recommendations. The research roadmap provided a clear path for the research from the initial conceptualisation of the study to the dissemination of the results and findings.

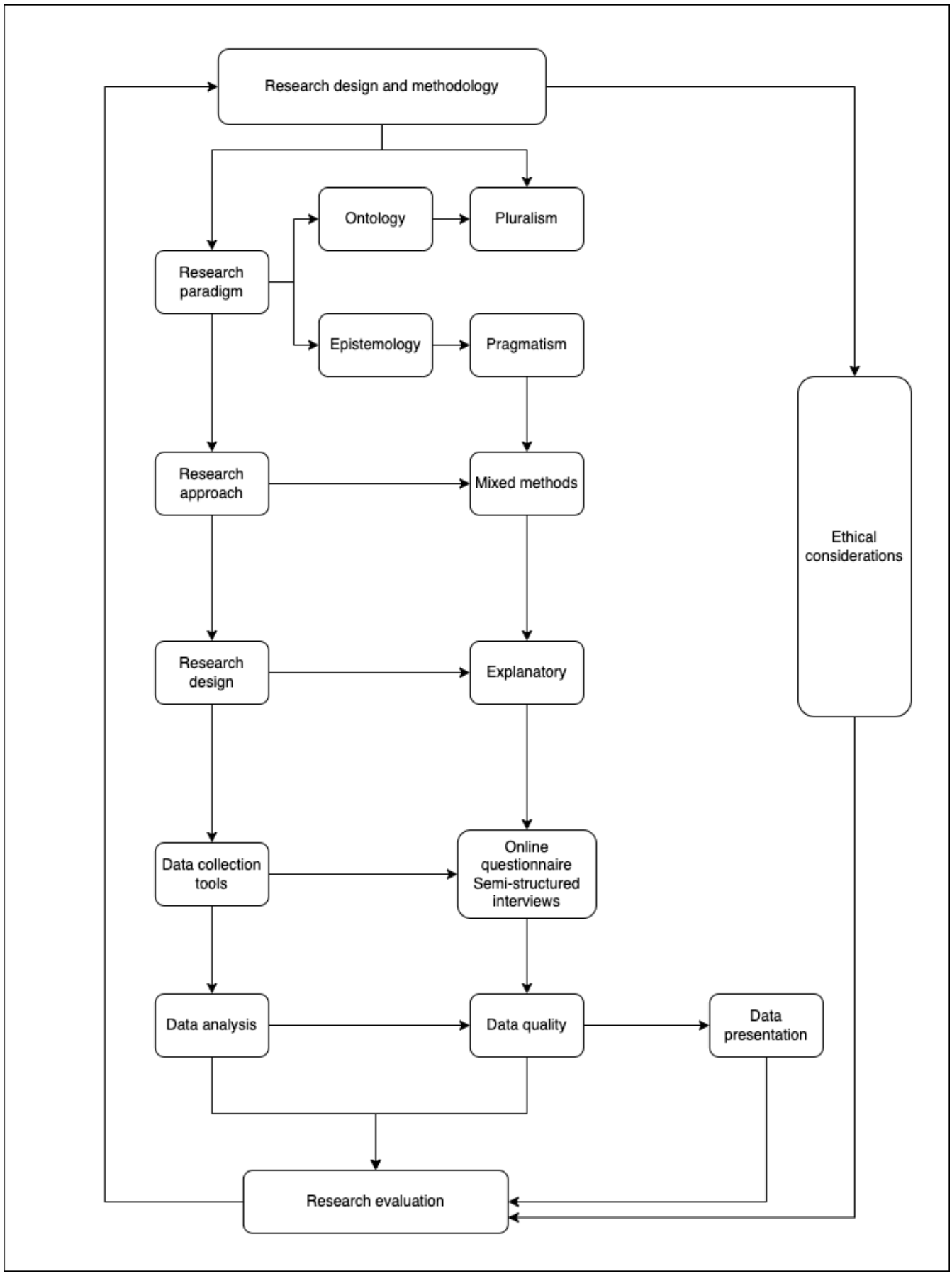

Figure 3.1: Application of research methodology (Researcher 2023)

3.2 Research paradigm

According to Maree (2016:56), it is important to understand what constitutes “valid” research and what research methods are most suited to pursue in a specific context. Rehman and Alharthi (2016:51) believe that the elements of a research paradigm are the researcher’s ability to understand and describe “the nature of reality” and the ability to attain knowledge. Khaldi (2017:16) concurs with Rehman and Alharthi (2016:51) in that the research process comprises four major dimensions: ontology, epistemology, methodology, and methods, which are underpinned by an all-encompassing interrelated practice referred to as the research paradigm. The choice of research paradigms and the philosophical assumptions aligned with the process are important in shaping how research is conducted. All research, whether it is qualitative or quantitative research, is based on underlying assumptions. This section explores the philosophical paradigms behind the approaches and methods used in research studies. Philosophical approaches and assumptions form the basis of any research process. The researcher may not consciously be aware of these assumptions, but research is influenced by them, and it is therefore necessary to identify these assumptions (Creswell & Creswell 2018:5; Leedy et al 2019:8). Researchers need to understand the philosophical assumptions in a research method as it underpins the research process and design (Creswell & Creswell 2018:6). Researchers are influenced by a set of beliefs that guides their actions and ways of thinking and although there are various debates about the types of beliefs researchers portray in their research works. Creswell and Creswell (2018:6) highlight four philosophical assumptions as positivism, the interpretivism, pragmatism and transformative. These are discussed below under ontology and epistemology.

3.2.1 Ontology

Ontological research relates to a point of view about research specifically within a world view and is based on the assumptions that researchers have about reality, and what kind of reality exists in the world about which the researcher can investigate and acquire knowledge (Rehman & Alharthi 2016:51). The main ontological approaches are realism, materialism, and idealism. The realist position is that there is an external reality which exists independently of human understanding and beliefs. Basically, it has the view that something is real, and it exists. This viewpoint is supported by the

positivist and post-positivist position (Maree 2016:57). The materialistic position is that there is a real world, but the emphasis is on material objects, comforts, and considerations and not spiritual or intellectual values (Maree 2016:58). The ontology that supports the materialist position is called ‘materialism’. Materialism highlights the importance of material objects and physical comforts and it disregards the role of spiritual or intellectual values in human lives (Maree 2016:58). Idealist portrays that reality is only known through people’s mind and the ideas that they construct. The ontology that supports the idealistic position is called ‘idealism’. One of the ontology views is that of constructionism. This view is constructed socially and subject to change. This is popular with qualitative researchers undertaking an interpretivist process (Maree 2016:59). The pluralism philosophical position portrays that there are many different ways of understanding reality and that no single way of understanding is favoured over the others. Pluralism emphasises that there are multiple perspectives, values, and beliefs that can coexist within society and that these various perspectives enrich our understanding of the world (Maree 2016:59).

3.2.2 Epistemology

Epistemology, on the other hand, is more interested in 'the nature and forms of knowledge', that is, how knowledge is attained and how it is communicated to others things (Rehman & Alharthi 2016:52). Epistemology allows the researcher to dive deeper into queries such as what kind of knowledge existed and how individuals came to know such things (Rehman & Alharthi 2016:52).

3.2.2.1 The positivist/post-positivist paradigm

The post-positivist paradigm is a prominent epistemological position that highlights the importance of empirical evidence and scientific methods in acquiring knowledge. This paradigm portrays that reality is multifaceted and subjective and that it exists. The positivist methodology places more emphasis on experimentation research that yields quantified data results (Rehman & Alharthi 2016:53). Although it is believed that constructed reality is influenced by gender, culture, and general upbringing views, the post-positivist adopts the approach based on careful observation and numeric measurement of the objective reality that exists in the world. Researchers who embrace the positivism approach accept and support validity in a quantitative form.

This post-positivist assumption is identified with the more traditional form of research and supports quantitative research (Creswell & Creswell 2018:7; Maree 2016:59).

3.2.2.2 Interpretivism

The interpretivist approach highlights the importance of understanding and interpreting human behaviour and experiences in their social and cultural context. According to Creswell and Creswell (2018:8), people create meaning as they interact with the world they are interpreting, and engage to understand and make sense of the world. Interpretivists argue that human behaviour cannot be understood only through empirical observation or scientific methods, but requires an understanding of the subjective meanings and experiences of individuals in their social and cultural context and they believe that human behaviour is influenced by a variety of factors, including social norms, values, and beliefs (Creswell & Creswell 2018:8).

3.2.2.3 Transformative approach

The transformative philosophical position emphasises the importance of social and political change in shaping knowledge and understanding. Transformative position is that a study should be interlinked with politics and a political agenda to understand social oppression (Creswell & Creswell 2018:9). This approach focuses on social issues and involves participants in formulating the questions for data collection and aiding in analysing the data. Transformative research empowers participants, provides a voice and raises awareness of their causes to improve their livelihood (Creswell & Creswell 2018:9).

3.2.2.4 Pragmatism

Pragmatism is an epistemological and philosophical approach that underlines the practical consequences of ideas and beliefs. It is a practical and flexible approach to problem-solving that prioritises what works best in a particular situation and not relying on abstract theories and principles (Creswell & Creswell 2018:10). Pragmatism highlights the importance of problem-solving, experimentation, and empirical enquiry and that practical results are valued more than abstract theories (Creswell & Creswell 2018:10). The pragmatic approach focuses on what works to solve problems, rather than focusing on methods to identify problems. This approach is associated with the mixed methods approach, and the researcher has more freedom of choice to choose

the methods, techniques, and processes that suit their needs. This approach makes use of a pluralistic method to gain knowledge about the problem (Creswell & Creswell 2018:10). Pragmatism is underpinned by the idea that knowledge is based on experience and that an individual's perception of the world is shaped by their social experiences (Creswell & Creswell 2018:11). This study was underpinned by the pragmatic approach as it allowed the research the flexibility to choose from multiple methods, assumptions and different forms of data collection and analysis (Creswell & Creswell 2018:11).

For this study, the pragmatist epistemology was used, as it guided the researcher in understanding the participants' knowledge based on experience and allowed the researcher to interrogate the participants' point of view. Creswell and Creswell (2018:11) state that a pragmatic approach guides the research design toward the exploration of the research topic and allows the researcher the liberty to choose methods, techniques, and procedures that would best suit their research needs. The interpretive approach allows the researcher to take a far wider approach to address issues of influence and effect and to be able to question why and how certain approaches are taken (Walsham 1995:79).

3.3 Research approach

The research approach indicates the plans and procedures for research that forms the steps from a broad assumption to detailed methods of data collection, data analysis and the interpretation of data. Three research approaches are identified, namely the qualitative, quantitative, and mixed-method approach (Creswell & Creswell 2018:3). A brief outline of the three approaches follows.

3.3.1 Qualitative research

Qualitative research can be seen as an interpretive methodology, as the collected data can be interpreted with meaningful results on the mind-set of the participant. Qualitative research design is used when studying human behaviour, opinions, and motivations (Mavodza 2020:5). The use of qualitative research allows the researcher to explore a wide variety of areas in the in the social world. This can include the daily life, the understanding, experiences, and working life of the research participants

(Mason 2002:1). According to Denzin and Lincoln (2005), qualitative research is a multifaceted research method that involves an interpretative and a naturalistic approach to the research undertaken. Qualitative research allows for various knowledge claims, inquiry strategies, and various data collection methods and analysis. According to Parahoo (2014:56), qualitative research aims to explore human behaviour, beliefs, experience, and motivation.

3.3.2 Quantitative research

The quantitative research approach focuses on testing objective theories by studying the relationship with variables. These variables are measured on instruments yielding numbered data for analysis using a statistical process. The quantitative approach is based on the post-positivist approach and experimental design. The data collected are measured and interpreted using statistical procedures and hypothesis testing. It usually incorporates closed-ended questions, predetermined approaches and numeric data (Creswell & Creswell 2018:4, 17).

3.3.3 Mixed method research

The MMR approach includes the combination of qualitative and quantitative collection of data and integrating the data using the pragmatic approach and theoretical frameworks to collect, analyse and interpret the data. This approach is based on the sequential, convergent, and transformative assumptions. This approach uses open- and closed-ended questions, a mixture of both predetermining and emerging approaches for data analysis and interpretation (Creswell & Creswell 2018:7). This approach was adopted in this study because it allowed the researcher to use both quantitative and qualitative methods to provide a more comprehensive picture and understanding of the research question under study. The use of both quantitative and qualitative methods enhanced the validity of the research findings as the quantitative method provided statistical data and the qualitative method provided an in-depth more detailed data that allowed the researcher insight into the participants' experiences. MMR allows for triangulation of the findings as different sources of data were compared to validate and confirm the results (Creswell & Creswell 2018:15).

3.4 Research design

Parahoo (2014:164) describes the research design as a plan on 'how, when and where' the data will be collected and analysed. The research design used in this study was an explanatory study, as quantitative data were collected first, and then qualitative data were collected to supplement the quantitative data. For the MMR explanatory study, sequential and quantitative data are first collected, and then qualitative data are collected to supplement the quantitative data, as some quantitative data could require further clarity, and the qualitative data will augment this. In this study, data were collected from DUT library participants to understand the implications of the 4IR on librarians and the importance of continuing their professional development. Data were scanned for identical patterns and similarities to illustrate the generality of the patterns attained (Khaldi 2017:17). The explanatory sequential mixed method was used as one of the research designs as it allowed the researcher to analyse the results quantitatively and then further explained the results as qualitative data (Creswell & Creswell 2018:15).

According to Johnson and Christensen (2017), this two-phased sequential design allows the researcher to first collect and analyse quantitative data and then collect and analyse the qualitative date based on the quantitative results. The explanatory sequential mixed method design was applicable as it allowed the researcher to develop an in-depth analysis of the study (Creswell & Creswell 2018:14).

3.5 Population

A study population refers to a portion of an identified target population from which a sample is selected to study (Babbie 2017:202). Creswell and Creswell (2018:150) refers to a study population as a group, such as, individuals in a particular occupation or from a specific demographic group and whom the researcher wants to investigate to learn more about a particular setting or environment. The population for this study consisted of 70 full-time library staff members employed at the DUT and it excluded the part-time library assistants. Research focused on full-time librarians who were employed at the DUT library, regardless of their professional qualifications or level of occupation at their current position in the library. This allowed the researcher to fully engage with the participants and establish how their roles had evolved and the impact

the 4IR had on their jobs, as well as their participation in CPD during their transition. The summary of the targeted study population is presented in Table 3.1.

Table 3.1: Summary of study population

Designation	Data collection tool	No of participants
Coordinators	Online questionnaire One on one interviews	5
Assistant librarians	Online questionnaire One on one interviews	7
Library assistants	Online questionnaire One on one interviews	32
Librarians	Online questionnaire One on one interviews	15
Managers	Online questionnaire One on one interviews	5
Training librarian	Online questionnaire One on one interviews	1
Marketing librarian	Online questionnaire One on one interviews	1
Postgraduate librarians	Online questionnaire One on one interviews	2
Copyright specialist	Online questionnaire One on one interviews	1
Digital librarian	Online questionnaire One on one interviews	1

3.6 Sampling

The two basic sampling methods in research are probability and nonprobability sampling. It is important that the sampling strategy is relevant to the study framework and can address the research questions. Probability sampling is usually not commonly used in qualitative research (Merriam & Tisdel 2016:96). In probability sampling, the sample is chosen from a population and the selection is based on a random selection of participants. Random sampling enables the researcher to assume that the sample

represents the total population (Leedy et al 2019:172). Probability sampling has different sampling techniques. These are simple random sampling, stratified random sampling, proportional stratified sampling, cluster sampling, and systematic sampling. Each characteristic of the population will require a relevant sampling technique that is best suited to those characteristics of the population. Simple random and systematic sampling is appropriate for a population that is generally a homogeneous group of people. Stratified random sampling is more suited for a population type that contains definite strata that are more or less equal in size. Proportional stratified sampling is appropriate for a population that contains strata that are in different proportions within the population whilst cluster sampling is appropriate for populations that contain clusters with similar characteristics (Leedy et al 2019:175-177).

To ensure that the sample population is representative for the study, it must be carefully chosen and identified. In nonprobability sampling there is no way of predicting that each component of the population will be represented in the sample (Leedy et al 2019:177). Nonprobability sampling is usually popular for qualitative research as the researcher uses mainly the data to solve the qualitative problem that the study focuses on. The most common types of sampling methods used in qualitative research are purposive sampling, quota sampling, and snowball sampling (Daniel 2012:14).

Quota sampling selects participants on the basis of certain prescribed characteristics in that the sample has the same proportion of characteristics that exists within the population being studied (Babbie 2017:197). Snowball sampling occurs when a researcher collects data from some individuals and asks the participants to locate other members within the population group (Babbie 2017:196).

Purposive sampling or judgemental sampling is a nonprobability sampling method that is focused on a population group and is made to represent that population based on the researcher's judgement (Babbie 2020:193). According to Maree (2016:85), purposive sampling is common for qualitative research.

According to Johnson and Christensen (2017), sampling in mixed methods is categorised into two criteria, one is the time orientation, which responds to the

question of whether “quantitative and qualitative phases occur concurrently or sequentially.” Concurrent time orientation refers to when the data are collected at the same time for both the quantitative and qualitative phase of the study. Sequential time orientation takes place when the data are collected in stages, which means that the data from the first stage are used to shape the selection of data in the second stage. The second criterion of the mixed sampling design is called the sample relationship. This determines whether the relationship between the samples are identical, parallel, nested, or multilevel. An identical sample the same group of participants are used in the quantitative and qualitative phases of the study. The nested sample is when the participants selected for one phase are a subset of the population selected for the other phase. In a multilevel sample, the quantitative and qualitative samples are selected from different levels of the population. The parallel sample is when separate quantitative and qualitative samples are drawn from the same group of participants and respondents in the study. Participants are selected with a specific purpose to represent a group, specific criteria or a phenomenon key to the research (Johnson & Christensen 2017). The relationship between both qualitative and quantitative samples was identical as the same pool of individuals participated in both phases of the study.

This study used the MMR approach, and every participant in the sampling population had an equal chance of being chosen for the study (Onwuegbuzie & Collins 2007:288). For the purpose of this study, parallel sampling was used; that is, different samples for quantitative and qualitative phases were used, but participants were drawn from the same population. In this regard, for the quantitative study, all the librarians (70) were e-mailed questionnaires electronically. To augment quantitative data, interviews were conducted with some participants who met certain criteria that included their experiences, availability, and willingness to participate in the face-to-face/virtual interviews, as the research participants are part of a targeted group, that is, academic librarians. The researcher has in-depth knowledge about the population group and therefore was able to make informed selections from the specified population grouping of librarians from each of the DUT site libraries. Therefore, this study included participants who met the relevant criteria, which are librarians working at the DUT library.

3.7 Data collection methods

Data collection is the manner in which information is gathered and measured from relevant sources to respond to the research problem and to understand the problem by evaluating the results (Maree 2016:37). It involves collecting information from various participants or individuals to enhance and provide validity to a study, and several data collection techniques or instruments can be used to gather data. Many research studies use both questionnaires and interview techniques to gather information (Hilton, Fawson, Sullivan & DeJong 2020:187). In qualitative research, questionnaires, interviews, observation, and document analysis can be used to gather information from participants. In quantitative research, data are collected through online surveys, questionnaires, experiments, controlled observation, polls, and interviews. It is important to keep research questions in mind when determining the data collection methods to use (Maree 2016:37). Data for this study were collected using a self-administered online questionnaire that was distributed to librarians at the six DUT sites. A follow-up interview with part of the participant group was conducted to validate the study, and to seek clarification once the questionnaires was completed.

Due to COVID-19 restrictions and social distancing, the researcher used two data collection methods. The data collection was acquired whilst adhering to the social distancing laws. The first was data collection through an online questionnaire that was distributed to all academic librarians of the academic institution mentioned above. The online questionnaire included open-ended questions and was a fast and effective method of deriving data from the participants. Once the respondents returned the completed online questionnaire, the researcher collected more data using follow-up interviews to obtain greater clarity and depth. Follow-up interviews were conducted online via MS Teams, telephonically, and, where appropriate, face-to-face. The researcher purportedly selected participants to interview due to their background, knowledge, qualifications, and interest in the topic. According to Blackstone (2018:108-109), interviews are excellent for retrieving detailed information, as participants may have an underlying interest in the research topic.

3.7.1 Questionnaire

Several methods can be used to collect information from participants. Each data collection method has its own advantages and disadvantages. A questionnaire in qualitative research can be tricky and must be carefully designed. The researcher needs to bear in mind the type of data the questionnaire will generate and what techniques will be used to analyse the data (Maree 2016:177). Questionnaires in quantitative research need to consist of objective and descriptive questions that can derive good data from the respondents (O'Leary 2021:233). The advantage of written questionnaires is that they can be distributed to a larger group of participants by email, as was the case with the current study. Respondents can remain anonymous and feel more comfortable answering the questions, especially if a link is sent. The downside to questionnaires is the low return rate, as respondents do not feel obliged to complete the questionnaire and return it to the researcher. To generate useful data, questions need to be carefully planned, properly worded, and distributed (Leedy et al 2019:154).

According to Maree (2016:179), the questions on the questionnaires need to be formulated in a way that the respondents are not confused when responding. The language used should be simple and avoid ambiguity. For the mixed methods approach, the questionnaires should include closed as well as open-ended questions. The questions need to be formulated in a way that engages the respondents, and therefore, both closed- and open-ended questions are encouraged to generate in-depth and meaningful responses. Closed-ended questions are easier and quicker to answer and help avoid irrelevant answers and yield measurable and quantitative data (O'Leary 2021:235). Open-ended questions draw out honest answers and allow participants to respond adequately and engage with their thinking processes when responding. These responses allow the researcher to derive a thematic analysis from the responses (Maree 2016:180). This method of data collection was chosen because it allowed the researcher to reach the participants, who are geographically dispersed across six sites. It also allowed for a faster turnaround time in terms of getting the data back.

The questionnaire is a widely used data collection tool and was the most suitable for this study. The researcher used a structured set of questions that was designed to

gather information from the respondents in a standardised and systematic manner. The questionnaire was administered and emailed to all participants online using a DUT subscribed software, namely QuestionPro, which is an online research method survey tool used in collecting data for research purposes.

3.7.2 Interviews

An interview in qualitative research is a two-way conversation where the researcher asks the participants questions to elicit detailed feedback to gather data for the study. The aim is to elicit rich descriptive data that will assist the researcher in understanding the participants' views on the particular field of interest. Qualitative research involves open-ended or structured interviews, semi-structured, and structured type interviews (Maree 2016:93). Interviews can be conducted face-to-face, via telephone, or on virtual platforms (Leedy et al 2019:153).

An open-ended or unstructured interview is flexible and includes open-ended questions where the researcher delves into the participants' views, ideas, beliefs, and attitudes towards a specific topic. These types of interviews are intended to draw descriptive responses from participants (Maree 2016:93).

The semi-structured interview consists of predetermined, open-ended questions the researcher prepares for the participants. The researcher asks questions that can lead to follow-up questions to probe deeper and receive further clarification from the respondents. The interview questions need to be specific with cautiously worded questions to delve deeper with the participants (Maree 2016:93).

A structured interview consists of questions that are detailed and prepared in advance. In this scenario, the researcher controls the pace of the interview and administers the questions in a standardised method. All the participants receive the same questions in the same format and the interviews are conducted by the same person. In a structured interview, there is no flexibility with the format of the questions and the sequence in which they are asked, and they often consist of closed-ended questions (Maree 2016:93).

Structured and semi-structured interviews are similar in that for both interviews, the questions are pre-planned and developed prior to the interviews. The difference is that the questions for a structured interview which are posed in the same order and exactly the same way are often closed-ended, and the questions are mostly open-ended for a semi-structured interview. Interviews can be time consuming and costly if the researcher/interviewer has to travel to interview the participants (Maree 2016:94).

For this study, the researcher used semi-structured interviews as it provided the researcher flexibility with follow-up probing questions. The researcher was able to dig deeper into the responses and seek clarification of the responses and points of view of the participants.

3.8 Data analysis

Data analysis refers to the way in which the research data that was derived for the study are systematically processed and organised in a way that is easy to understand and interpret. The overall findings are reviewed, compared to other literature and new findings are examined to highlight and support the research questions. The findings can reveal the limitations of the study and provide guidance to further future studies within the same field of study (Creswell & Creswell 2018:199).

In a qualitative study, it is advised that the original findings be referred to constantly to verify conclusions in line with the research problems. Interpretation and analysis of text and narrative (interview responses) must be guided by procedures of the specific data collection instruments used (Maree 2016:109-110).

For the purpose of this study, the data recovered from the online questionnaire was analysed using graphs, bar graphs, and tables through Microsoft Excel and Microsoft Word. The data derived from the online questionnaire were examined and described as quantitative data, whilst the data gathered from the interview sessions were analysed as qualitative data. The interview data were studied and organised systematically in line with the research objectives according to emerging themes. The verbal interactions were transcribed into written text and the researcher read through the data multiple times to be familiar and immersed in the content to gain a deep

understanding of the context. The researcher identified themes based on the similarity and connections of the data. Thematic analysis was used to determine the presence of emerging themes arising from the interviews, by analysing and identifying the similar patterns. Concise and meaningful names were assigned to each theme to capture the essence of the data gathered. This helped the researcher align the data thematically to determine the commonality within the date (Maree 2016:111). Content analysis refers to the systematic approach in identifying specific patterns, themes, and meanings within the data, and this was helpful in providing a quantitative description in identifying certain words, phrases, and themes within the data gathered from the questionnaires (Maree 2016:111).

Therefore, the MMR approach suited this research as both the qualitative and quantitative methods were used to analyse and interpret the data. Quantitative methods yield numerical data that can be transcribed into useable statistics, whilst qualitative data yield much more detailed and summarised data (Creswell & Creswell 2018:15). For this study, the MMR approach involved the collection and analysis of quantitative (online questionnaire) and qualitative (interview) data to test, analyse, interpret, and derive a more in-depth understanding of the study. The explanatory mixed methods was used for the purpose of this study as the researcher first conducted and analysed the quantitative research and then expanded on the results to describe it in more detail with qualitative research (Creswell & Creswell 2018:15).

3.9 Trustworthiness

The validation of qualitative research is important to determine the accuracy and trustworthiness of the data collected. Trustworthiness in research emphasises the credibility, authenticity, and believability of the research findings. Creswell and Creswell (2018:200) suggest the use of multiple validity procedures to identify the accuracy and trustworthiness of the findings. A key consideration for ensuring trustworthiness includes credibility, which involves establishing the authenticity and truthfulness of research findings. Dependability is another important aspect of trustworthiness and relates to the stability and consistency of research processes and findings over time (Creswell & Creswell 2018:200). Researchers can establish validity

by using appropriate research methods, ensuring that the sample is representative of the population being studied, and minimising potential sources of bias.

3.10 Reliability

Reliability refers to the consistency and stability of research findings over time and between different researchers (Creswell & Creswell 2018:200). Researchers can determine reliability by using standardised data collection methods by having multiple researchers independently analyse the data. Key factors for ensuring reliability include consistency in data collection, where the researcher must ensure that the methods used to collect data are consistent and standardised. The reliability of the test and the test retest assesses the consistency of the measurements when the same test is administered to the same participants on different occasions (Creswell & Creswell 2018:200).

Triangulation includes using multiple methods or data sources to confirm or validate research findings, and this can enhance the credibility and authenticity of the findings (Creswell & Creswell 2018:200). To establish trustworthiness in research requires careful planning, rigorous data collection and analysis, and transparency on potential sources of bias or limitations in the study. Researchers can ensure that their findings are credible, reliable and valid by using the above-mentioned steps (Creswell & Creswell 2018:200).

For the purpose of this study, the findings were triangulated by doing a follow-up interview to responses received from questionnaires and organising the data in a thematic manner in line with the research objectives and emerging themes. The researcher attempted to clarify the biasness by clearly stating the background and history when it was necessary for parts of the data interpretation.

3.11 Ethical considerations

It is necessary and important to highlight ethical considerations in relation to any study. Research involves the process of obtaining information from people, about people, and researchers need to obtain permission from the participants, protect the participant, promote the integrity of the study, develop a trust with the participants, and

assure the participants of their rights at all times (Creswell & Creswell 2018:88). The researcher must obtain informed consent from the respondents and participants before continuing the data collection research process. The participants must be assured that no harm will come to them and that their anonymity will be guaranteed and confidentiality in revealing who disclosed what in the interviews or questionnaires will always be maintained. Participants must be assured that they are protected at all times and that the online questionnaire and interviews are voluntary (Babbie 2017:64). The researcher ensured that all protocols were followed and that the study was conducted in a manner that followed all expected ethical considerations in relation to collecting data involving human participants. Participants were assured that their participation was voluntary and that their identities were kept confidential. The covering letter to the online questionnaire highlighted the confidentiality and anonymity of the participant or respondent at all times (see Appendix B). During the interviews, the researcher once again highlighted the participants' anonymity throughout the study. The researcher asked permission for virtual interviews to be recorded from the participants prior to each interview session. The face-to-face interviews were not recorded but captured manually. The researcher had to obtain ethical approval from the relevant institutions, including UNISA (see Appendix E) and permission was also granted by the DUT to conduct the study (see Appendix F & Appendix G).

3.12 Evaluation of research methodology

It is important for any study to evaluate the trustworthiness and authenticity of its process (Kuada 2012:100). The research process requires the researcher to engage with the participants and obtain their feedback and points of view on the research in terms of responding and partaking in the research. This study used the mixed methods approach and followed an explanatory study, with a review of previous literature, and the data collection methods used for this study were online questionnaire and individual follow-up interviews.

Due to the COVID-19 pandemic and the restrictions imposed, it was difficult to conduct interviews, as most of the participants worked from home. The researcher therefore undertook to use an online self-administered questionnaire with open-ended questions that allowed the participants to fully engage with the research and provide responses

in their own words. This allowed respondents to complete the online questionnaire at their own time and pace. As Mavodza (2020:5) would attest, respondents completed the data questions in relation to their own understanding of things. A further follow-up interview was conducted with 10 participants to augment quantitative the data. The data collection and analysis for this study encountered some challenges. The slow and low responses of the participants were disappointing, despite the researcher constantly sending reminders via email, telephone, and personally. Some participants opted for the interview questions to be emailed, while others opted for telephonic interviews. Two interviews were carried out while adhering to the COVID-19 protocols and they were conducted with facemasks on, in a physical setting. There were challenges in attempting to record the interviews as some of the participants were not comfortable with the session been recorded. The researcher thus attempted to take notes to record the responses.

3.13 Summary

This chapter discussed the research methodology and the process followed to obtain the data and the population that made up the study. This particular study employed the constructivist / interpretivist methodology approach, as this study required a plan of action and a research design that guided the research process. The methodology helped the researcher to select the correct data collection tools that would produce the most appropriate results. Data for this investigation were collected through semi-structured interviews, open-ended questions, and an online questionnaire that was distributed to all participants. Chapter Four discusses the data analysis and interpretation of the findings.

CHAPTER FOUR
DATA ANALYSIS AND PRESENTATION

4.1 Introduction

The previous chapter examined and outlined the research methodology that was applied in this study. It covered methodological aspects such as research paradigm and approach, research design, population and sampling techniques, data collection instruments, and the ethical considerations that were applicable for this study. This chapter analysis and presents the findings of the study.

Rose and Sullivan (1993:4) explain data analysis as a practical application of understanding and interpreting the data by using certain techniques in describing and evaluating the gathered data. Data analysis allows the researcher to put the collected data in context and present them in a meaningful way for better understanding for interested parties. Silverman (2017:34) describes the data analysis process as a means of deriving information to shape the study. The data that were retrieved for this study followed a mixed methods research approach with the use of an online questionnaire and additional interviews to augment the quantitative data. Data were evaluated and coded to determine the themes of the collected data. As Babbie (2013:396) explains, coding is essential for data collection. Data must be classified and categorised for ease of processing and understanding (Babbie 2013:397). The data were analysed and presented in the form of graphs, figures, and tables. For the purpose of this study, data were analysed and interpreted as per the objectives of the study using thematic analysis. Quantitative data were analysed and presented in the form of graphs, figures, and tables while qualitative data were thematically analysed. Thematic analysis allowed the researcher to identify patterns and themes based on the study objectives. To recap, the specific research objectives of the study were as follows:

- To determine how the roles and responsibilities of academic librarians have evolved in view of current disruptive technologies.
- To identify skills and competencies that will help academic librarians understand and transform with the impact of innovation and technologies.

- To establish the effects of the 4IR on the roles of academic librarians in the changing information environment.
- To determine how academic librarians utilise CPD to embrace the changing landscape of libraries.
- To assess whether the current infrastructure of the DUT library supports the 4IR and the changing roles of librarians.
- To suggest a model of aligning librarians' roles and skills with the 4IR.

4.2 Analysis of data in the present study

The collection of data through the use of both quantitative and qualitative measures is important in determining a particular phenomenon. The means of analysing the data to produce systematic and structured data that makes sense and can clearly explain the research objectives is important to any researcher (QuestionPro 2022). There are various ways in which data can be analysed (Silverman 2017:34). Different researchers choose different approaches to analyse their research findings in ways that would suit their study needs. Data for this study were collected and analysed using the MMR approach, which includes analysing the data using both the quantitative and qualitative approach by identifying similar patterns and organising the data in themes. Data for this study were collected through an online questionnaire and a semi-structured follow-up interview. All data collected from the questionnaire were quantitatively analysed by systematically scanning the observations descriptively for similarities and differences. The data from the interviews were qualitatively analysed by scanning for common categories. The data was captured and described using a thematic approach and presented according to the objectives of the study. The responses of the participants contributed to the themes derived from each objective that made up this study. Presenting the data in themes is a popular method of qualitative data analysis and it helps the researcher contextualise the data in a more meaningful way (De Farias, Dutra-Thomé, Koller & De Castro 2021:163).

4.3 Response rate

A response rate is the percentage of individuals who participated in a study or survey out of the total number of people who were eligible to participate. A high response rate indicates that the sample is likely to be representative of the population being studied,

while a low response rate may suggest that the sample is biased or not fully representative (Busetto, Wick & Gumbinger 2020:6). The response rate can be calculated by dividing the number of completed responses by the total number of eligible participants and multiplying the result by 100. As reflected in Table 4.1, a total of 41 librarians out of the 70 (100%) responded to the self-administered questionnaire online resulting in a response rate of 59%. Furthermore, ten librarians were identified based on their experience, availability, and willingness to participate in follow-up interviews to augment the quantitative data.

Table 4.1: Response rate

41 Completed questionnaires _____ = 59% response rate 70 Participants were contacted

There is always a debate around the issue of acceptable percentages in response rates amongst researchers. Babbie (2016:264-265) refers to the "body of inferential statistics" used in association with research questionnaires and anticipates that all respondents should undertake to complete the questionnaires. Since this rarely happens, non-responsive bias becomes a concern as the response rate can influence the quality of the data. The response rate of 59% is considered acceptable for online responses, as Nulty (2008: 302) explains that online questionnaires usually yield an average of around 33.3% response rates. Based on this statement, the researcher continued with the analysis of data. Quantitative data were further augmented with interview data. Interview, as a method of collecting data, has various advantages, such as more accurate responses because of contextual naturalness; a greater likelihood of self-generated answers; a symmetrical distribution of interactive power; greater effectiveness with complex issues; more thoughtful responses; and more accurate results.

4.4 Participants' profile

The respondents for this study were librarians employed at the DUT multi-library sites and were selected for the questionnaires based on their full-time permanent positions.

Participants selected for interviews were based on their availability, experience, and willingness to participate in the interview sessions. The study focused on the librarians regardless of their professional qualifications or level of occupation in their current positions in the library. This allowed the researcher to fully engage with the participants and establish how their roles had evolved and the impact the 4IR had on their jobs, as well as their engagement with CPD during their transition. Qualitative data saturation is when the sample size of the participants reaches an adequate percentage and an "information-richness" that is deemed relevant for the study is attained (Busetto *et al* 2020:6).

The population for this study consisted of 70 library staff employed at the DUT. Due to Covid-19 regulations and the social distancing protocols in place, the most efficient manner in retrieving feedback was by emailing the questionnaires to the respondents. The number of respondents that actively participated in completing the questionnaires was 41 respondents. The researcher was able to use the 41 responses to continue with the study, as the responses provided an adequate percentage to inform the study. Busetto *et al* (2020:6) suggest that a response rate of 50% or higher can be considered as excellent in most circumstances. The study was further supplemented with the follow-up interview data of 10 participants to reach the desired saturation level. As mentioned above, the research focused on librarians who are employed full-time in the DUT library regardless of their professional qualifications or level of occupation in their current position in the library. Table 4.2 describes the demographics collected through the online questionnaire distributed to all respondents who made up this research sample. The table displays the 41 respondents in a hierarchical list from the library director to the library assistants. The profile of the respondents in terms of their designations, work experience, and qualifications suggests that there is a good mix of librarians of both senior and junior ranks. To ensure anonymity for the respondents, no codes were assigned to the sample population in Table 4.2.

Table 4.2: Educational background and work experience of participants [N=41]

Respondent designation	Years of experience at DUT	Time in current position	Qualifications
Director	7 months	7 months	PhD in information science
Manager: Campus library & sites	15	3 months	Master's in information technology
Manager	23	18	Bachelor in information science
Librarian: Marketing & communication	6	2	Master's in information science
Librarian: Training and development	1 +	1 +	Honours in information science
Postgraduate librarian	24	24	Honours in information science
Librarian digital services	10	2	Postgraduate diploma: LIS
Librarian (x5)	Ranging between 5-13 years	Ranging between 5-13 years	Ranging between Bachelor in information science, honours in information science and master's in information science
Subject librarian (x7)	Ranging between 10-33 years	Ranging between 1-33 years	Ranging between postgraduate diploma: LIS, honours in information science, master's in information science and a PhD
Co-ordinator: IT & systems	33	33	Diploma: Information technology
Coordinator: Site	21	19	Honours in information science
Librarian: Circulation	12	12	Master's in information science
Assistant librarian (x4)	Ranging between 10-28 years	Ranging between 1-10 years	Bachelor in information science
IT technician (x2)	Ranging between 6-27 years	Ranging between 1-4 years	N\A
Admin assistant	8	5	N\A
Library assistant (x12)	Ranging between 2-27 years	Ranging between 1-27 years	Ranging between matric, national diploma: LIS, and bachelor in technology: LIS

The researcher followed the online questionnaire with individual interview session with 10 librarians employed at the DUT library to further augment the quantitative data.

Table 4.3 describes the list of participants in no particular order that participated in the individual interview sessions. Participants for the interviews were selected based on their willingness to participate and their expertise and experience in the relevant field. The participants' extensive knowledge and familiarity with the subject matter provided valuable insights to the research during the interview sessions. The interview questions were semi-structured in it allowed the researcher to explore further with clarity-seeking questions to explain the responses. To ensure anonymity for the participants, no codes were assigned to the interview participants in Table 4.3.

Table 4.3: Interview participants [N=10]

Participant designation	Years of experience at DUT	Time in current position	Qualifications
Subject librarian	33	18	Master's in information science
Postgraduate librarian	10	10	Master's in information science
Librarian	6	2	Master's in information science
Subject librarian	23	14	PhD in information science
Librarian	1	1	Honours in information science
Library assistant	28	28	Postgraduate diploma: LIS
Subject Librarian	10	1	Honours in information science
Librarian: After hours	11	2	Bachelor in information science
Manager	15	3 months	Master's in information technology
Subject librarian	13	10	Master's in information science

The interviews helped the researcher to obtain further information which was used to explain the quantitative data. Although permission was sought from DUT for the overall study, individual interview participants were also approached to request their consent for participation in the study. As revealed in the study, the participants had a wide range of qualifications from matric, bachelors, honours, master's to PhD, mostly in information science. In terms of work experience, it ranged from just under a year to over 30 years of experience. This suggests that the participants were relatively qualified in their current positions and had a number of years of professional experience and knowledge within the library discipline.

4.5 Data presentation

This segment presents the findings and the themes that emanated from the online questionnaire and individual interviews. Quantitative data were collected from the questionnaire, while qualitative data were collected from interviews. Qualitative data were analysed and presented thematically for ease of understanding. The quantitative data are described in figures and tables, and the qualitative data are described below the quantitative figures and tables. This study employed a thematic data analysis based on the following themes derived from the research objectives:

- The evolving roles and responsibilities of academic librarians
- Skills and competencies for academic librarians in the new role
- Effects of the 4IR on the roles of academic librarians in the changing information environment
- Utilisation of CPD to embrace the changing landscape of libraries
- Library infrastructure for 4IR
- A model to align librarian roles and skills with the 4IR.

Throughout this chapter, codes were used to represent the study participants.

The responses from the emailed online questionnaire respondents were recorded as:
R1 – R41: Respondent

The follow-up interviews were recorded as:

IP1– IP10: Interview participant

4.5.1 Evolving roles and responsibilities of academic librarians

The first objective of the study sought to analyse the data that supported the evolving roles and responsibilities of academic librarians. Data from the questionnaire are presented in charts and tables. Momoh and Folorunso (2019:2) argue that the roles and responsibilities of librarians have evolved due to the continual rapid changes in technology over the years. The primary objective was to assess the extent to which the roles and responsibilities of the academic librarians have transformed in response to the advent of disruptive technologies. Indeed, libraries have evolved from providing

traditional face-to-face information to users in the library to now providing them with online access to all information resources (Ahmat & Hanipah 2018:59). This sentiment is reflected in Figure 4.1, as the respondents believed that their roles and responsibilities have evolved within the library. Among the respondents, 29% (12) expressed the belief that technological advancements have influenced librarians' working methods. Additionally, 32% (13) agreed that librarians now engage in a greater amount of online work and have significantly increased their online interactions, compared to the previous year following the 4IR. Furthermore, 24% (10) of the respondents perceived that the changes in the technological evolution of the library had an impact on the services provided to users. The consensus was that the traditional ways of working have changed. The librarians noted that many changes occurred with the introduction of new technologies and systems. As Wong and Chan (2018:109) explain that the new technological changes challenge the traditional ways of librarians' work.

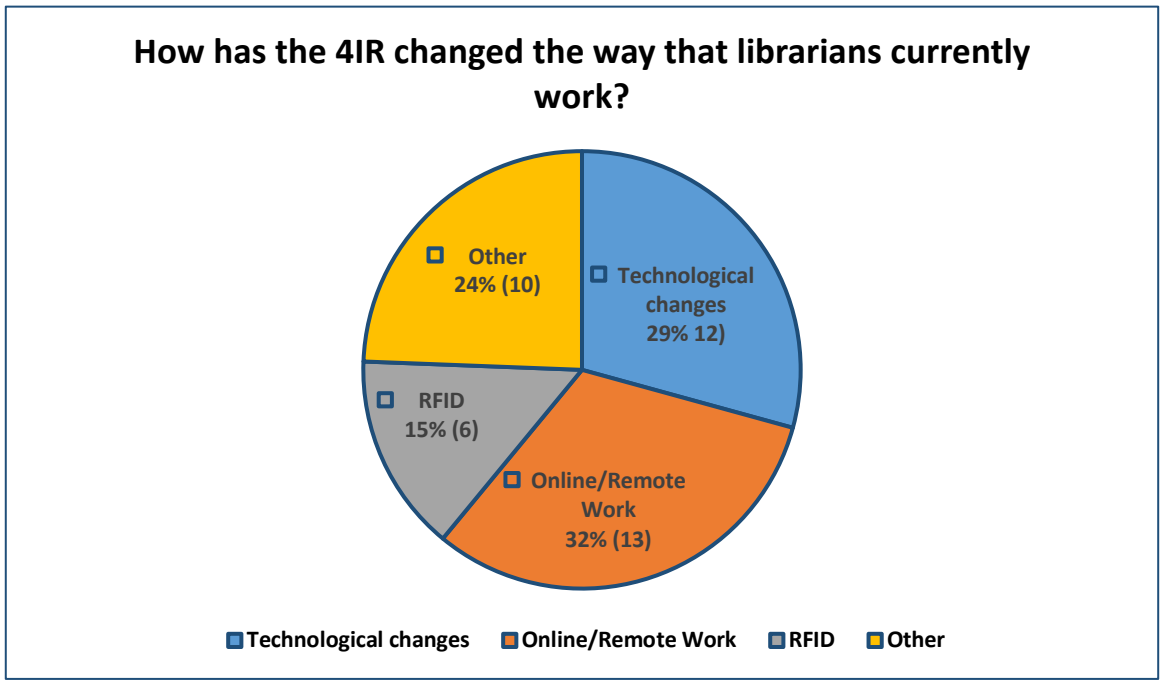

Figure 4.1: Changes in librarians work (N=41)

A follow-up was done through interviews for the reason of the changes of the roles and responsibilities and different responses were provided. In line with Fernandez's (2020:24) views on how the 4IR will affect the librarians' usual way of working, responses from the interviewed participants were as follows:

IP7 acknowledged that:

They (libraries) have changed immensely, even the outbreak of COVID-19 has shown that certain library activities do not need a librarian to be physically in the library. Many activities can be done virtually/online.

IP8 stated that:

The roles have evolved as every year; we experience less and less circulation of print material as users are drawn to online resources.

IP9 stated that:

The purchasing of less print resources impacted cataloguers and processing staff as they now have less print resources to work with. More cataloguing work is done online on the institutional repository and ebooks.

IP10 agreed that:

Definitely, the librarians' roles have changed from physically engaging with users to online interaction.

Ayinde and Kirkwood (2020:143) concur that the 4IR redefines jobs and brings about risks and opportunities with new skills development for librarians. Indeed, the 4IR changes the traditional ways of working. As Eberhard et al (2017:58) mention, various skills that are essential for adapting and adjusting to the changes the 4IR embodies, the participants acknowledged that they would require a new skills set to keep them relevant. The DUT librarians in their responses deliberated on a few of the skills sets that are required; that is, IT skills, problem-solving skills, creativity, and critical thinking skills. The following interviewed participants agreed that the 4IR brings about changes:

IP3 stated that:

Academic librarians will have to keep up with the new high-tech, changing spaces to accommodate the new ways of doing business.

IP4 explained that:

It will change how academic libraries offer their services and libraries will need to move from traditional way of doing things to the new ways which involves more of information technology.

IP5 stated that:

New skills will be required to library staff.

4.5.1.1 The impact of COVID-19 on academic librarians

The COVID-19 pandemic has further accentuated the transformations occurring within libraries. Some librarians specifically experienced a rapid pace of change within the DUT library due to the impact of COVID-19. As displayed in Figure 4.2, as librarians began working remotely, others sensed that new technologies caused the shift. A significant majority of 82% (34) of librarians acknowledged that the COVID-19 pandemic and subsequent government-imposed lockdown expedited the changes within the DUT library. On the other hand, a smaller proportion of 17% (7) expressed uncertainty regarding this matter. Kosciejew (2020:308) states that libraries played a huge role in providing relevant information on the pandemic by providing factual health information to users. Libraries had to increase their capacity and adjust to the changes caused by the pandemic, to ensure that information was virtually accessible. The librarians' responses in Figure 4.2 are in line with Kosciejew (2020:307) that the changes experienced due to the COVID-19 lockdown accelerated the 4IR and changes at the DUT library.

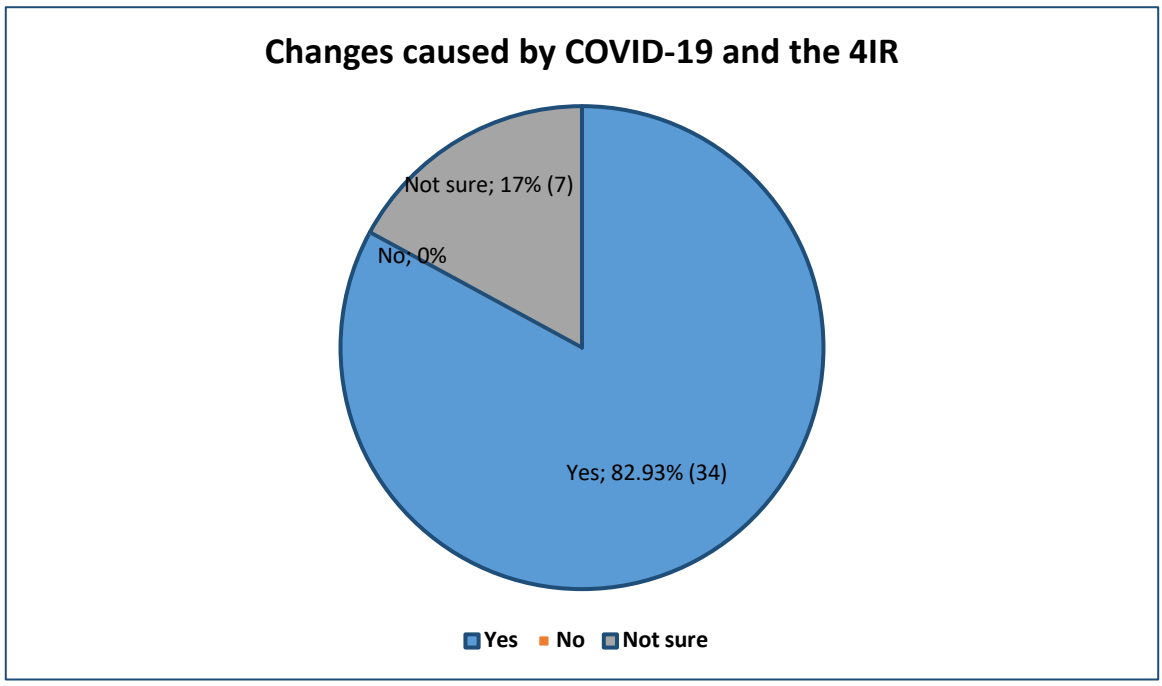

Figure 4.2: Changes caused by COVID-19 and the 4IR (N=41)

In an interview, several participants expressed their consensus on how COVID-19 and the forced lockdown taught librarians that remote work was possible with 4IR. These findings align with the perspectives of authors Connell, Wallis and Comeaux (2021:5) who argue that it was feasible to engage in remote work while still providing services to library users. The following are views expressed by the interviewed participants.

IP1 indicated that:

Librarians, specifically information services librarians have to adjust to working virtually using online tools to engage with library users to offer support for research, teaching and learning.

IP2 stated that:

We (librarians) were also surprised to find that we could work remotely and produce good results, if not better in some cases. With the availability of new, better, and faster technology, we are able to provide content effectively and timeously to the users.

IP9 explained that:

Greater use of technology, more e-resources, better searching tools, less face-to-face interaction. More online queries and IL classes.

The imposed lockdown accelerated the adoption and adjustment of librarians to new technologies. The participants agreed that the traditional ways of working in the library environment was changing in an attempt to meet user needs. Interviewee IP7 believed that the lockdown was the initiator to propel the DUT library into the 4IR. The participant stated that:

Yes, 4IR was indirectly introduced by COVID-19, the university had to shut down and quickly find ways in which staff and students' needs were met.
The university had to introduce multimodal teaching and learning to accommodate COVID-19 regulations.
Some staff members had to work at home or remotely and this had a great impact on staff and students because they had to learn how to work/study remotely using different online platforms.

4.5.1.2 Changes in the roles of librarians

When asked whether the traditional roles of working in the library had changed, as shown in Figure 4.3, 76% (31) of the respondents agreed that it had changed, while 17% (7) were not sure and 7% (3) believed that there were no changes in the way they worked. Librarians were helping more users virtually through online chats and the library LibChat platform. LibChat is a communication platform used in libraries to facilitate real-time interactions between library staff and library users. LibChat enables libraries to provide virtual reference services, offer support for research enquiries, and address general enquiries or concerns from users. It enhances the accessibility and convenience of library services by enabling users to connect with librarians remotely through instant messaging or live chat features (Goss & Decker 2022:423). There were fewer onsite, face-to-face interactions. Wong and Chan (2018:109) reiterate that the traditional roles of librarians as collection gatekeepers and information mediators are fast changing and have been replaced by devices connected to the internet searching.

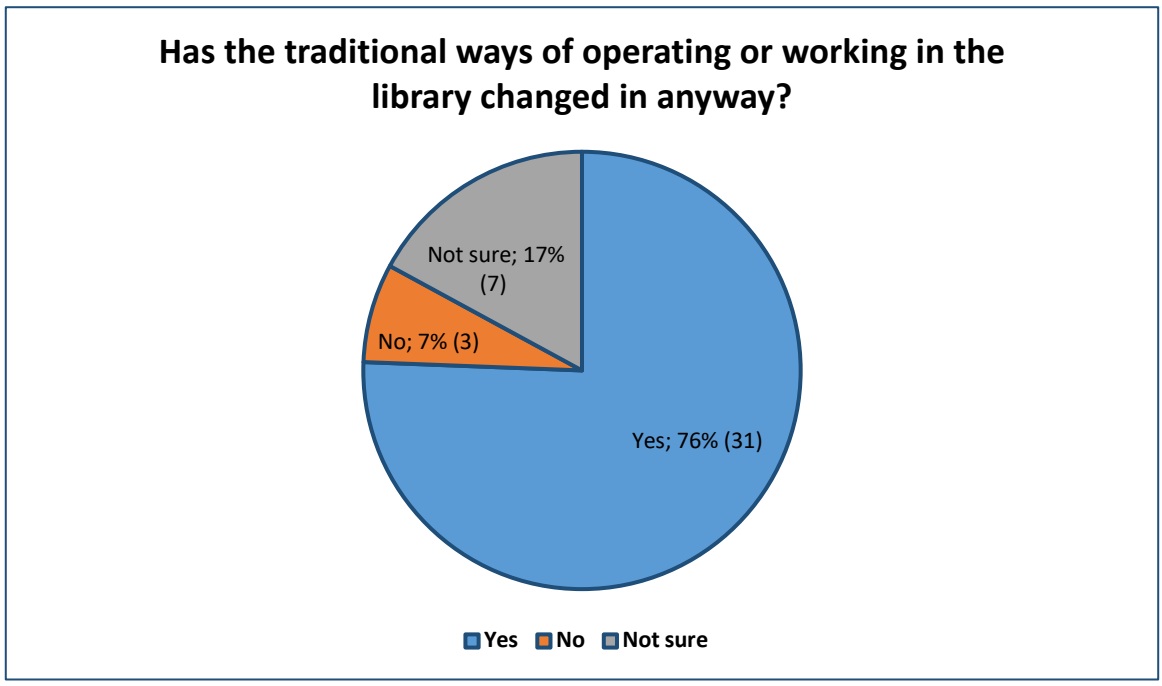

Figure 4.3: Changes in library functions (N=41)

The respondents alluded to the shift in the current librarian role and how technology impacted the way the job evolved. Wong and Chan (2018:110) believe that librarians need to be adaptive and proactive in responding to the challenges brought about by technological and environmental transformation. Information obtained from the interviews emphasised the need for librarians to be relevant.

Participant IP10 summarised the shift by responding that:

> *Academic libraries will have to move with the trend of 4IR and implement services that can be available online and be accessible anywhere in the world without one physically having to walk in the library to get resources.*

The DUT academic librarians experienced a shift in their role within the institution, becoming actively involved in the teaching and learning activities at the university. This observation aligns with the perspectives put forth by Otike and Barát (2021:19) that academic librarians are now required to support teaching and learning initiatives within the institution. The librarians were now working closely with the relevant faculties to collaborate and engage on finding better ways of reaching out to users. The research unit worked closely with the library to engage in furthering the research activities at the university. The librarians, in alignment with Tenopir et al (2014:85), were

undergoing a transformation in their roles, which encompassed actively promoting open access research and in engaging with the researchers to educate them about the advantages of research data and the importance of proper data storage for future use. As the following interview participants revealed when discussing the changes experienced in the way that the library evolved:

> IP1 revealed that:
> *The library was on track with engaging and collaborating with all the departments regarding research data and the importance of sharing and exchanging of knowledge amongst the researchers.*
>
> IP2 explained that:
> *Big data needs to be explored further.*
> *The research data management (RDM) is an initiative that the library set up to collaborate with researchers.*
>
> IP3 indicated that:
> *Although we were previously focused on providing collections, now we need to collect data and find out what our users need.*
>
> IP10 reaffirmed that:
> *We need to engage with our researchers and research community to encourage them to share their data and research findings.*

4.5.1.3 Remote/virtual services

The influence of the technological changes allows the librarians to provide services remotely to the users. According to Balashova and Gromova (2018:4), the 4IR endorses many of the transformations that impacted on the world and economy. This revolution allowed the various disciplines to transform and improve the performance of librarians in their functions to provide a better and faster service to users. The responses from the librarians on whether the DUT librarians could provide a successful service to their users are captured in Figure 4.4. The responses indicate that 51% (21) of the librarians believed that they could provide a successful service to

their users remotely, while 39% (16) were not convinced and believed that the face-to-face interactions with users were more effective than remote interaction. As noted by the librarians' responses, they were pleased that with new innovations, they could work and successfully deliver a service to their users from virtually anywhere. They were no longer confined to work in university offices. With changes in libraries and access to information, it is no longer necessary for the librarian to be confined to an office space. Access to information and servicing the users can be provided from any space electronically (Kumari 2015:487). DUT librarians have attempted to adhere to online instruction despite many challenges. The idea of engaging in face-to-face interaction affected the way in which DUT librarians used to try to interact with and help their users. Many DUT users are from disadvantaged backgrounds and even when librarians accessed the relevant information for the users, there were connectivity challenges for the users in retrieving the information. Ten per cent (4) of the participants were uncertain as to whether virtual services would benefit users.

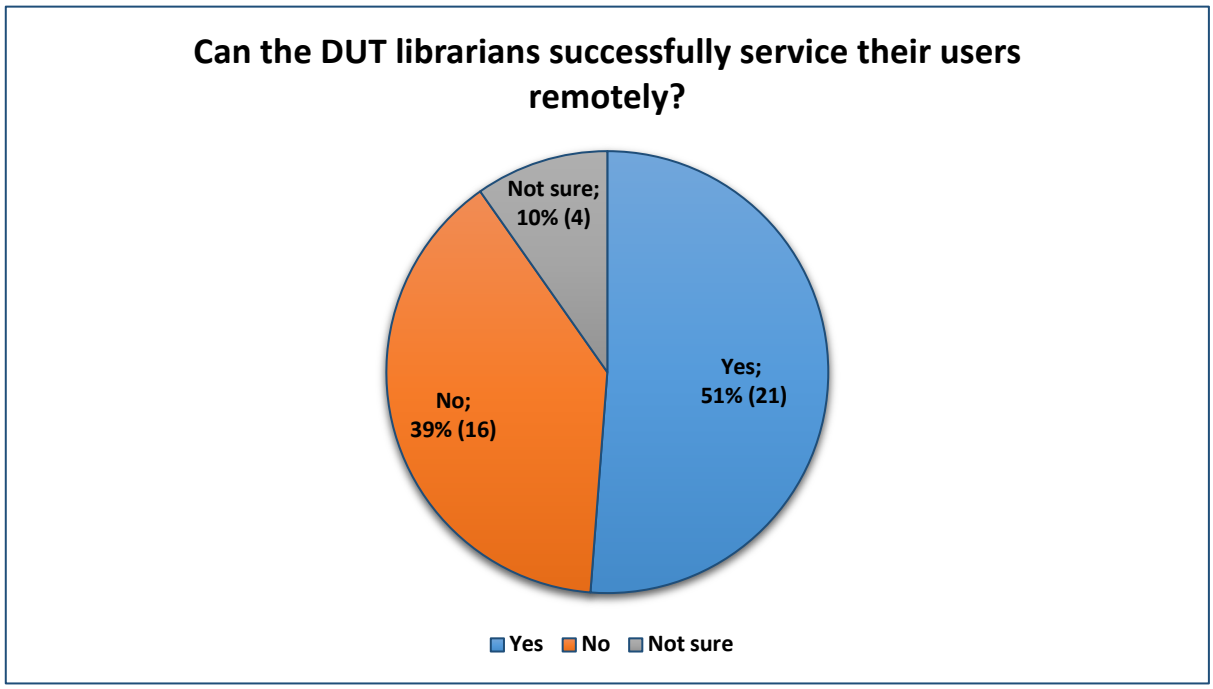

Figure 4.4: Responses on working remotely (N=41)

Concerns were raised regarding the users and how some of them struggled to get used to online interactions. Nyahodza and Higgs (2017:40) express concerns over students from disadvantaged communities and the lack of internet access.

Concerns raised by IP4:

Slow adoption or lack of understanding amongst our users as they are not familiar with these new changes and technology and the lack of data bundles created challenges.

IP9 stated that:
It's very difficult on the part of the user, since we not as equipped like other countries with much access to computers, laptops, data etc. Although librarians are forced to use 4IR, the impact is not as good as face-to-face with their users.

The other concern raised related to how paperback copies of books can be made available to remote users, although one cited document delivery services as an option. However, such arrangements require librarians to be physically in the office.

The responses provided on the impact of new innovations and the 4IR on their roles validate the stance of Balashova and Gromova (2018:4) on the transformative potential of the 4IR in an industry that has conventionally been perceived as conservative in adopting digital technology. As articulated by the participants below, there has been a significant transformation in libraries and the roles of librarians due to technological innovations.

IP3 explained that:
Librarians felt that they could *now help students online, which was not possible before. 4IR and new innovations has improved the technological side of the library.*

IP6 stated that:
4IR is a group of latest technologies shaping the world of work, impacting on the production, business processes and manufacturing of good and services. It affects all sectors of the economy. As such, libraries are no exception to the 4IR technological revolution.

IP10 expressed that:

Librarians are able to provide information or assisting the library users anywhere in the world, this has eliminated the physical boundaries. There is less reliance on physical infrastructure, enhanced discoverability of collections.

Participant IP4 stated that the one advantage of *technology is that now more students can be trained online* as more users can be reached online, whereas in face-to-face interactions, space is limited. As Hussain (2020:4) mentions, the 4IR will enhance the library environment providing librarians with alternate ways of working. The various responses from the librarians confirm how the 4IR changed the way that they work and interact with their users. The implementation of various new technologies allowed librarians to work remotely and still interact with users. This is similar to Connell et al's (2021:17) finding that the closure of the libraries did not discourage the librarian-user interaction, as users continued to seek help from the librarians.

4.5.2 Skills and competencies for academic librarians in the evolving role

The study's second objective was to recognise the skills and competencies necessary for academic librarians to comprehend and adapt to the influence of innovation and technologies. This objective intended to determine the type of skills that academic librarians should possess to navigate the 4IR and its innovations competently. The respondents concurred with Pfeiffer (2015:6-7) regarding the significance of regularly updating skills and competencies for librarians, enabling them to effectively adapt to environmental changes.

As reflected in Figure 4.5, a total of 56% (23) of the respondents expressed the view that IT skills are essential for academic librarians. Furthermore, 15% (6) of the respondents identified basic computer and search skills as crucial, while 19% (8) listed communication skills, and 10% (4) emphasised the importance of advanced programming skills as important competencies for achieving proficiency in their work.

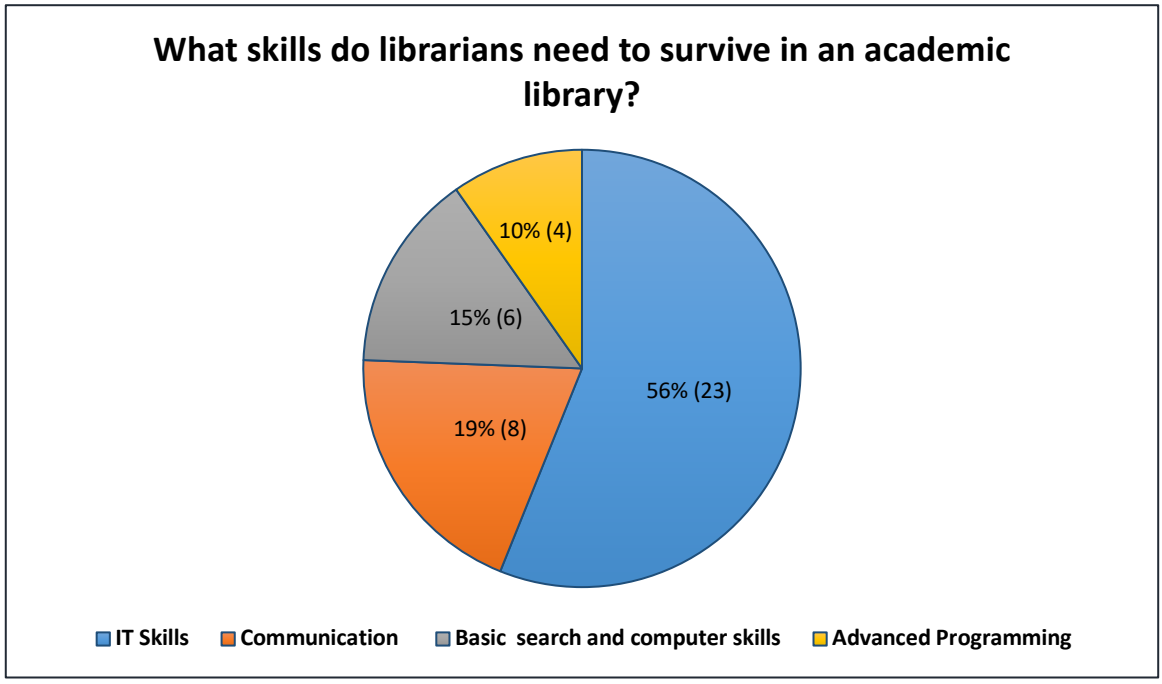

Figure 4.5: Academic librarian skills (N=41)

The interviewed participants agreed that librarians need to continuously expand their skills and knowledge competency and that it is important for librarians to be familiar with basic IT skills.

For example, Participant IP4 stated that:

> *Staff have no choice but to change with changes within the library and find new ways of doing things. We need to learn new ways to better skill ourselves to continue to serve our users.*

Another participant, IP3, stated that:

> *Software skills are essential in the everyday life of librarians. We also play an important role in educating our users on how to use various software for better services.*

When asked about the new skills required due to changes in their library, the responses from DUT librarians were diverse. Some respondents mentioned the need to acquire additional skills to effectively carry out their duties, while two respondents did not provide a direct response to the question, as depicted in Figure 4.6. Figure 4.6 illustrates the adaptation of the DUT library to a new library management system

(LMS) and a discovery layer, which consequently led to the acquisition of new skills by the librarians. In Figure 4.6 in can be observed that 36% (15) of the responses highlighted the necessity for librarians to acquire proficiency in searching and working on the two newly introduced platforms within the library. Furthermore, 32% (13) of the respondents reported the requirement to learn various IT-related skills. This finding is consistent with the perspective of Ayinde and Kirkwood (2020:144), which emphasises the librarian's role in coordinating and implementing new technologies within libraries. Additionally, respondents indicated the need to acquire research skills, accounting for 5% (2) of the responses, while 7% (3) of the respondents emphasised the importance of developing digital skills. These results demonstrate that librarians had to acquire a wide range of new skills to effectively assist users and researchers in their respective endeavours.

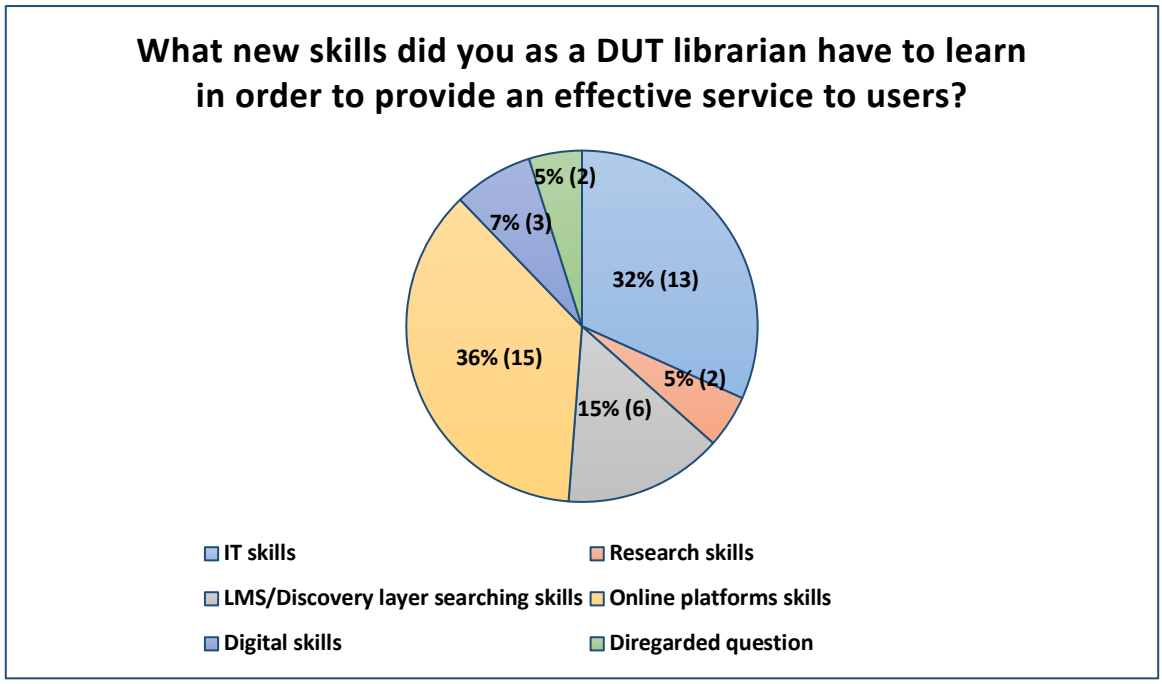

Figure 4.6: New skills required as DUT librarians (N =41)

4.5.2.1 Information technology skills

The acquisition of IT skills enables librarians to effectively utilise and navigate the new technologies introduced in the library. These skills could include proficiency in using software applications, managing databases, troubleshooting technical issues, understanding network infrastructure, and staying updated with emerging trends in the IT field (Shilenge & Telukdarie 2021:459). By developing these IT skills, librarians can

enhance their ability to support library users and researchers in accessing and using digital resources effectively. Almost all respondents, approximately 99% (40) acknowledged the importance of IT skills as a vital tool for survival in academic libraries, with only 1% (1) expressing uncertainty. This aligns with the viewpoint expressed by Balashova and Gromova (2018:1) that IT will actively contribute to the transformation of businesses during the 4IR era.

In support of this notion, Shilenge and Telukdarie (2021:459) concur that IT skills are indispensable for navigating the challenges of the 4IR era, emphasising the importance of synergy between operational technology and IT skills for optimal practices and a productive work environment. Figure 4.7 visually represents the percentage of librarians who affirmed the essentiality of being knowledgeable about current software and information packages. This finding resonates with the claim made by Oladokun and Mooko (2022:13) that it is imperative for librarians to possess familiarity and expertise in new software and systems relevant to their roles. Overall, the overwhelming consensus among the respondents reinforces the critical role of IT skills in academic libraries, acknowledging the need for librarians to stay informed and adept in order to effectively meet the demands of the evolving technological landscape.

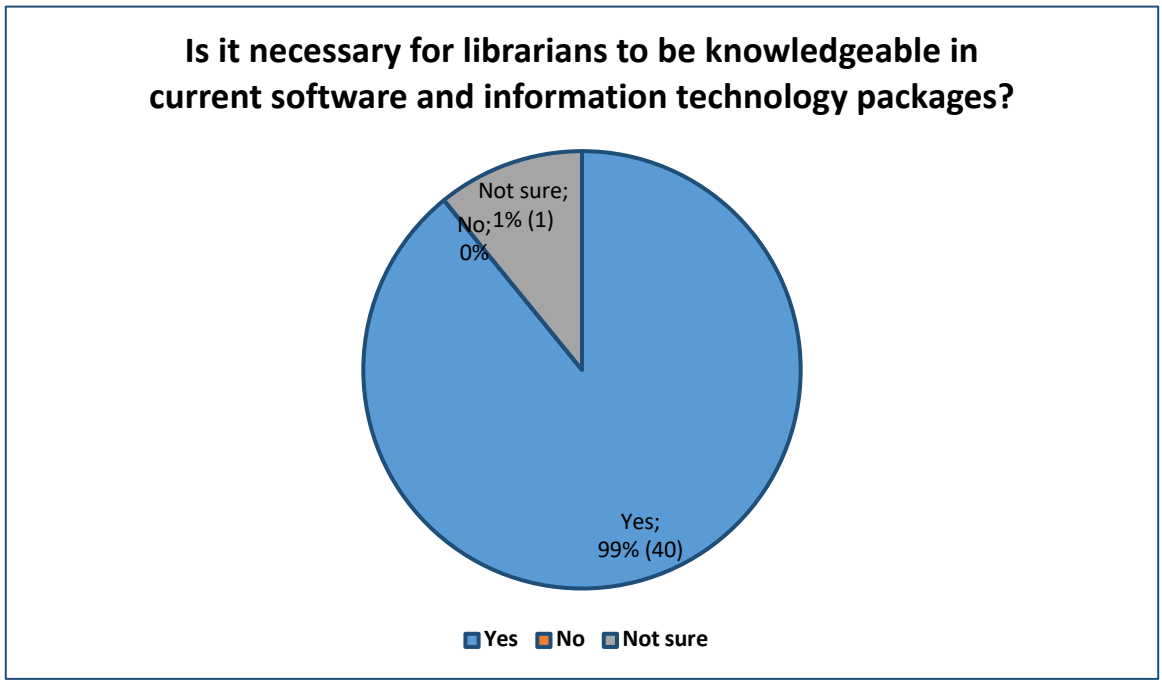

Figure 4.7: Software and Information technology packages (N =41)

Several participants emphasised the importance of IT-related skills. This is in agreement with Balashova and Gromova (2018:1) that technology is important in shaping future work. In the evolving landscape of libraries, characterised by digital transformations, librarians must cultivate technical skills, including software development, coding, and database management, to stay abreast of current trends. This shift towards digitisation necessitates that librarians acquire these technical abilities to effectively adapt to and harness the potential of emerging technologies within library settings. By developing these skills, librarians can play an essential role in facilitating seamless integration of digital resources and services, ultimately improving the library's ability to meet the evolving needs of its users in an increasingly digital world.

Participant IP1, for example, indicated that:

> *It was imperative for librarians to have strong IT skills and familiarity with the use of databases and the internet.*

Participant IP3 explained that:

> *Information technology skills have become a prerequisite for academic librarianship* and that it was necessary to have a knowledge of *computer skills in order to keep up with the ever-changing technologies. Thinking skills in order to be open-minded enough to accept that things change in a rapid manner and be able to communicate with others.*

In the past, technology skills were separated from market-related skills such as librarianship. However, according to Lee et al (2018:5), these separations have disappeared, as technologies and various disciplines are now combining rapidly in unexpected ways. These combinations in information technology are prompted by various innovations and connectivity with various disciplines.

Participant IP9 stated that:

> *Softwares are developed to make services better and often get outdated, and new versions are leased so often and the old softwares become not compatible*

with the new devices. Librarians are the once who need to suggest new systems that needs to be acquired and used.

In addition to the widespread agreement among participants regarding the importance of IT skills for all librarians, Table 4.4 presents a compilation of responses from the open-ended questions in the online questionnaire, shedding light on the diverse range of IT-related skills that DUT librarians need to possess. The responses captured in Table 4.4 encompass a broad spectrum of skills, including basic internet skills and effective search techniques. Furthermore, they extend to encompass abilities such as navigating and utilising online teaching platforms and as well as knowledge of advanced programming languages and other IT-related computer languages. Table 4.4 showcases the diverse and extensive set of IT skills that is crucial for DUT librarians to retain in order to meet the demands of their evolving roles in the digital age.

Table 4.4: Responses on technology skills for librarians (N =41)

Respondents	Responses
Internet and IT skills	
R1	*Strong IT skills and familiarity with the use of databases and the internet.*
R2	*Necessary to have internet and information technology.*
R4	*Possess IT and information retrieval skills.*
R6	*Librarians require a wide range of skills – both technical, professional and soft skills.*
R10	*IT skills and continuous training to be on par with all IT-related skills.*
Advanced technical skills	
R3	*Understanding and knowledge of makerspaces, block chain technology, augmented reality, cloud computing, and artificial intelligence.*
R5	*Skills pertaining learning management systems, remote service offering, New Library ERP skills (e.g. FOLIO), data-driven decision-making etc.*

	Cloud-based technologies, artificial intelligence, internet of things, system integration skills, APIs, big data, open-source, open science.
R8	*Librarians need to know Python, machine learning, deep learning, R for data analysis. How to use the online technologies available to support teaching, learning and research. Investigate ways to move library services to the cloud to make available off-site / online library services.*
Online and Digital searching skills	
R16	*Conducting classes online using Moodle for assessment.*
R20	*Computer skills and skills on how to use the different databases to access the information to provide for the users.*
R23	*Online teaching and learning skills, use of various software to assist users online (LibApp to create guides, chat with users, etc.), use of various platforms to assist with teaching, assessments.*
R28	*Software skills (dependant on the job and responsibilities), navigating online environment, utilising Ms Teams, Zoom features, digital literacy, online training, managing teams online and creating portfolio of evidence. Quality checks on systems and procedures for smooth operation of Moodle, Blackboard, Teams for teaching.*
R31	*Digital skills critical thinking skills cognitive skills social skills for the digital environment social ethics for the digital environment Information skills.*
R35	*Computer skills and navigation on the online worlds and to understand how things work.*
R41	*Computer skills in order to keep up with the ever-changing technologies.*

4.5.2.2 Communication

The library environment operates as an interconnected system where collaboration and constant communication among various sections and individuals are vital. This aspect of interconnectedness and teamwork was emphasised by many respondents in the study, aligning with the perspective presented by Mohideen et al (2022:522) that communication is an essential skill in any profession. The respondents expressed a shared belief in the importance of having strong communication skills. Table 4.5 presents a collection of open-ended responses from the online questionnaire, shedding light on their viewpoints regarding the importance of communication within academic libraries and within the DUT library community. The responses captured in

Table 4.5 provide insight into the reasons why effective communication skills are considered fundamental for librarians.

Table 4.5: Responses on communication skills (N =41)

Respondents	Responses
R1	*The ability to work in a team. Good communication skills and the ability to work with people from a range of backgrounds and with a range of needs.*
R7	*Collaborating with others is important, as our jobs are interrelated.*
R8	*Co-ordinating with others - people with different skills working together to offer the better/best service.*
R20	*Agreed that communication skills were necessary.*
R24	*Online interactions with patrons.*
R33	*Digital skills, social skills for an online environment when engaging with the DUT community, e.g. through platforms such as Moodle and MS Teams Social Ethics, e.g. email awareness of information skills and legal implications for the digital environment.*

The librarians' responses align with the conclusions drawn by Eberhard et al (2017:52), highlighting the importance of communication as a crucial skill in the context of the 4IR. Librarians are employing interactive learning methods to effectively communicate with users and academics within the institution. They must possess strong online and in-person communication abilities to effectively promote library services and interact with users.

For example, Participant IP2 stated that:

> *Good communication skills is essential for librarians to be able to identify user's needs, discuss their issues and be able to assist with the challenges they face in retrieving information.*

According to Mohideen et al (2022:522), it is crucial for librarians to possess effective communication skills to meet user needs, whether in oral, written or online formats. In the context of the 4IR, communication has become more convenient, with technological advancements eliminating previous obstacles that impeded the flow of

communication. Artificial intelligence, high-speed internet, and cloud technology have significantly accelerated communication, enabling librarians to reach users through their smartphones and mobile devices. The librarians at DUT library are aware of these advancements and actively engage with users through various communication channels at their disposal.

4.5.2.3 Critical thinking skills

Critical thinking skills are essential for librarians, as they engage in a wide range of tasks and responsibilities within their profession. The emergence of new technological innovations brought about a significant transformation in the role of academic librarians, leading to a drastic change in their interactions with users. According to Shupe and Pung (2011:409), this shift in interaction can be attributed to technological advancements. Librarians must critically evaluate the quality, relevance, and reliability of information sources. Critical thinking skills are required when librarians need to evaluate the quality, relevance, and authority of the library's collection development and the needs of the users. Librarians are now required to have critical thinking skills and an adaptable mindset to embrace the impact of these changes on libraries and to be able to evaluate new technologies, understand their implications, and make informed decisions about their adoption and integration. In accordance with the skills requirements as mentioned, Eberhard et al (2017:54) also emphasise the importance of critical thinking, problem solving, and cognitive skills as crucial attributes for individuals in 4IR. In response to the question on the necessary skills for the 4IR, many of the respondents highlighted the indispensability of critical thinking skills for librarians. These viewpoints are supported by Ayinde and Kirkwood (2020:148), who assert that critical thinking skills are highly sought after in libraries that are continually evolving. Table 4.6 presents selected responses to the online questionnaires, further strengthening the understanding that critical thinking skills are essential in the evolving technological environment.

Table 4.6: Responses on critical thinking skills (N =41)

Respondents	Responses
R1	*Creativity coordinating with others decision making people management.* *Thinking skills in order to be open-minded enough to accept that things change at a rapid manner.*
R2	*Critical thinking, service orientation, creativity, people management, listening.*
R6	*Being creative, collaborating, critical thinking, keeping up to date with technology.*
R8	*Complex problems solving, coordinating with others – people with different skills working together to offer the better/best service.*
R9	*Problem-solving skills.*
R14	*Critical thinking and communication skills.*
R20	*Complex problem-solving skills.*
R26	*Critical thinking skills.*
R28	*Emotional intelligent, shrewd judgement or decision-making, knowledge management, active learning, analytical thinking, problem solving skills, innovation, creativity.*
R30	*Critical thinking active listening complex problem solving.*
R39	*Complex problem-solving skills.*

4.5.2.4 Flexibility of librarians to adapt to changes

Librarians need to demonstrate a willingness to promptly embrace change and possess a flexible mindset in their thinking and work approach. Lee et al (2018:11) emphasise the significance of flexibility in effectively embracing the 4IR and responding to its dynamic shifts. Several respondents echoed this sentiment, acknowledging that the ability to adapt to changes is a valuable skill that contributes to providing successful services to users. The importance of adaptability and flexibility in the evolving landscape of the 4IR is underscored by Eberhard et al (2017:54). These skills are essential to facilitate a wide range of activities within the library environment. Figure 4.8 provides insights into the librarians' ability to adapt to changes at the DUT library. Among the respondents, 70% (28) expressed a positive outlook towards adapting to changes, while 20% (8) were unsure and nervous. Additionally, 10% (5) chose not to respond to the question.

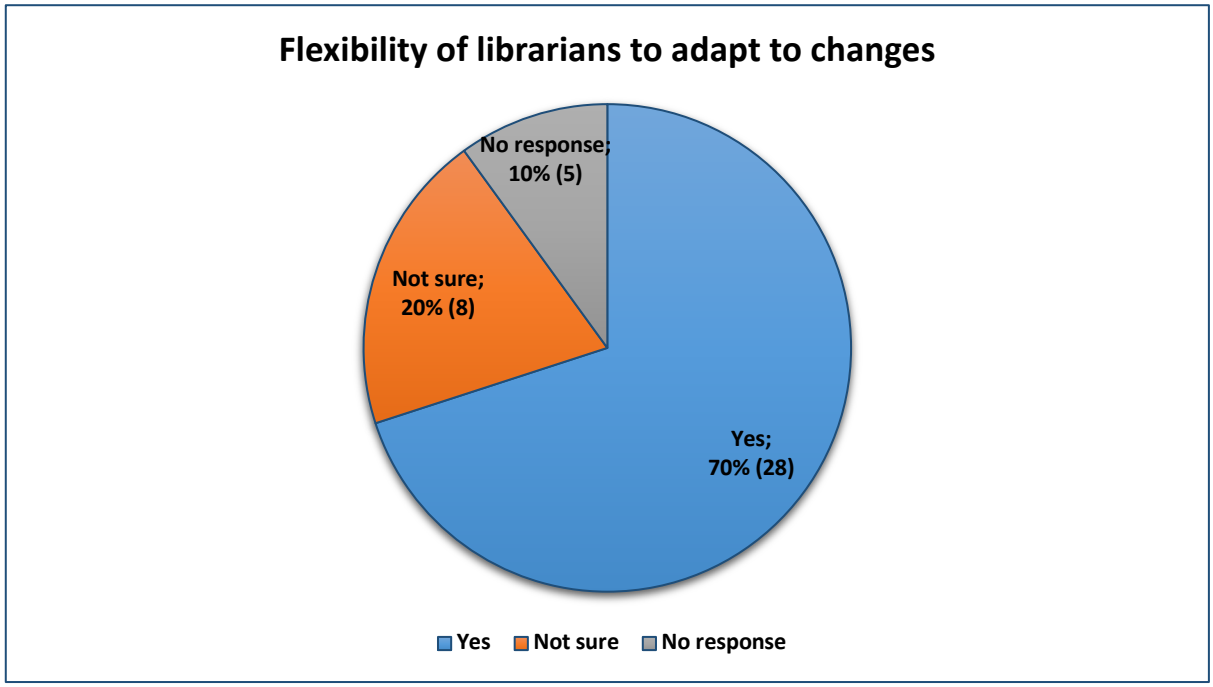

Figure 4.8: Flexibility of librarians to adapt to changes (N=41)

While the participants interviewed acknowledged the necessity for librarians to exhibit adaptability and resilience in the face of workplace changes, there were individuals who shared their personal sentiments regarding change.

Participant IP8 explained that:

> *Most of us are intimidated by the changes and cannot adapt to them, as we fear that our services will be outdated and redundant.*

Participant IP4 shared their experience of acquiring and mastering new working methods to effectively reach and engage with users.

> *I had to attend workshops on how to use Ms Teams, Moodle and other learning platforms*.

Whilst another participant, IP9, attempted to explain why it is important for librarians to adapt to the changes:

> *To avoid being obsolete and feeling unwanted in the library sector and also to be able to adapt will mean that there is still a place for us in the library.*

4.5.3 Effects of the 4IR on the roles of academic librarians in the changing information environment

The third objective of the study was to establish the effects of the 4IR on the roles of academic librarians in the changing information environment. As Ahmat and Hanipah (2018:57) indicate, people are mostly set in their ways and their behaviour does not change easily. Changes in people occur over a period of time through a continuous process of time. Ahmat and Hanipah (2018:57) believe that it takes two years or more to change an individual's behaviour and mindset to embrace new ways of working. The responses to the open-ended question on the online questionnaire on the librarians accepting change gracefully were not all similar. Below are the varying responses captured on the online questionnaire.

Respondent R40 indicated:

> *Not all librarians are willing to change their "set" ways. Staff in general are resistance to change.*
>
> *In order for a positive change to occur, the need for change must be fully explained. There is a need to see what kind of change is needed and believe that it is achievable. They must have the ability and confidence to achieve it and must be involved throughout the change process in the workplace.*

Respondent R41,succinctly described the way most of the library staff feel with all the changes that the library and librarians are undergoing.

> *There are mixed responses. Some librarians adapt easily and embrace the changing technologies whilst some are concerned, as it will negatively affect their jobs.*

Another response from R29 on the effect of the 4IR on the librarian was that:

> *As much as most of the tasks are done by machines, human intervention will always be there.*

When questioned about what skills were required for 4IR intervention, the responses captured in Figure 4.9 highlights common themes such as critical thinking skills, IT skills and management skills. IT skills were prioritised with the highest percentage,

accounting for 39% (16) of the responses. The second highest response, at 32% (13) pertained to the knowledge of emerging technology such as AI, robotics, IoT and Blockchain. Mohideen et al (2022:522) affirm that critical thinking skills play a vital role in the 4IR, contributing to skills development, mindset cultivation, information creation, and overcoming challenges posed by disruptive technologies. Out of the 41 respondents, 19% (8) recognised the significance of critical thinking skills in the context of 4IR. Additionally, 10% (4) of the respondents emphasised the importance of management in the 4IR environment.

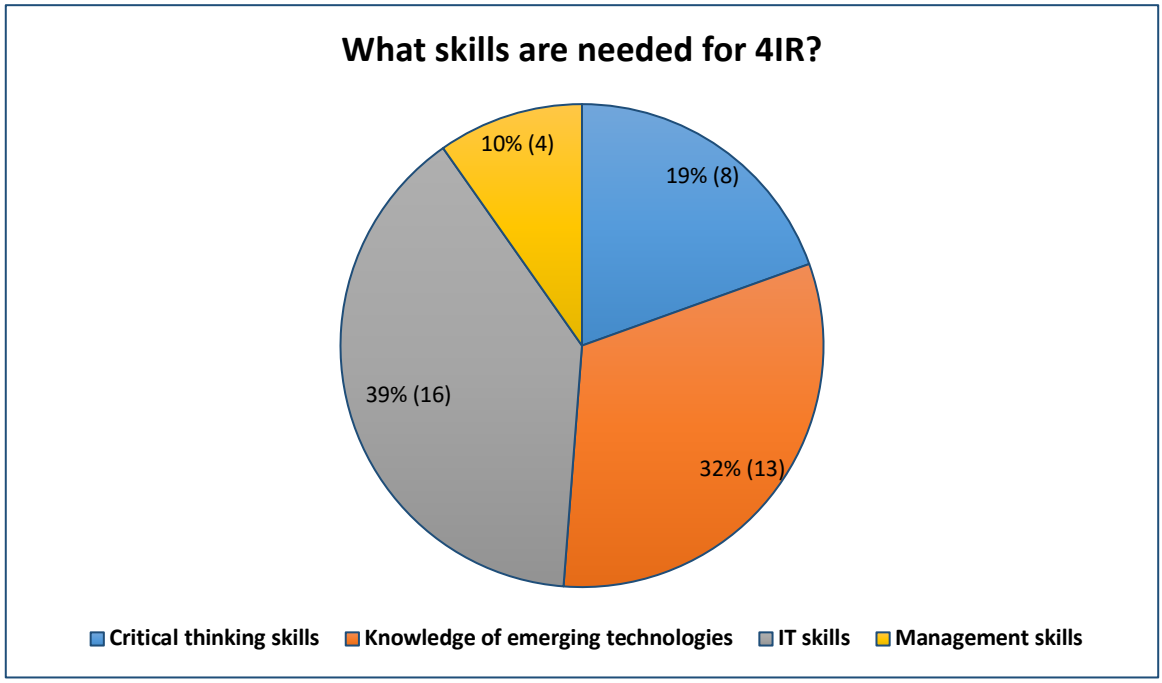

Figure 4.9: 4IR Skills (N =41)

4.5.3.1 Influence of 4IR on librarians' current job

All respondents (41) unanimously agreed that the introduction of new technological advancements and the 4IR had a significant impact on the way librarians worked in the library. In order to adapt to these librarians had to adapt the way they interact and engage with users. The traditional methods of user interaction underwent a transformation following the implementation of RFID technology. With the availability of self-checkout library resources and renewal of resources on their own using self-checkout stations, library users became less dependent on the assistance of circulation staff, as they could now independently check out and renew library resources. Pfeiffer (2015:13-14) highlights the influential role of technology in driving

changes in the workplace and, when effectively integrated into the environment as a "blended workforce," it can contribute to improving both work and personal life. The outcomes of the open-ended online questions, as reflected in Table 4.7, reveal that the DUT library experienced numerous transformations as a result of the impact of the 4IR.

Table 4.7: Changes at the DUT library (N =41)

Respondents	Responses
R1	*Technological changes and the use of electronically stored and retrieval information systems have changed the way students and researchers are able to access, retrieve, and use information, and this has decreased face-to-face interaction with librarians.*
R5	*This is in the area of stock-taking where the recent implementation of RFID technology allows self-service, self-check in and shelf-check out of library items. This effectively means that job profiles of the positions involved should be redesigned and repurposed to stay relevant with the latest technological developments and new service expectations.*
R6	*Increased awareness and adoption of technology, automation and IoT. Greater emphasis on the IT dept.*
R8	*Librarians, specifically information services librarians have to adjust to working virtually using online tools to engage with library users to offer support for research, teaching and learning.*
R13	*Will see less print books and replace them with high speed of connection of internet and lots of computers.*
R17	*Academic librarians now engage with students and staff on digital world, e.g. MS Team, Skype.*
R23	*Librarians were able to work remotely which was never thought possible.*
R28	*The introduction of mobile services, remote access, and more electronic resources than print material. Circulation of material is also hugely affected with the introduction of self-check in (RFID) and online referrals and consultations.*
R34	*Less work and less engaging with students.*
R35	*In my view, all academic libraries are currently looking for and changing ways of offering services to our users. For example, students use their smart phones for almost everything, so we are looking at how, for*

	example, students can print using their smart phones, use their smart phones as OPACS to search the, and so on. Creating QR codes for different online services.
R37	*Enhancement of services.*
R40	*Librarians work online, using online teaching and learning platforms, such as Moodle and Blackboard. Librarians use Microsoft Teams and Zoom for meetings and lectures. Books and journals are easily accessible online and has become a preferred method of searching and for use.*
R41	*Totally, librarians now work smarter and quicker.*

4.5.3.2 Remote working

One of the most profound impacts of the 4IR on librarians is on the way they work. Working remotely for librarians means that they are able to carry out library-related tasks and responsibilities outside the physical library grounds. Remote work offers librarians the flexibility to work from home or a different location, allowing them to balance their professional and personal lives effectively (Mpofu & Nicolaides 2019:17). The expectation for librarians to be physically present and in front of users when providing help and guidance has evolved. The implementation of new innovations and the technologically digital landscape within the DUT library enabled the continuity of library services during lockdown, providing librarians with the necessary tools to assist users remotely. According to Dube (2022:149), the 4IR facilitated the successful transition to remote work for academic institutions and librarians during the pandemic. The availability of digital resources online and the utilisation of various online communication tools provided by academic institutions enabled librarians to deliver a satisfactory level of service to users. Numerous online applications supported librarians in their remote work efforts. Approximately 70% (28) of the librarians expressed contentment with providing remote services to users remotely, while 10% (5) preferred face-to-face interactions. Moreover, 20% (8) of the librarians expressed their satisfaction with the ability to remotely access the library catalogue and continue with acquisitions, receiving and cataloguing processes. The responses indicated a decrease in face-to-face interactions, with more users opting for online chat communications when seeking assistance. The implementation of the new library system called FOLIO (Future of Libraries is Open) facilitated easier access for

librarians and enabled them to continue to work remotely with ease. Figure 4.10 illustrates the responses received from the librarians.

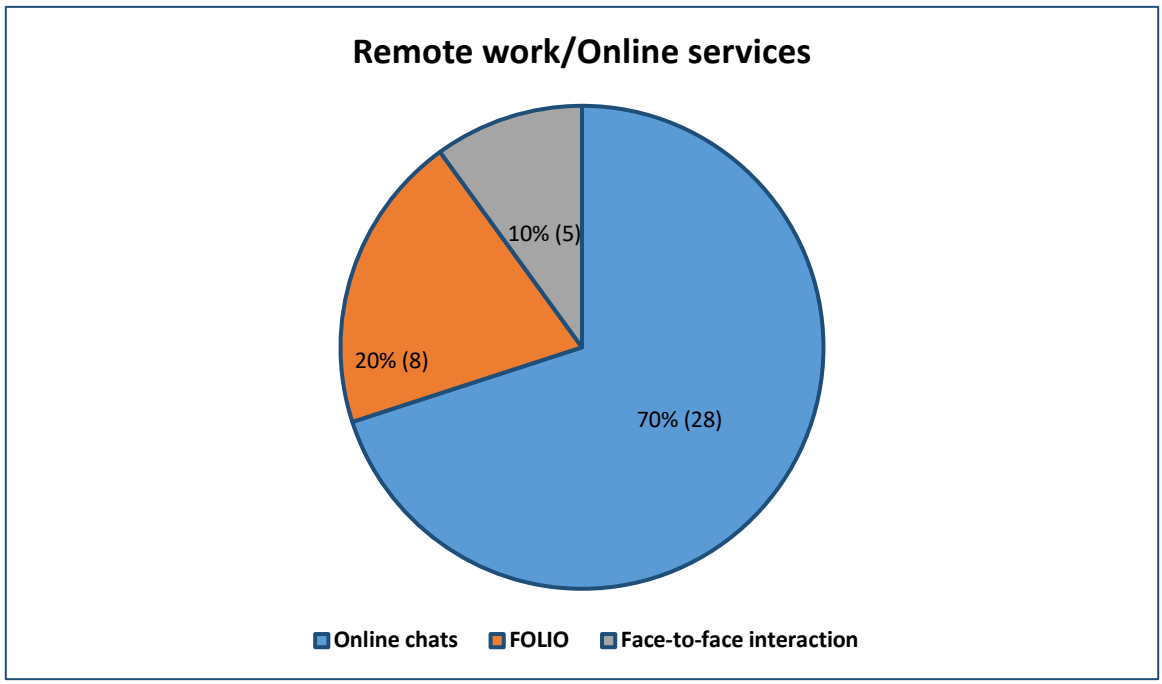

Figure 4.10: Remote work/online services (N =41)

Two respondents provided detailed explanations regarding the range of online services that the DUT library offers, which are captured in Table 4.8.

Table 4.8: Remote work/online services responses (N =41)

Respondents	Responses
R23	*Academic librarians were able to continue with teaching and learning as well as supporting students online with their queries. Resources, assistance and links were made available via LibApps*
R33	*An interactive chat facility to engage with DUT community that supports teaching, learning and research. VIDEOCONFERENCING - Meetings such as faculty boards, library meetings, workshops, and student reference queries are facilitated through digital spaces such as MS Teams. Subject librarians also teach on these types of platforms. E-RESOURCES - Although the library finances are limited, there has been a drive to adapt a larger electronic collection of resources. Again this became more transparent during the pandemic. LIBGUIDES - Subject librarians use these to contextualise the*

	service and resources offered to students. This contains resources for specific departments.

Some interview participants supported the idea for librarians to work remotely. For example, Participant IP1 posed a question that, "*If librarians can work remotely, why not offer a hybrid system for librarians?"* Participant IP10 added that, "*With the types of services that the DUT library provides, including online services, librarians are able to provide services from anywhere and don't have to be restricted to a building."*

4.5.3.3 Service delivery

The delivery of services in libraries encompasses the range of services and resources provided to library users to meet their information needs and improve their overall library experience. Effective service delivery in libraries requires a customer-focused approach, responsiveness to user needs, continuous evaluation and improvement of services and embracing new technologies to improve access and convenience (Shonhe 2020:2). The introduction of various technological innovations significantly enhanced library service delivery, as acknowledged by the respondents. A notable improvement was the establishment of online chat groups, which facilitated direct communication and engagement between users and librarians whenever assistance was required. This interactive platform proved to be valuable in addressing user queries and providing timely support to users. Table 4.9 documents some of the responses regarding the positive impact of these enhanced library services.

Table 4.9: Responses on service delivery in the library (N =41)

Respondents	Responses
R2	*LibChats where students are enquiring subject librarians for online help. Users are encouraged to do their searches online.*
R3	*IT has positively affected the library services.*
R8	*The DUT libraries were already doing more to improve their services and has access to different electronic resources.*
R9	*It has resulted with much Improved service delivery and access to the users of the libraries.*
R19	*Better services, better tools, informed staff to help users.*
R21	*LibChat services, electronic databases, mobile technology etc.*

R25	*Users don't need to be physically in the library and there is an increase in the use of online services.*
R26	*Faster better delivery.*
R28	*Libraries are now adopting mobile technology as an alternative delivery model for library services.*
R30	*Services are efficient and fast. IT improved service delivery.*

During the interview, participant IP4 mentioned that the DUT library has taken steps to support users online by implementing a chat pop-up on the library website. This chat feature enables library users to easily seek assistance and obtain support from library staff.

4.5.3.4 New technologies

New technologies refer to the advancements and innovations in various fields that introduce new tools, systems, or methodologies to improve and transform existing processes. The DUT library has enthusiastically adopted new technological innovations, leading to the introduction of new ways of working within the library. The circulation staff, for example, had to learn to use RFID technology as part of their daily operations. Additionally, a new library system named FOLIO was introduced and integrated, resulting in modified workflows and the adoption of novel approaches. The respondents expressed a strong conviction about the importance of librarians staying informed and up-to-date on emerging technologies that influence their profession. This sentiment was reinforced by the unanimous support received through the online questionnaire, with 100% of the responses endorsing the notion. According to the respondents, technology played a pivotal role in enabling the library to deliver high-quality service to its users. This aligns with the observations made by Mathew and Baby (2012:2), highlighting the indispensability of IT skills for all library professionals. The viewpoints of the respondents regarding the use of new technologies in the library are documented in Table 4.10.

Table 4.10: Responses on impact of technology (N =41)

Respondents	Responses
R5	*New Cloud-based Library Service Platform (FOLIO), use of LibChat, MS Teams and Analytics are some of the early indicators for the readiness to 4IR. COVID-19 has in fact helped to accelerate the pace for the adoption of many 4IR type of technologies.*
R7	*Everything is about technology these days. Without technology, the library wouldn't have been able to function properly during these times.*
R14	*Keep up with the current available technologies.*
R15	*Faster better delivery.*
R23	*It has changed the way the library functions. More information technologies are now available and it makes finding information easier too.*
R24	*Nothing can be done effectively without information technology.*
R36	*Learn new technologies, apps, lessons that involve critical thinking, digital literacies, online IL, online consultations.*
R37	*It has greatly impacted libraries and the way the work but in a positive way.*
R39	*Keep abreast of technology.* *Knowledge of technology is integral to the services offered and in understanding the library users.*
R40	*It has changed the modes of service delivery, and the changing technological applications and environment in which we work.*
R41	*IT has played a huge role in libraries because library staff work smartly, and users can readily receive the services they need through it.*

Participant IP10 expressed support for the use of new technologies by stating that, *"the world is technological changing. Change is fast moving, and with the installation of fibre in every home, this means that humans will 100% rely on technology. Therefore academic libraries should not be left behind."*

4.5.3.5 Fear of the 4IR and the unknown

It was interesting to observe that while participants embraced the new innovations and technologies endorsed by the DUT library, there remained a sense of scepticism and fear towards the unknown aspects they entail. The librarians expressed apprehension and fear regarding the 4IR and the uncertainties it brings. As noted by Kumari (2015:493), the library environment is undergoing a transformation and librarians need to be aware of these changes and evolve to accommodate and understand the technological changes. It is crucial for libraries and librarians to adapt to the development and introduction of new technology in order to keep up with changes and

provide quality services to users. However, the respondents expressed concerns about potential job losses resulting from these technological innovations. Figure 4.11 illustrates the responses from the librarians to the area of their profession that they believed would be the most affected by the 4IR. According to the feedback, circulation was perceived as the most susceptible area, with 34% (14) of the respondents indicating its vulnerability to new technologies. Processing received 29% (12), while acquisitions and periodicals were tied at 12% (5) each. Cataloguing followed with 8% (3) and 5% (2) of the respondents were uncertain about the potential impact.

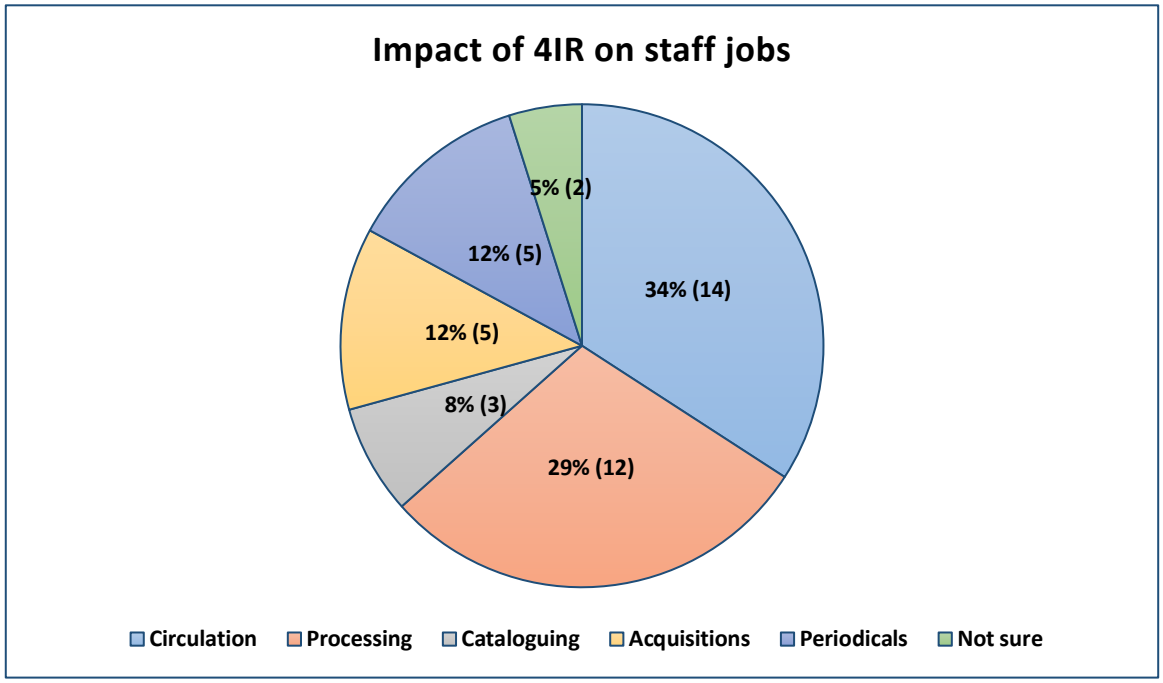

Figure 4.11: Impact of 4IR on staff jobs (N =41)

Below are responses from the interviewed participants on their view regarding the impact of the 4IR on the entire library.

> IP2 stated that:
> *The whole academic library sector is impacted. Academic librarians need to adapt and become flexible. Academic libraries need to explore and investigate new forms of digital services within their institutions. Should they not be forward thinking jobs run the risk of become obsolete? Reduced need for staff managing physical items would impact most jobs, from stack to cataloguing and librarians, who would have less need to maintain a physical collection.*

IP6 agreed that:

4IR definitely has an impact on academic libraries. Libraries are now shifting paradigms from traditional ways to modern ways. People and machines are connecting to each other at high speed. A certain group of people and their jobs will become redundant. Replacing them with new workers with the needed skills or with machines that do the job cheaper.

Table 4.11 presents selected responses from the respondents regarding their concerns about job losses, which is line with the discussion by Ghislieri et al (2018:3) regarding the fear among librarians about job losses and the possibility of being replaced by robots and automated machines. This sentiment is consistent with the findings of Tella, Okojie, Abdullahi and Ajani (2022:552), who emphasise that librarians harbour anxieties about potential job losses resulting from the automation of specific library functions.

Table 4.11: Impact of 4IR on staff (N =41)

Respondents	Responses
R7	*Circulation – not needed so much. Processing also not needed as much as more e material. Cataloguing roles changing – less intellectual cataloguing. IT support – do more to assist users. The roles of librarians are changed to assist students in being self-sufficient.*
R11	*All jobs or activities such as shelvers/stack attendants and circulation staff where technologies such as RFID can decrease some of the activities humans used to perform.*
R21	*Stack attendant: If there are machines or robots that can sort and store books, why will stack attendants be needed? Issue desk/circulation staff: the introduction of the RFID (self-check system) was a wake-up call to me, students were able to check in and out items on their own, using this machine. Very little assistance from our circulation staff was needed.*
R35	*Circulation services will definitely be impacted, for one reason DUT is currently implementing RFID self-service technology. Meaning you no longer need two people at the desk for student services but one. Also other sections within the library will be affected, if the university decide to only acquire online material instead of hard copy books.*

R39	*Reduced need for staff managing physical items would impact most jobs, from stack to cataloguing and librarians, who would have less need to maintain a physical collection.*
R41	*4IR will have a huge impact on academic libraries; for instance, activities that are traditionally done by humans, such as shelf reading, circulation, stock taking, can be done using technology. A library can use a "robot" to perform activities such as offering basic information queries.*

4.5.4 Utilisation of continuing professional development to embrace the changing landscape of libraries

This objective was to determine how academic librarians use continuous learning to embrace the changing landscape of libraries. CPD allows librarians to adapt to and embrace the evolving landscape of libraries. By engaging in CPD activities, librarians can remain updated with latest advancements, technologies, and best practices in the field. This enables them to effectively respond to the changing needs and expectations of library users. Furthermore, CPD encourages librarians to be proactive in seeking professional growth and learning opportunities. It empowers them to explore emerging trends, explore new ideas, and expand their professional networks. Many articles in the literature discuss the importance of continuing education and the need to stay updated on the latest trends within one's profession. As Engelbrecht et al (2007:581) explain, CPD is the ongoing continuous learning for individuals in assisting them to keep up-to-date with the ongoing changes within their disciplines. The concept of lifelong learning is of significant importance within the library environment and can manifest in various ways, including participation in conferences, workshops, trainings, and participation in skill-based courses and activities. Librarians who embrace CPD are better equipped to tackle challenges, implement new strategies, and contribute to the continuous improvement of library services.

Figures 4.12 to 4.15 represent the acknowledgement and support from the participants regarding the CPD-related questions.

CPD is an essential aspect of librarianship as it plays a crucial role in ensuring that librarians remain current in their profession. The field of librarianship is constantly evolving with new technologies, information resources, and emerging user

expectations. CPD allows librarians to stay abreast of these changes, ensuring that they are equipped to meet the evolving needs of users. During the study, the respondents were asked about the significance of CPD in librarianship. Notably, there was a unanimous consensus of 100% (41) among librarians that CPD is an essential aspect for librarians. This aligns with the perspective shared by Shonhe (2020:2), who emphasises the importance of continuous learning for the 21st century librarians to maintain their professional relevance. The respondents agreed that engaging in CPD activities would enhance productivity and improve library services. Figure 4.12 visually presents the responses provided by the respondents.

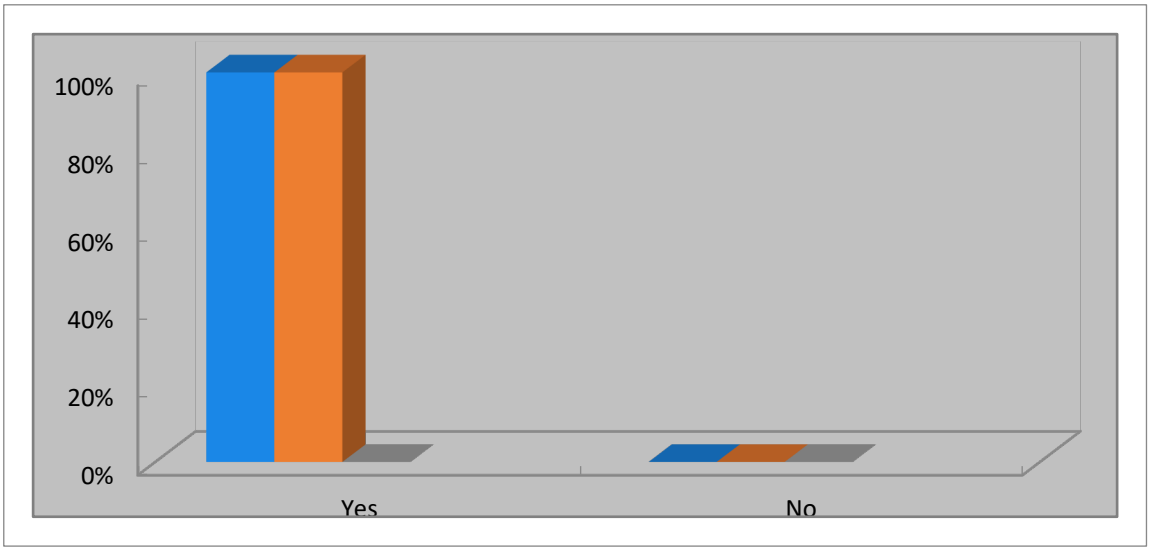

Figure 4.12: Is CPD an important aspect of librarianship? (N =41)

CPD plays a significant role in enhancing the professional competence and skills of individuals in various disciplines, including librarianship. CPD can help librarians to identify and address gaps in their professional competencies (Moonasar & Underwood 2018:47). The librarians were asked about the impact of CPD on improving professional competence and skills. It was unanimously agreed that CPD plays a crucial role in improving professional competence and skills. This finding is consistent with the research conducted by Shonhe's (2020:1), who similarly highlights the necessity of CPD for librarians to enhance their skills and competency levels, enabling them to stay updated with trends. By updating their knowledge, librarians are aware of new theories, methodologies, and trends, enabling them to apply the most current knowledge in their work (Shonhe 2020:1). Notably, all respondents, without exception,

expressed their agreement on the importance of CPD initiatives. Mohideen et al (2022:528) further elaborate on the significance of competence and skills development for librarians in the context of 4IR. They emphasise that in this era, librarians must continuously improve their knowledge and skills, encompassing both soft and hard skills, to remain competitive in the job market. Figure 4.13 visually illustrates the responses provided by librarians about the impact of CPD on professional competence and skills.

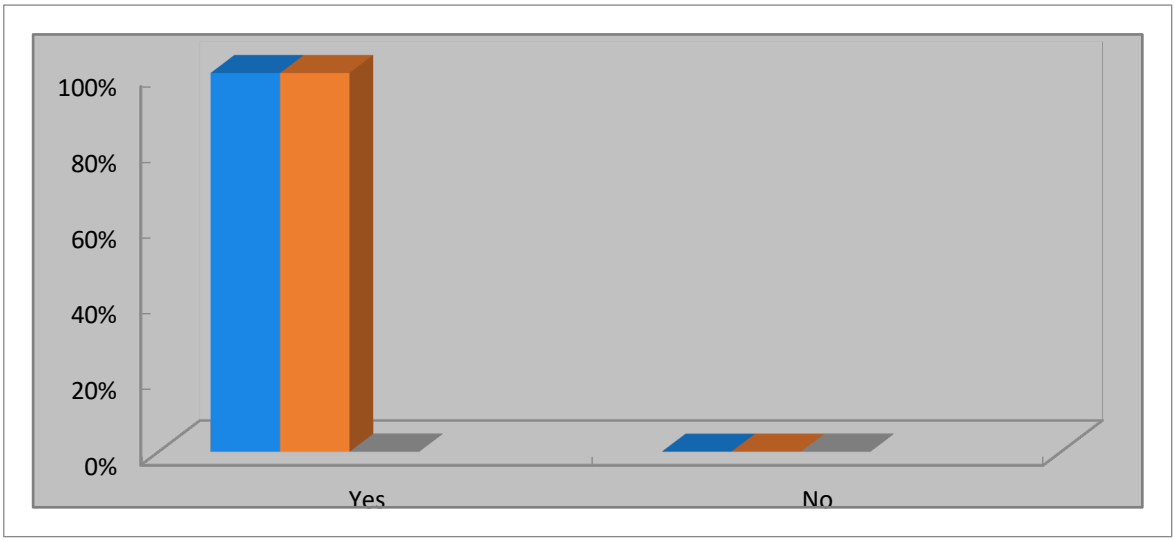

Figure 4.13: Does CPD improve the professional competence and skills of individuals? (N =41)

CPD has a significant impact on the effectiveness of library services. By engaging in CPD initiatives, and developing their skills and knowledgebase, librarians are able to remain current with emerging technology and are better equipped to provide relevant and high-quality services to the users. Through CPD, librarians can learn about user-centred approaches, effective communication strategies, and various innovative service models (Mohideen et al 2022:528). The respondents were asked about the impact of CPD on the effectiveness of the library service. The 41 respondents unanimously agreed that CPD improves the effectiveness of services rendered within the library. The consensus among the respondents, which is consistent with the research conducted by Shupe and Pung (2011:409) which suggests that continuous learning positively affects librarians' ability to deliver high-quality services to users. The respondents firmly believed that continuous learning played a crucial role in

enhancing service delivery within the library, enabling them to provide an efficient and timely assistance to users. Figure 4.14 shows the unanimous responses received from the respondents.

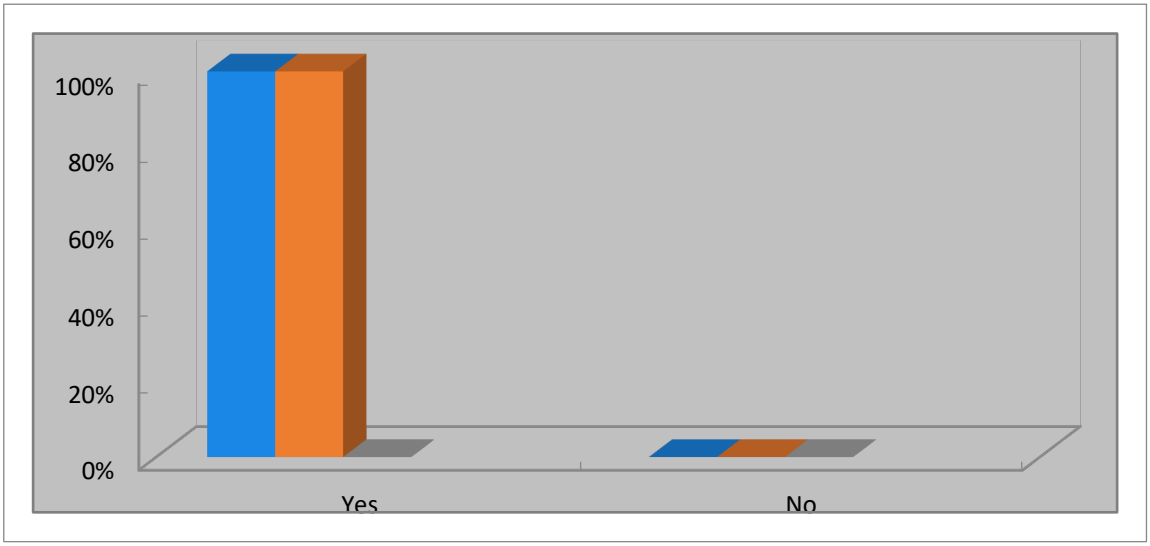

Figure 4.14: Does CPD enhance the effectiveness of services rendered within the library? (N =41)

Through continuous learning, librarians can gain a deeper understanding of the 4IR and its influence on libraries. CPD provides librarians with opportunities to explore and learn about technological innovations and trends associated with the 4IR. Respondents were asked about the impact of CPD on a librarian's understanding of the 4IR and its effect on libraries. The responses indicated unanimous agreement (41) that CPD actually facilitates librarians to gain a better understanding of the impact of the 4IR on libraries. This is similar to the views expressed by Mpofu and Nicolaides (2019:9) on how the 4IR changes the very nature of work by introducing new technology and causing a shift in the current ways of working. Librarians are noticing a transition to hybrid work models, enabling them to reach users beyond the physical confines of a building. Shilenge and Telukdarie (2021:472) further elaborate that continuous knowledge updates empower individuals to adapt to changes brought about by 4IR and disruptive technologies. Figure 4.15 shows the responses of the librarians.

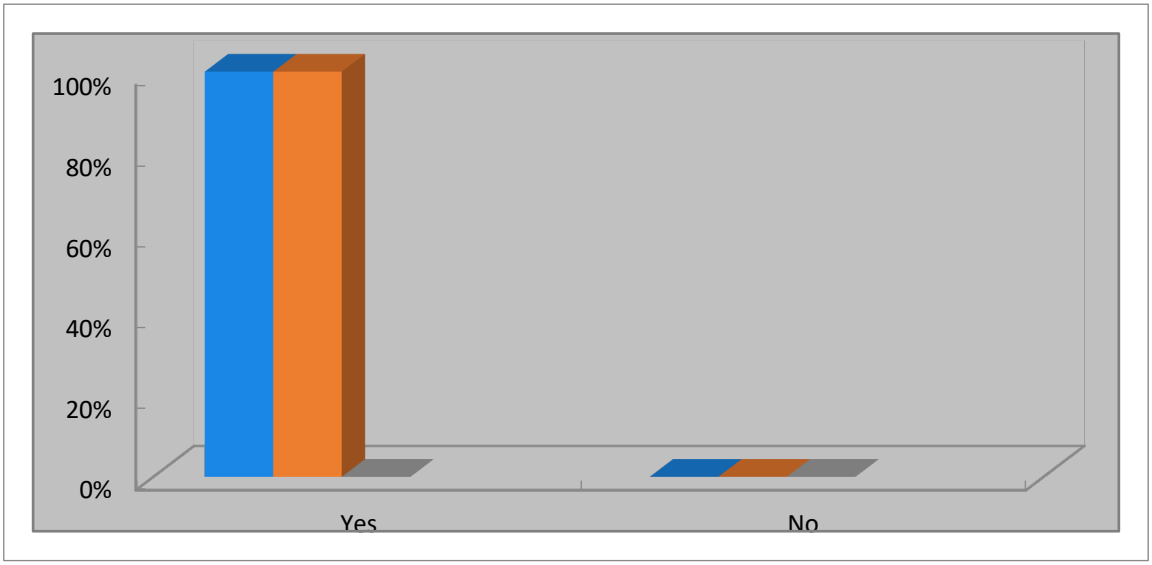

Figure 4.15: Does CPD allow one to better understand the 4IR and its impact on libraries? (N =41)

CPD is a valuable tool for librarians to embrace change, enhance their skills and deliver high-quality services that meet the evolving needs of users. The participants interviewed expressed their support and belief in the promotion of CPD activities within the library. They recognised the value of continuous learning and professional development for librarians. The participants acknowledged that CPD helps librarians stay updated with latest trends, technologies and best practices in the field. They highlighted that by encouraging and supporting CPD, libraries can improve the knowledge and skills of their staff, leading to better services and better support for library users.

Participant IP1 stated:
Library management should encourage staff to participate in CPD to keep up with current and future trends in library organisations. It is important to continue to develop skills to remain relevant in one's job. Staff should be encouraged to attend conferences, workshops, and training sessions regularly.

Participant IP3's viewpoint underscores the importance of investing in CPD to maintain a dynamic and effective library environment and stated that: "*by engaging in CPD activities, staff will be equipped with crucial skills necessary to meet the challenges and opportunities of 4IR technologies."*

The study participants felt strongly that CPD was important, as they all valued their jobs and were aware that if they did not understand changing technologies and evolve, they would be at a loss to provide a proper service to their users.

As one of the participants (IP8) succinctly captured the important essence of CPD:

> *A well-developed employee can perform their duty to the best of their ability due to their improved skills. Making a good impression on users is important, it boosts ones confidence, and self-confident employees excel at their duties.*

4.5.4.1 Relative merits of continuing professional development

Continuous professional development offers many benefits and challenges for both employers and employees. Moonasar and Underwood (2018:50) shed light on the dilemma surrounding CPD, where employers desire their employees to participate in CPD activities to enhance their skills, but obstacles such as finances and time constraints hinder the actual implementation of CPD.

For employers some benefits include:

- Enhanced employee performance as CPD enables employees to acquire new knowledge, skills, and competencies, which can directly contribute to improved performance in their roles (Mohideen et al 2022:528).
- By offering CPD opportunities, employers demonstrate a commitment to employee development and growth. Employees who perceive that their professional development is valued by their employers are more likely to be engaged in, and committed to, their work (Cheng 2017:446).
- CPD ensures that employees remain relevant in their field and are able to keep pace with the fluctuating changes in the environment, which in turn helps the librarians to remain competitive and deliver quality services to users (Pan & Hovde 2010:2).

In line with Shonhe (2020:2), the findings revealed that the DUT librarians emphasised the importance of staying updated with changes and trends in the profession. They recognise that active engagement in continuous educational development and skills building is crucial for meeting the challenges posed by new innovations and providing

quality service to users. In support of CPD, numerous national and international professional associations, as well as interest groups, offer resources such as webinars, online talks, online training sessions and newsletters that librarians can participate in (Pan & Hovde 2010:8). Since the advent of COVID-19, many of these activities have been made available at no additional cost. Table 4.12 presents insightful responses to the open-ended questions regarding the benefits of CPD. The respondents' view highlights the value and advantages associated with engaging in CPD activities within the library profession.

Table 4.12: Benefits of CPD (N =41)

Respondents	Responses
R1	*When an individual gains or develops skills that contributes positivity to an organisation/company's growth and success.*
R2	*Staff development to empower staff; Individual personal development, Acquiring technological tools that will assist information literacy training.*
R4	*CPD will improve productivity and the library services.*
R5	*By keeping abreast with latest technological changes and being in the virtual space and improve their skills through attending to workshops etc.*
R8	*They have to attend training so that they can work with technology effectively and efficiently.*
R11	*CPD mutually benefits the employer and employee.*
R19	*Staff see opportunities to be developed to perform other duties.*
R21	*A well-developed employee can perform their duty to the best of their ability due to their improved skills. Making a good impression on users is important, it boosts ones confidence and self-confident employees excel at their duties.*
R23	*It actually benefits the country and the world because Librarianship is not confined to just the institution but we work with impact globally.*
R24	*CPD helps the employee stay productive and institution benefits from having productive employees.*
R30	*Employers play a key role in CPD for employees. For high performing businesses, this means that learning and development is imbibed within your culture. Employers invest in learning and development programs, actively encouraging employees to reap the benefits of CPD. The benefits of CPD for employers include: Ensures high standards throughout the*

	organisation, contributes positively to an organisation's growth and success, enables a culture of learning and promotes a healthy working relationship with employees, boosts employee productivity and helps build a more efficient and motivated workforce, improves employee retention as employees feel valued and loyal to the company, And enables employers to embrace change and react to the changes within your industry.
R32	*Benefits mostly individual, through continuous learning professional growth, and other ideas.*
R33	*CPD will support individuals to learn new knowledge and also reinforce what they were lacking in. This will help them be better at their jobs. It is also important that new job specifications, tasks, or duties are introduced in the library. This will help staff quickly adapt to their new duties. This will then ensure the individual and the institution can expect a competent staff who is confident in their position.*
R37	*Learning doesn't stop. Every time there are new developments in technology.*
R39	*Ongoing skills development and learning provides the individual with meaning, and the employer/institution with resources.*
R40	*CPD develops in individual terms of growth both professionally as well as in one's personal life. It enables one to become better at their job and to contribute to the progression of the organisation. It enables a culture of learning and promotes a healthy working relationship with employees. It ensures high standards throughout the organisation.*

However, there are also challenges associated with CPD:

- Financial constraints are a great challenge for many employers. Allocating sufficient financial resources to support CPD activities, including training programmes, workshops, conferences and activities can be a challenge as limited budgets may restrict the extent to which CPD opportunities can be provided (Pan & Hovde 2010:7).
- Balancing CPD activities with daily work responsibilities can be challenging for employees. Finding time to engage in CPD activities while meeting job demands can be difficult, particularly when workloads are high and deadlines are tight (Moonasar & Underwood 2018:49).

- Employers may face challenges in effectively prioritising and implementing CPD initiatives. Developing a strategic plan for CPD, identifying relevant activities and aligning them with organisational goals require careful consideration and planning (Moonasar & Underwood 2018:53).

Addressing these challenges require a collaborative effort between employers and employees. While employers can foster a supportive work environment that encourages and facilitates CPD participation, employees can take personal responsibility for their professional development by seeking out relevant opportunities, effectively managing their time and demonstrating the value of CPD to their employers.

4.5.4.2 CPD engagement

The staff demonstrate a strong awareness of the importance of CPD and the advantages it offers in terms of self-growth and development. Respondents acknowledged that continuous improvement is indispensable to provide high-quality service to library users and to serve as a reliable support system for the academic institution. Their understanding underscores the crucial role of CPD in maintaining professional competence and ensuring effective contributions to the needs of users and the institution as a whole. As stated by Orick (2000:322) and supported by Oladokun and Mooko (2022:5), the inability of librarians to adapt and stay up to date with emerging trends would hinder their capacity to effectively contribute and deliver quality services to library users. The viewpoints expressed highlight the necessity for librarians to evolve and familiarise themselves with new developments in order to fulfil their roles successfully. Figure 4.16 presents the diverse perspectives among the respondents on the frequency of learning new skills and staying up to date. The results indicated a range of viewpoints:

- Twenty-nine per cent (12) of the respondents believed that learning new skills when the need arises is important.
- Twenty-four per cent (10) expressed the belief that a continuous and frequent update of skills is necessary.
- Ten per cent (4) had conflicting views, with some emphasising the importance of daily learning and others suggesting biannual updates.
- Twelve per cent (5) considered quarterly updates to be sufficient.

- A notable 15% (6) of the respondents were of the view that an annual update was sufficient to learn new skills and stay up to date. This perspective suggests that these individuals believed that acquiring new knowledge and skills on a yearly basis adequately met their professional development needs.

It is important for librarians to assess their own learning needs, consider the expectations within their environment, and engage in ongoing self-reflection to determine the most appropriate frequency of learning new skills applicable to their requirements. By being proactive, seeking relevant learning opportunities, and staying informed about new trends in their discipline, librarians can ensure that their skills remain current and aligned with the evolving demands in their profession. Pan and Hovde (2010:2) emphasise the significance of continuous learning initiatives for fostering specific skill sets and empowering librarians. They argue that such professional development efforts not only benefit the individual librarians, but also contribute to the overall advancement of the library. Similarly, Ayinde and Kirkwood (2020:148) assert that continuous learning of new skills is essential for thriving in the 4IR environment. They argue that while certain traditional job roles may diminish, new opportunities will emerge that demand a different skills set and levels of competency. Both perspectives underscore the importance of ongoing learning and skills development to equip librarians with the capabilities required to adapt to changing trends and effectively meet the evolving needs of libraries and their users. Continuous learning initiatives not only empower individuals, but also contribute to overall growth and resilience of libraries in the face technological advancements and shifting professional landscapes.

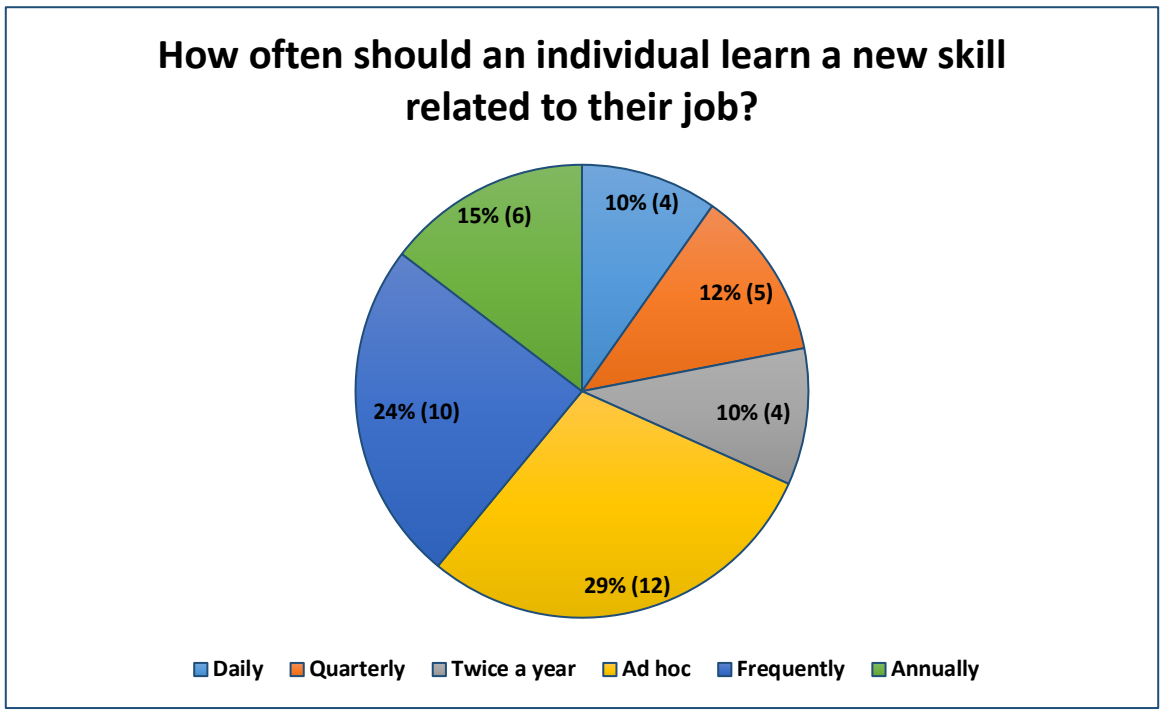

Figure 4.16: Frequency in learning a new skill (N =41)

4.5.4.3 Continuing professional development initiatives to support DUT librarians

Encouraging staff members in every institution and profession to participate in diverse CPD activities is crucial. This practice allows individuals to grow and develop within their respective professional field and provide exceptional services to their users. Academic librarians, as highlighted by Pan and Hovde (2010:5) enjoy the advantage of being affiliated with the parent university that offers abundant educational resources. The university actively promotes various skills development training activities for librarians, providing them with opportunities to improve their skills. Librarians can make the most of the university's resources to nurture their professional growth and personal development. Librarians will also have the library development initiatives to choose from and, therefore, will be in a gainful position in further developing themselves. Pan and Hovde (2010:6) further indicate that academic librarians are well supported with a rich mine of CPD resources within their environment.

Respondents were encouraged to share their insights into initiatives that could benefit them and promote CPD in the library. Figure 4.17 illustrates their beliefs, indicating that further studies and self-development were deemed important by the respondents

to stay updated and informed about changes in their discipline. Various suggestions were made, including workshops, webinars, and conference attendance, as means for DUT librarians to remain relevant in their profession and continuously embark on enhancing their knowledge and skills.

According to the results of the online questionnaire, 24% (10) of the respondents emphasised the importance of further study to remain relevant to new trends, while 22% (9) believed that attending conferences helped them stay abreast of trends in their field. Some librarians (15% or 6 librarians) highlighted the value of attending webinars, participating in self-development activities, and reading the latest articles as contributions to CPD activities. Additionally, 19% (8) expressed their satisfaction with training sessions and workshops as effective ways to enhance their knowledge base and skills level, while 5% (2) were uncertain about the benefits of CPD initiatives.

These findings highlight the diverse preferences and perspectives of the respondents regarding the various avenues available to them for professional development and staying updated in their field.

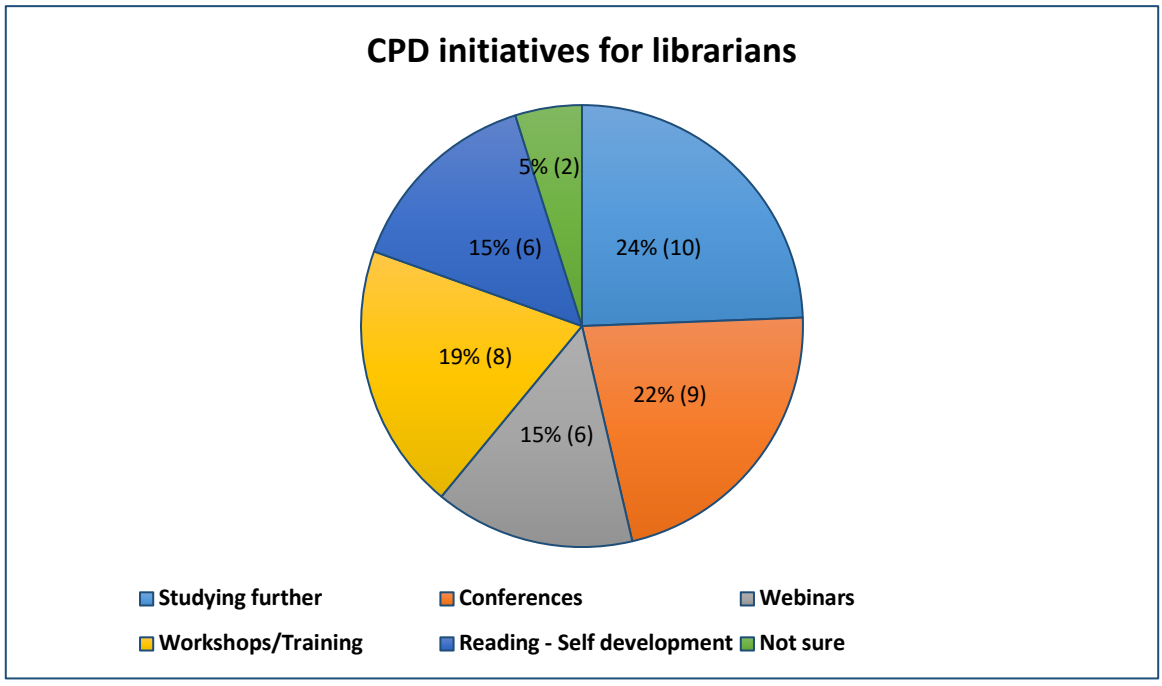

Figure 4.17: CPD initiatives for librarians (N =41)

One of the interview participants (IP8) mentioned the peer mentorship initiative that was just activated at the DUT library. The participant indicated that:

> *It is good for us young staff to be able to draw on the experience and knowledge of our senior colleagues when we need it. I enjoyed been mentored to present a paper in the library research day programme. This gave me confidence in myself.*

This idea of peer coaching, as supported by Pan and Hovde (2010:6), aligns with the findings mentioned earlier. Peer coaching or mentoring creates valuable opportunities for librarians to participate in collaborative learning and development by sharing their knowledge and experiences with each other. It enables librarians to learn from their peers, exchange ideas and gain insights into different approaches and perspectives within their profession. By fostering a culture of peer coaching, librarians can further enhance their professional growth and expand their skill sets through meaningful interactions and mutual support (Pan & Hovde 2010:6).

4.5.4.4 Challenges of continuing professional development

Although there were consensus among the librarians that CPD was important and that it enhanced their work and service delivery, there were challenges in getting all the librarians to participate in CPD activities. Some of the respondents professed that it was a challenge to attend the CPD activities, as the times were not suitable for all staff. Some of the views are reflected in Table 4.13.

Table 4.13: Challenges of CPD (N =41)

Respondents	Responses
R17	*CPD activities were not planned with Circulation staff in mind. The times scheduled for events are during lunch times or when some staff had to manage the issue desk.*
R20	*There were less opportunities for some individuals as it seemed that the subject librarians and management only enjoyed the benefits of attending programmes.*
R23	*CPD is important but we don't necessarily have a choice in the activities that we participate in. It is difficult to fit in activities, but we are sometimes forced to participate in unnecessary activities, too.*

As Oladokun and Mooko (2022:4) point out, CPD for academic librarians is vital to ensure that they keep abreast with the changing needs of the users. It is further stated that employers must be proactive in providing learning opportunities for their staff. However, challenges may arise when faced with resistance from staff. It can be difficult for employers to ensure that all levels of staff are included in learning initiatives, as not all initiatives may be relevant to every level of staff. This situation can also present challenges for librarians. Financial constraints can play a role in determining the extent of CPD programmes that an employer can offer to its employees, as noted by Pan and Hovde (2010:4). The availability of financial resources can affect the variety and quality of CPD initiatives that employers can present to their staff. These limitations need to be taken into account when considering the implementation of CPD programmes within the organisation. The formal education received in institutions can prepare librarians for effective performances; however, situations in the actual workplace can arise where librarians are not equipped to handle and resolve them. Instances such as these require informal, on-the-job or in-service training for newly qualified professionals. It is difficult to keep up with the evolving technological changes that impact on the academic libraries due to lack of funding, resources, and time. The responsibility of staying current and relevant in one's profession extends to individual librarians as well. As highlighted by Oladokun and Mooko (2022:13), librarians who are unable to adapt to the changing environment and embrace new technologies may no longer be considered as an asset to the profession. It is essential for librarians to actively engage in continuous learning, professional development and keeping abreast of emerging trends and technologies to ensure their ongoing value and contribution to the field. By embracing these responsibilities, librarians can enhance their skills, adapt to changing demands, and remain effective and valuable members of the profession.

4.5.5 Library infrastructure for the 4IR

This objective was to determine whether the existing infrastructure of the DUT library is aligned with the requirements of the 4IR and the evolving roles of librarians. Academic libraries typically rely on their parent institution to provide the necessary hardware and software infrastructure to support their operations and systems. In the context of 4IR initiatives, the infrastructure required for academic libraries often

involves cloud-based technology, innovative systems, secure hardware, and software. Cloud-based technology plays a crucial role in providing flexibility, scalability, and accessibility to library resources and services. It enables libraries to store and manage vast amounts of digital content, collaborate with other institutions, and offer remote access to users (Wada 2018:17). Innovative systems include various technologies such as integrated library systems, digital repositories, discovery platforms and learning management system, among others, which enhance the library's capabilities and user experience. By investing in and maintaining the infrastructure that supports cloud-based technology, innovative systems, and secure hardware and software, the DUT library can effectively adapt to the requirements of the 4IR and provide enhanced services to their users. The DUT library, in collaboration with the university, is actively working to inculcate a culture of research, teaching, and learning that promotes creativity and innovation within the academic community. According to Nkosi, Aboginije, Mashwama and Thwala (2020:2117), infrastructure to support 4IR initiatives encompasses more than just hardware and software. It also includes the employees and facilities required by students in an academic institution. Infrastructure includes physical spaces such as laboratories, library study areas, lecture rooms, and other facilities that are integral to the teaching and learning process. The DUT library gradually introduced new technologies, avoiding sudden disruptions or excessive attention. This measured pace has been confirmed by one of the interviewed participants (IP6), "*from my perspective, the direct impact of 4IR technology are currently not evident in any pronounced way. One may assume that once 4IR technologies are fully implemented and operational in all DUT libraries, the impacts will become more apparent."*

On the other hand, some participants who were interviewed were more perceptive of the new systems and they expressed that the DUT library embraced the 4IR and is prepared to continue implementing 4IR innovations.

As reflected by Participant IP8

> *The library is progressing with technology and ensuring that the infrastructure is well equipped to support various online platforms, such as DSpace, FOLIO, library publishing, digital works.*

Participant IP10 concurred with this sentiment, indicating that:

> *The library is committed to staying up to date with technological advancements and has improved their systems, with new implementations such as, FOLIO and EDS. The library is using LibChat, to get to their users. Implemented electronic classrooms, RFID and embraced the new technology packages to help our clientele.*

4.5.5.1 Effectiveness of library services

In Figure 4.18, the responses from librarians regarding the effectiveness of library services for users, before the advent of disruptive technologies, were quite diverse. Surprisingly, 41% (17) of the respondents believed that the DUT library was fairly effective in providing services to users. It should be noted that 10% (4) of the respondents chose to ignore the question, while 17% (7) were uncertain about the delivery of the service. Furthermore, 20% (8) of the respondents considered the service to be average before the implementation of technological advancements. On the other hand, 12% (5) expressed the opinion that the library was not effective in meeting user needs in the past. These findings indicate a range of perceptions among librarians regarding the effectiveness of library services prior to the integration of disruptive technologies. While a significant portion viewed the library's services as fairly effective, others had mixed opinions or believed that improvements were necessary. These responses highlight the importance of leveraging technology to improve library services and meet evolving user expectations.

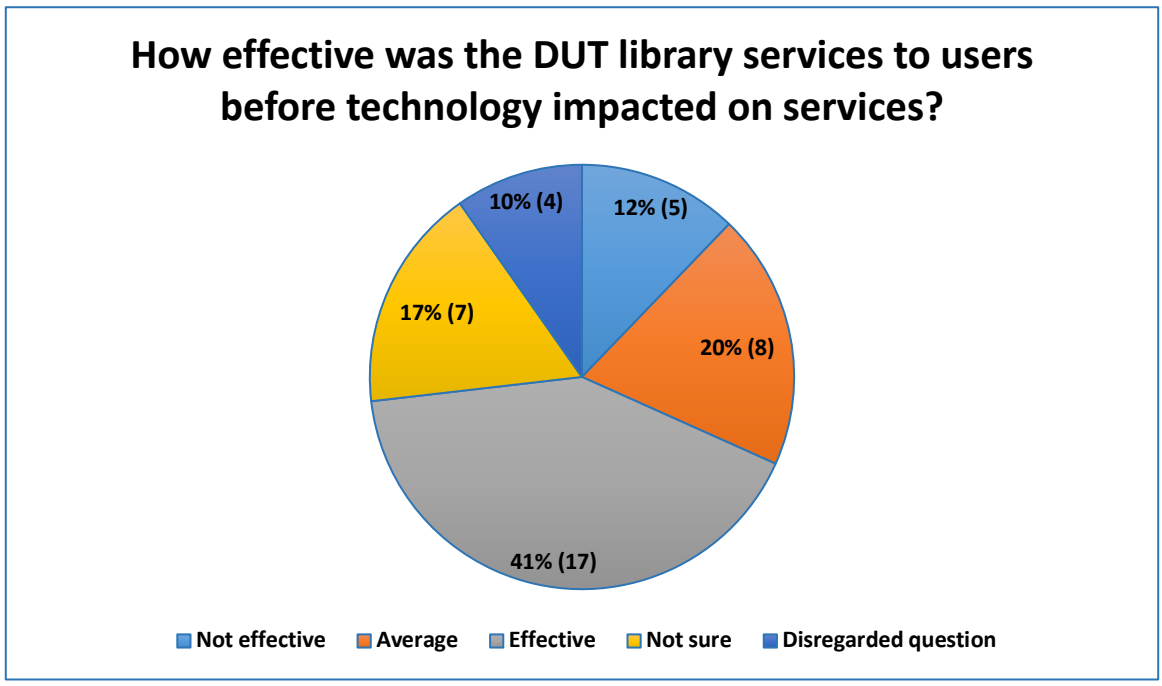

Figure 4.18: Effectiveness of library services before the impact of technology (N =41)

One of the participants (IP8) qualified his response regarding the effectiveness of library services before the introduction of new technologies. According to IP8, "*the library services were considered effective given the period that we are living under at that time.*"

Regarding the views of the respondents on whether the DUT library was taking proactive steps to prepare for the 4IR, these views were obtained through an open-ended online questions and are captured in Table 4.14. Participants shared their perspectives on the proactive measures taken by the library in anticipation of the 4IR, as expressed in Table 4.14.

Table 4.14: Does the DUT library support the 4IR? (N =41)

Respondents	Responses
R7	*Changed most library systems to open-source. Library has adopted new ways of doing things.*
R8	*The library has moved the library system to a cloud based service, We have an online discovery tool, The Information Services Unit offer their services online, The IT Student Support Unit offer online services.*

R10	*Installed a software that allows students to access information at any time. Installed RFID, employed more IT specialists to assist students with their laptops computer queries.*
R11	*Moving towards digitising more existing resources for online availability.*
R13	*Created new and opened up spaces that are suitable for technology use.*
R23	*There has been lots of investigating, planning and implementation of information and communication technology. The library has, in some instances, been the leader in moving in the direction of innovation. The DUT library has been very progressive.*
R37	*Embraced the IT developments and integrated them to their strategic plans. DUT is introducing a range of tech materials in accordance with the 4IR. The introduction of the FOLIO software is supposed to have many advantages.*
R36	*There is LibChat where students can talk with librarians off campus, users can access information off campus. There is an increased of the IT presence in the library, provide IT support to students, implemented new systems and automated some procedures.*
R41	*Implementing RFID (hopefully in future user can perform self-service returns, etc.) It has a repository whereby users can access research articles and theses online Has a discovery tool that can be accessed (by registered users) anywhere as long as they have access to WIFI and appropriate devices.* D*eveloping staff in terms of learning new technological skills provide technological services.*

4.5.5.2 4IR readiness for the DUT library

The readiness of the DUT library for 4IR initiatives is dependent on many factors and specific initiatives implemented by the library. According to Figure 4.19, the majority of respondents (83%: 34) agreed that the acquisition of new technology at the DUT library led to a significant improvement in library services. This indicates a positive impact of technology on the overall effectiveness and quality of services provided. On the other hand, 12% (5) of the respondents expressed scepticism about the extent to which technology improved the library services, while 5% (2) respondents remained undecided this matter.

To gain further insights and qualifications regarding the responses, Table 4.15 provides additional details from the online questionnaire.

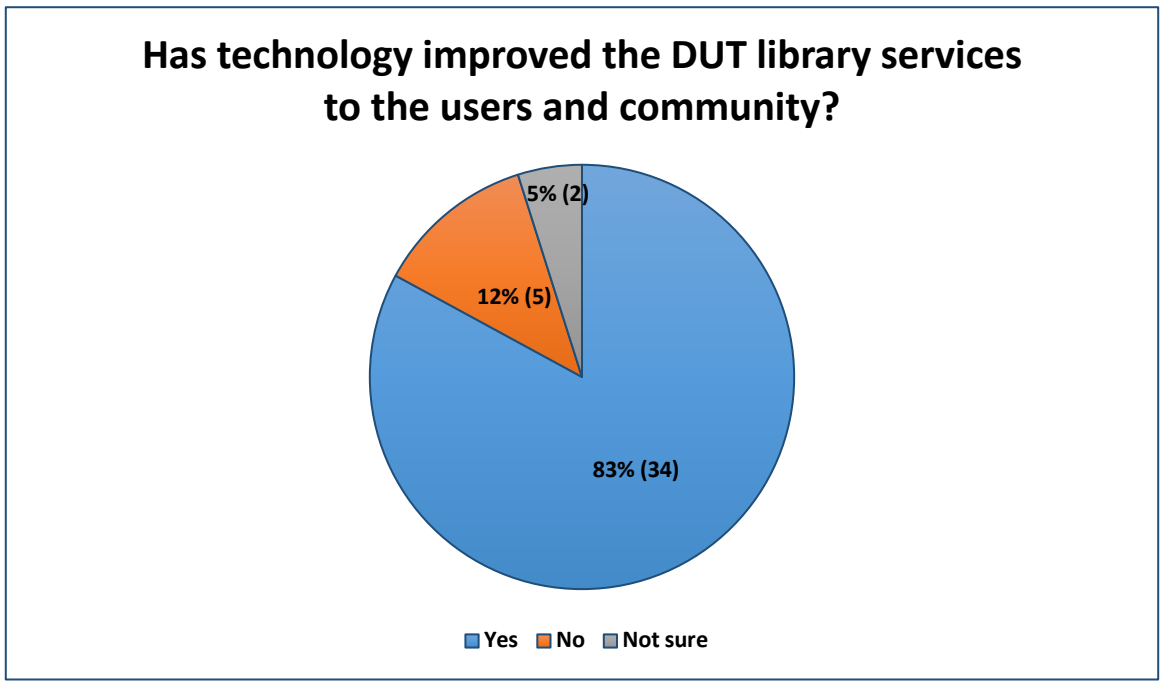

Figure 4.19: Improved services due to technology (N =41)

Based on their perceptions and responses listed in Table 4.15, the respondents provided qualifications and expressed their belief that the services at the DUT library had improved, indicating that the library was ready for the 4IR. Ayinde and Kirkwood (2020:146), supports this notion stating that new technological innovations have the potential to improve and enhance library services. The implementation of new technologies and innovative approaches makes the library smarter and more appealing to users. The librarians identified several technologies the library had implemented, including automation of services, self-checkout kiosks, cloud computing, increased subscriptions to databases and e-resources, interest in open access initiatives such as open educational resources (OERs), the transition to an open-source library system FOLIO, and the implementation of RFID technology.

Table 4.15 captures some responses collected during the study, providing insights into the improved library services. The responses in Table 4.15 highlight the positive impact of IT and online services in enhancing library services at the DUT library. The responses highlight the support during challenging times, the creative engagement with users through digital platforms, convenient access to assistance and resources, and the flexibility of accessing information remotely. Overall, these qualifications align

with the understanding that technology has improved library services and played a crucial role in adapting to the changing needs of library users.

Table 4.15: Improved services due to new technology (N =41)

Respondents	Responses
R7	*IT has improved the services, eg the students were assisted non-stop during the corvid 19 pandemic.*
R8	*It has with the online services being offered. Staff are finding creative ways of engaging with Library users off-site using Teams, Google Hangouts, social media platforms, WhatsApp.*
R9	*Users are able to chat to a librarian online, there are able to loan out books without assistance from circulation staff.*
R10	*Students are able to access information where they are. Visiting the library is by choice.*
R18	*The library services are going to where the users are. This talks to the convenience for users.*
R26	*Yes, on and off campus access of information at any time.*
R27	*There are more services and services that can be taken to the users remotely too.*
R30	*More virtual classes, accessing information remotely.*
R39	*Technology has increased discoverability of and accessibility to a broader range of resources and services while also providing filters to increase relevance.*
R41	*It has tried its best and has ensured that it was in the same level with more advanced libraries not only nationally but internationally as well.*

The participants who were interviewed expressed positive views about the adoption of new technologies by the DUT library to support 4IR innovations. The participants agreed that the library was well prepared for 4IR integration and highlighted specific initiatives and technologies that demonstrate this preparedness. The responses are captured in the following:

IP1 stated that:

- *RFID has been implemented across all DUT libraries.*

- *Librarians can work online and remotely using new technologies.*
- *Learning management systems such as Moodle have been implemented for classroom activities and assessments.*
- *Tools such as Teams and Zoom are used for meetings and classes.*
- *Online chat tools on the library website enable user queries.*
- *The introduction of the 4IR provides an opportunity for librarians to re-profile their competencies and reinvent themselves in order to remain relevant.*

IP2 explained that:

- *RFID technology will make stocktaking processes easier and faster.*
- *Makerspace initiatives indicate a move towards embracing 4IR technology.*
- *Mobile apps have been developed for user convenience.*
- *Adoption of the new library system FOLIO demonstrates preparedness for 4IR.*
- *There is a focus on handling big data sets.*

IP3 stated that:

- *RFID projects in all DUT libraries and the adoption of a new open-source library system exemplify the move to 4IR.*
- *The library engages with other libraries to learn from their experiences in handling 4IR.*

IP10 explained that:

- *The adoption of open-source systems and the upgrading to a new Discovery service demonstrate preparedness for 4IR.*
- *Increased adoption of electronic resources aligns with supporting and embracing the 4th industrial revolution.*

These responses highlight various technological advances and initiatives implemented by the DUT library, such as RFID technology, online collaboration tools,

open source systems, and the adoption of new library services and resources. Participants view these measures as indications of the library's readiness and willingness to embrace the 4IR and its associated technologies and challenges.

4.5.5.3 Human capital

The DUT library is fortunate to have a skilled and diverse staff workforce, whose range of skills and expertise contributes to creating a vibrant and active hub. The participants acknowledged the creative approach of DUT library management in utilising positions left vacant due to retirements or resignations to create new roles that align with the era of innovations and change. By repurposing these positions, library management demonstrates a proactive stance towards embracing new technologies and adapting to the evolving needs of the library and its users. This approach allows the library to tap into fresh talents and skills that can drive innovation and contribute to the library's ongoing development. Overall, the participants recognised the importance of having a skilled staff workforce. A few responses from the interview participants:

Participant IP1 acknowledged that:

> *The DUT library has a staff workforce equipped with the necessary skill sets to handle 4IR and its implications. Staff are continuously attending seminars and workshops to keep up with the current and future technologies and trends. People and technology are consistently connected to each other, ensuring that learning takes place.*

IP2 recognised that:

> *The library has some very efficient and forward-thinking staff who strive to drive change. However, challenges such as student unrest and COVID-19 pandemic, which can make implementing new initiatives more difficult.*

IP3 explained that:

> *The DUT library has always been advanced in terms of new technologies in the university. The library was the first place to find solutions during COVID 19 and lockdown in terms of how the library will reach out to the library users to provide service and the library had to introduce LibChat online, use other social media*

platforms like WhatsApp for group chats, Facebook, MS Teams, and Moodle for teaching and learning, etc.

IP9 highlighted the library's proactive approach by creating new positions:

The library has initiated new posts to move forward with digital scholarship and the creation of a digital librarian, data curation, digitisation, and marketing librarian are proof that we are moving on the right track.

These responses collectively highlight the efforts of the DUT library to stay ahead in terms of technological advancements, staff development, and adaptation to challenging circumstances. The library's commitment to embrace new technologies, provide innovative services, and create relevant positions shows its commitment to progress in the context of the 4IR.

With the continuous disruptive technology impacting library services, it is imperative to have employees who are willing to embrace the changes and actively participate in activities that enable them to stay up to date, as these employees will play a pivotal role in driving the 4IR forward (Ghislieri et al 2018:3). The following are observations made by the interviewed participants about how the library and its staff manage the challenges and opportunities presented by the 4IR.

IP3 explained that:

The library has proven that it can handle 4IR with the new systems and educating staff on how to handle the new systems. With all the new stuff happening, the move to start a Makerspace, etc. means that yes, we are coping and well prepared.

IP4 acknowledged that:

As any new developments, there are always challenges, but as you go along, staff can adapt as they get used to it. With 4IR there is always new developments coming out and one has to adapt to it. DUT library is coping with the new developments and staff are adjusting to new ways of working.

IP6 emphasised the importance effective strategies:

> *The library needs to develop sound strategies to deal with the implications of whatever eventualities/consequences/challenges and opportunities 4IR brings with it.*

IP9 confirmed that:

> *The DUT library is coping well, as systems are being streamlined and integrated. The library has some efficient and forward-thinking staff who try to bring about changes.*

IP10 expressed optimism that:

> *I think if we have funding, if we have skills, if we have technology, we can embrace disruptive innovations. Look at how face-to-face interaction has fallen away, we never thought that we would be sitting at home behind devices and attending meetings, etc. So yes, we are moving forward and we definitely are embracing 4IR.*

4.5.6 A model to align librarian roles and skills with the 4IR

Aligning librarians' roles and skills with the needs of the 4IR requires flexibility and adaptability. As emerging trends and technologies continue to shape the academic library landscape, libraries must respond by enhancing the skills and services of their librarians. Recognising the impact and implications of the 4IR, academic libraries around the world placed strong emphasis on improving librarian skills (Ocholla & Ocholla 2020:357). This involves providing training, professional development opportunities, and resources to help librarians stay updated with the latest trends and technologies relevant to 4IR. The DUT library placed emphasis on staff reskilling and CPD-related activities. Additionally, efforts have been made to create new library spaces that attract and engage users. One such initiative is the establishment of a makerspace, which aims to foster creativity and engineering skills among library users (DUT 2023). The participants in the study acknowledged the importance of working smarter and reaching out to users anywhere, at any place, and anytime with access to resources. The required skills for staff to thrive in the in the 4IR era include adaptability, creativity, innovation, and problem-solving, which were highlighted by the

participants. Here are some responses from the interviewed participants regarding staff access to information.

Participant IP2 acknowledged that:

> *We have skilled staff who adapt to the new changes. Students can access information wherever they are and no longer need to be restricted to visiting the library.*

IP3 expressed that:

> *One online book can be used by many students that are thousands of miles away from campus. That is the beauty of technology.*

IP5 stated that:

> *Libraries are now shifting paradigms from traditional ways to modern ways. People and machines are connecting to each other at high speed. Certain groups of people and their jobs will become redundant, replacing them with new workers with the needed skills or with machines that do the job cheaper*.

IP8 stated that:

> *It depends on the position you have in the library; for some librarians, it has improved the way they perform their duties, which is good. For others, it has reduced the workload for them, giving them the opportunity to perform other duties that may not have been on their job profiles. For example, circulation coordinators have been added to the LibChat service, a platform where students can interact with librarians.*

IP9 explained that:

> *In addition to the growing 4IR technologies within the library, the move to online communication [information needs/learning and teaching] users has been exacerbated by the COVID-19 pandemic. Job profiles have to be revised creatively to still allow staff to be functional and relevant in their respective positions With regard to circulation specifically, it is expected that staff would be more proactive in terms of their interaction with users. As opposed to being passive and waiting for users to approach the circulation desk, staff will have to approach users by offering to be of service/help.*

IP10 believed that:

> *New technology has helped to speed up the rate in which information is created, edited, disseminated and stored for future usage.*

These responses from the interviewed participants demonstrate the positive impact of technology on library services, including improved access to resources, improved job performance, revised job profiles, and increased speed and efficiency in information handling.

4.5.6.1 Aligning the library with the 4IR

The process of aligning the library with the 4IR involves adapting and integrating emerging technologies, strategies, and services to meet the changing needs of users and the demands of the digital age. It requires a proactive approach to embrace new technologies, reimagine traditional library roles, and improve digital literacy among staff and users. The aim is to leverage technology to enhance information access, provide innovative services, and stay relevant in the rapidly evolving digital landscape. Table 4.16 presents the response of the librarians regarding the alignment of the library with the 4IR. It was interesting to note that the librarians shared a common perspective that the library is a dynamic entity that must adapt and embrace change. This point of view aligns with Ranganathan's (as cited in Carr, 2014:153) fifth law that 'a library is a growing organism' that evolves over time.

Table 4.16: Aligning the library with 4IR (N =41)

Respondents	Responses
R1	*Improve service delivery and the provision, sharing and accessing of information faster and better services.*
R4	*It helps strengthen the library programs and facilities in ways that foster better services and higher patron satisfaction.*
R6	*To keep up to date with the rest of the world.*
R8	*It is important because it here and we have to embrace it in order to effectively function in the current society otherwise libraries will be obsolete.*
R12	*Libraries are part and parcel of the developing world thus should move with the technological developments.*

R15	*It has moved us into a better space that has facilitated the research process. It has made discovering information easier too.*
R16	*Libraries are evolving entities.*
R19	*It is important to be up-to-date with technology because it is keeping the library on par with current trends in the world.*
R27	*It is important for a library to survive, the indigo generation lives in a virtual world.*
R32	*Any technology that supports the efficiency and effectiveness of the library in terms of the resources and services it offers is important.*
R34	*Libraries cannot function in the absence of technology, tools and systems.*
R35	*To service all types of users. Those who are unable to access libraries because they are working, students are able to access information at any time whenever they want.*
R37	*New technologies will help libraries strengthen their programs and facilities in ways that foster better services, higher patron satisfaction, and more positive perceptions.*
R40	*The smart use of technology can help libraries strengthen their programmes and facilities in ways that foster better services, higher user satisfaction and more positive perceptions.*
R41	*Almost everything is automated nowadays, information can be retrieved faster and user do not have to come physically to the library, e.g. one can access information using discovery tools, institutional repositories, etc. Cataloguers can perform some activities virtually as well.*

4.5.7 Recommendations

This subdivision presents recommendations geared to resolve the research problem and tackle the challenges posed by the impact of the 4IR on the DUT library. The study participants were invited to share their insights into and recommendations for how the library can adapt to the changing landscape and ensure its sustainability. It was encouraging to gather from an interview with IP9 the positive stance of the DUT library towards technology innovations.

Participant IP9 explained that:

> *DUT libraries have embraced technology and not evaded it and have made electronic resources available and implemented EDS, the discovery tool that*

allows our library users to access all electronic resources remotely from anywhere. Training has been provided to staff members on new systems, and they are encouraged to participate in CPD initiatives.

Participant, IP2 responded that:

There has been lots of investigating, planning and implementation of information and communication technology. The Library has in some instances been the leader in moving in the direction of innovation. The DUT library has been very progressive.

IP5 explained that:

Created platforms for the learning of the new ICTs. The library assisted in the teaching and learning of new tools and applications. Continuous professional development of staff. Encourage staff to participate and attend webinars on information literacy, 4IR, open access, OERs, digital divide etc., conferences, and workshops.

These recommendations highlight the importance of embracing technology, continuous learning, and being proactive in adopting innovative practises to ensure that the DUT library remains sustainable and meets the evolving needs of its users in the era of the 4IR.

The participants highlighted that the implementation of new and improved technologies in the library had an impact on certain library jobs, either affecting the workload or reducing the need for certain tasks. The implementation of RFID and the increase in online resources, in particular, influenced the circulation of physical library resources.

IP7 expressed that:

Circulation of print resources, stocktaking, archiving, digitising of information, preservation of material, teaching and learning activities/methods, communication methods or meeting methods, storing of information, cataloguing, acquisitions, and shelving, were impacted by the adoption of new technologies and a decreased emphasis on purchasing of printed resources.

Participant IP10 shared a broader perspective, stating that:

> *I cannot think of any academic library jobs that wouldn't be affected by 4IR because 4IR technologies and tools touch on every business process of the modern academic library. All jobs will be affected by the 4IR just in different ways.*

These insights emphasise the transformative nature of 4IR technologies and their implications for library operations and job roles.

It was reassuring to observe that despite the changes occurring in the library, the participants maintained a positive outlook and expressed confidence in the adaptability of librarians to meet the evolving demands. Participant IP4 highlighted the increasing importance of IT skills and the role of subject librarians in providing guidance to users on effective information retrieval:

> *In all likelihood, IT will gain greater traction and momentum to support new technologies within the library. Subject librarians – users will still require guidance on how to search for information and be able to effectively use the information they find.*

IP5 emphasised the potential of 4IR:

> *With 4IR technology, anything is possible, one cannot be 100% sure that there is a library job that is safe. I can safely say that technology still needs assistance from humans, in order to feed information into a machine or robot that still needs assistance from humans.*

These perspectives reflect an optimistic view that librarians can embrace technological changes and continue to provide valuable support and assistance to library users. While new technologies may reshape certain aspects of library work, the participants recognised the importance of human expertise and assistance in optimising the use of technology for information retrieval and management.

While there is a general sense of optimism among librarians, concerns about job security and the need for continuous learning are still prevalent. The DUT library has taken initial steps towards embracing the changes associated with the 4IR, which are seen as significant progress. However, there is recognition that there are still many unexplored aspects of the 4IR that the library needs to investigate and implement.

According to IP6:

> *The library is still miles away from actually implementing 4IR technology. The library is still in the infantry stages of investigating using an AI information system to help users, but what about expert systems and blockchain technologies.*

Ayinde and Kirkwood (2020:147) define expert systems as software that relies on a "database of expert knowledge to offer advice or make decisions." The authors further explain that technologies such as expert systems, drones, and blockchain have the potential to improve library service delivery and provide information services at a higher level for users and researchers. These observations highlight the need for the DUT library, and libraries in general, to continue their exploration and implementation of 4IR technologies. Although progress has been made, there is still a considerable distance to be covered to fully harness the potential of technologies such as AI, expert systems, and blockchain to enhance library services and meet the evolving needs of users and researchers.

The participants strongly emphasised the importance of librarians actively participating in initiatives to maintain their relevance and knowledge within the profession. They offered valuable suggestions, as captured in Table 4.17, on how librarians can embrace the 4IR and ensure their continued relevance in their role.

Table 4.17: How to remain relevant in the current environment? (N =41)

Respondents	Responses
R2	*They must attend trainings and keep themselves up to date with current information.*
R4	*Improve their IT skills.*

R5	*Investment in capacity-building development initiatives is the best way to keep abreast with the changes of time. Librarians need to be techno-savvy.*
R6	*Librarians need to be willing to adapt to new ways of working, come out of their comfort zones.*
R12	*Librarians need to read actively – it's the only way to keep abreast of changes, tap into existing thinking and develop new ways of working.*
R13	*Keep developing themselves, learn new things.*
R14	*Research and stay updated at all times. Compare with other libraries.*
R15	*Librarians need to always update and upgrade skills to provide modern services to today's user.*
R23	*Knowledge on how to use the online technologies available to support teaching, learning and research.*
R29	*Soft IT skills, continuous personal development is the key to the ever changing librarianship/IT.*
R31	*Be advanced in technology and follow in the latest trends of information acquiring skills.*
R33	*Observing the latest trends by always benchmarking with others in the same field.*
R35	*Keep developing, they need to look for new coming trending related to their field and enrol for those courses.*
R37	*Librarians need to continuously engage in learning as the information and IT always surpass our knowledge and level.*
R38	*A distinction will have to be made. There is technical skills which allow you to use systems in the execution of your duties. There are also soft skills that are not given enough attention or emphasis.*
R39	*Digital literacy and a willingness to learn and embrace new technologies.*
R40	*Constantly keep updated with current trends and activities.*
R41	*Read current literature Have information sessions Attend trainings and webinars on Dewey, cataloguing trends and ethics in libraries.*

4.6 Summary

This chapter presented the data collected through an online questionnaire and individual interviews. These findings were organised according to the research

questions and objectives, and they included responses from both the interviewed participants and the online questionnaire participants. The findings clearly indicate that the DUT library is actively embracing new innovations and preparing its librarians for 4IR. Librarians are encouraged to participate in continuous learning activities to remain current in their profession. The library is ensuring that all staff are trained and reskilled to learn how to use the new technology the library has acquired. Significant efforts have been made to accommodate online resources and engage with users online. The librarians have been shaped to evolve with technological changes as the library engages with 4IR innovations. Various CPD interventions are shared with staff to encourage them to keep updated and allow them to learn more about what is happening at various other institutions nationally and internationally. Most of the staff believe that they will not be left behind as the library evolves to engage with new innovations, as training is always cascaded to all levels of the staff. The next chapter covers the interpretation and discussions of the findings in line with the literature that was reviewed and the research objectives that was outlined in the study.

CHAPTER FIVE
DISCUSSION AND INTERPRETATION OF FINDINGS

5.1 Introduction

The previous chapter described and presented the findings collected from the self-administrative online questionnaire and the individual interviews. This chapter discusses and interprets the data gathered from the study participants' responses. Interpretation of the data of findings is the process of conveying meaning to data collected from participants during a study (Harding 2019:105). The researcher analysed the data and assigned meaning to the data collected by objectively interpreting and translating the data within the objectives of the study. This discussion chapter reviews and interprets the findings gathered from the questionnaire and the interview sessions and arranges them into the context of the overall research (Arsyad, Purwo & Adnan 2020:302). This section allows the researcher to connect all the previous chapters and study the link between each part of the objectives underpinning the study.

5.2 Discussion and interpretation of findings

In this section, the findings are discussed and interpreted, guided by the research objectives of the study. The discussion themes were derived from the following research objectives:

- The evolving roles and responsibilities of academic librarians
- Skills and competencies for academic librarians in the new role
- Effects of the 4IR on the roles of academic librarians in the changing information environment
- Utilisation of CPD to embrace the changing landscape of libraries
- Library infrastructure for 4IR
- A model to align librarian roles and skills with the 4IR

These objectives served as a framework for the analysis and interpretation of collected data, enabling a comprehensive discussion of the findings in relation to the research goals.

5.2.1 Demographic profile of participants

The research participants for both the self-administered online questionnaire and the individual follow-up interview questions were based on the librarians employed at the DUT library, regardless of their professional qualifications or their current level of work at the library. Tables 4.2 and 4.3 in the previous chapter illustrate the educational demographics and the work experience of the participants. As stated previously, the study consisted of 41 library staff who completed the online questionnaire and 10 individual follow-up interviews with library staff to supplement the quantitative data. This allowed the researcher to gather and further explore the views and experiences of the librarians to better understand the subjects and the study. The participants' work experience ranged from just over a year to over 30 years of library experience and their professional qualifications varied from a library assistant post with a matric to a subject librarian with a PhD in information science. Other qualifications included a national diploma in library and information science, honours in information science, postgraduate diploma in library and information science and a master's in information science. The revelations on the work experience and professional qualifications indicate that the participants are qualified enough in their current posts to provide an adequate service to the users. Participants in possession of a matric certificate are library assistants who assist in the processing, circulation, and shelving of returned library materials within the DUT library. Although the qualifications varied among the DUT academic librarians, it should be noted that the staff who did not possess a library and information related qualification had many years of library field-related experience and could adequately serve in their positions as circulation assistants or as processing of library resources staff.

5.2.2 Evolving roles and responsibilities of academic librarians

As highlighted in Chapter Two, the technological advances brought about by the 4IR influenced many changes in academic libraries and impacted on the way that librarians functioned. The pandemic and government-imposed lockdown accelerated the changes within the DUT library and the librarians. During the lockdown, the librarians displayed surprising resilience and responded to the changes in working and reaching out to the users. New ways of working and reaching out to the users were required. The librarians believed that the 4IR was fast-tracked by the lockdown, as it forced the

librarians to embrace new ways of working with technology. Similar to Momoh and Folorunso's (2019:2) account that the roles and responsibilities of academic librarians over the years have evolved with the influence of technology, the DUT librarians also agreed that their job functions had transformed over time. The participants were mostly grateful that with the new technology and virtual platforms, they could continue working and providing a service to users. The findings of this study seemed to build in particular on the work of some of the researchers reviewed in Chapter Two. Librarians acknowledged that their roles and responsibilities evolved and changed with the introduction and implementation of new technologies. More users could be trained online and the users were no longer restricted to a confined space. The pandemic certainly fast tracked online and virtual classrooms for the library users. As soon as the university handed out data bundles to the users, the online classrooms and chats were populated. The librarians at DUT were soon responding to user messages and enquiries via their emails, LibChat, and online chats. These findings, as described by the participants in Chapter Four, are clearly in sync with Shupe and Pung (2011:409) in that the roles of librarians transformed rapidly with technology.

The data obtained are largely consistent with those of the other studies that were discussed in the literature review (Chapter Two). The roles and responsibilities of academic librarians have been impacted by technology, and new ways of working have been introduced as librarians are forced to meet the needs of their users by learning new ways of interacting with them through virtual platforms. This seems to be confirmed in Rahmah's (2020:358) study, as the author alludes to librarians transforming with "smart thoughts and actions" to meet the new innovations head on. A response from some participants regarding the changes the 4IR brought was the rapid turnaround time in receiving responses from users as the tasks were done virtually. The users were impressed with the online platforms and interacted robustly with the librarians. This is in line with Rahmah's (2020:358) study, in which he outlines that librarians are required to face the changes brought about by the 4IR and respond quickly to meet the dynamic demands of the library and users. The findings highlighted new roles that librarians had to adjust to and the *modifications of their job profiles* as they embraced the changes. The DUT library is evolving with the changes and introduced new portfolios and designations that are in accordance with changes in the

library environment. The DUT cataloguers found that they were cataloguing and adding metadata to more online resources and open-source works, such as e-books, dissertations, journal articles, and conference proceedings. The cataloguers' work evolved with the handling of fewer print resources and more electronic resources, and they found that they worked predominantly with many open-source databases and on the institutional repository. There were fewer print items for the processing staff to process and prepare for circulation. The processing staff were involved in mending and other library projects due to the decline in the number of print items. The DUT library created a digital librarian post to oversee the open scholarly research, which included library publishing, institutional repositories and research data management within the library. This is similar to research by Cox and Corrall (2013:1533) where the need for data curators, scientists, and open scholar posts for libraries is discussed. The findings are further consistent with Cox and Corrall (2013:1534) regarding information literacy skills and research instruction education that DUT librarians are involved in and the use of online platforms such as Moodle, Microsoft Teams, and other learning platforms. The findings are in sync with the literature review in Chapter Two, with regard to promoting the university's research output on open scholar platforms. The findings revealed that the subject librarians were actively involved in the teaching and learning activities with users and were partners with the faculties in reaching out to users about information literacy training. These teaching and learning aspects evolved with new technologies and most of the interactions moved to online sessions, which improved the teaching and learning experienced for users and librarians during the pandemic.

The DUT librarians as noted in Tenopir et al (2014:85) are on the front line in implementing research data services plans within the institution. Librarians are regarded to be more equipped and prepared to deal with researchers and understand the management of research data. The libraries need to be in the forefront and involved throughout the research process, which includes, curating, advising, and preserving the research outputs (Tenopir et al 2014:84). The introduction of research data management (RDM) services influenced the current work of academic librarians. As the findings further revealed, librarians were involved in working with researchers to encourage them to participate in research data management plans. The

researchers were mistrustful and protective of their data so they needed to be convinced that it was in their best interest to store their data safely and that it could help other researchers in the same field. This is aligned with Wong and Chan's (2018:111) view that research data management and digital scholarship are fast-growing initiatives that require the expertise of librarians to guide the development and implementation of these processes. As Tenopir et al (2014:85) point out, universities have a responsibility to transform with changes and ensure that they are able to meet the dynamic demands of academics and researchers by providing support to research activities. Activities relating to RDM and data-sharing services need to be encouraged, and with libraries and the skilled research librarians, it is understandable why this service is usually directed at the library as a starting point. The DUT library is actively involved in drafting the RDM policy and promoting this service with a dedicated librarian to follow up with the data management plan. The DUT librarians were encouraged to attend an RDM training session organised by the library management in 2018/19. This gave the librarians an opportunity to understand what was expected of them and the researchers in the implementation of RDM services at the university. Ahmad et al (2019:210-211) raise the discussion on the management and organisation of data and the different roles that academic librarians have with analysing, cataloguing, and storing the data for retrieval purposes. Librarians are supporting researchers and helping with ethical issues surrounding data storage and retrieval. This is another indication that the roles and responsibilities of academic librarians are transforming as needed. Although Ghislieri et al (2018:2) highlight the technological changes the various 4IR innovations introduce to the library environment and how it can change the way librarians work, not all librarians are affected in the same way. At DUT, cloud and mobile computing, and, to a certain extent, big data and machine learning are at play. Both staff and users are adjusting to these new ways of storing, accessing, and retrieving information. In essence, this type of technologies allows for much more freedom in the seamless accessing of information at any place, at any time, and this increased the librarians' productivity in making the information readily available for the users' consumption.

The interview participants believed that the increase in online resources enhanced library services and that users were benefitting from the online resources. Online

resource usage was predominantly much higher than physical resource usage, although this was mostly due to the pandemic and the closure of the university. The DUT library uses LibChat, which is an online chat service embedded in the subject librarians' and the library's web page, to interact with, and reach out to, users. Due to print decline in the purchasing and physical circulation of print resources, the workload and roles and responsibilities of the circulation staff have transformed. Some of the circulation staff have been added to the LibChat service to help with the user interaction, whilst others with an interest in technology have been encouraged to join the library IT section to help users with technical support. Although most of the participants believed that online and virtual services and the 4IR was a great transition, a few participants did not believe that the change was good for users. These participants believed that users were lost without face-to-face interaction, and that the type of students attracted by DUT was mainly from disadvantaged communities and was not familiar with new technology and innovations. Students in disadvantaged communities had no access to data or internet connectivity, and these sentiments were shared by Nyahodza and Higgs (2017:40), who found that users / students in disadvantaged communities cannot afford educational resources and internet access. Sutherland (2020:233) also expresses concerns regarding the lack of infrastructure in certain areas to support internet coverage and online educational resources. The DUT library provided on-site infrastructure for users, which includes free access to Wi-Fi and the circulation of tablets and laptops to enable users to access the online resources. Although data were provided for all registered DUT students during the lockdown, it is not known whether all students had devices to access the online resources.

The findings highlight the significant changes in the roles and responsibilities of academic librarians due to the evolving technological innovations. Librarians are adapting to new tasks and embracing technology integration to meet the evolving needs of library users in the digital age.

5.2.3 Skills and competencies for academic librarians in the new role

In seeking to investigate and analyse the skills and competencies that academic librarians require in the 4IR, it is necessary to first consider the way the evolving

technologies affected the academic libraries. Emerging technologies and innovations in the 4IR have highlighted the gap in librarian skills with all the new changes that have affected libraries. The 4IR created new opportunities and new ways of working whilst redefining jobs and skills for librarians which will enable faster service delivery and increased productivity to users (Ayinde & Kirkwood 2020:143). The findings are consistent in that the participants firmly believe that librarians need to redefine their current skill set and embrace new skills to ensure they are able to continue to be competent in providing quality services to the users. Communication skills and interpersonal skills are desirable skills for any librarian, regardless if the librarian works in the technical services or in the public service as it is necessary to communicate with users and with other librarians (Gerolimos and Konsta 2008:696). The findings revealed that technology, communication, creativity, critical thinking, problem-solving, and analytical thinking skills, and the ability to adapt to changes were essential skills that a librarian needed to possess to navigate through the 4IR. The data obtained from the participants were broadly consistent with the major trends in relation to the skill set required for the current environment, as discussed in Table 2.1 in Chapter Two of the literature review. These skills that were derived from the data are set of skills that will continue to be in demand in the future according to the World Economic Forum (2020:104-108). Although the findings revealed an important set of soft skills that is in line with current and future skills requirements, the findings were limited in mentioning the importance of emotional intelligence that is required in any workplace and job. Eberhard et al (2017:55) discuss the importance of critical thinking skills and creativity for future workers. Librarians should be more creative in developing new services and adapting to new ways of working to reach users.

The need for librarians to improve their skills and practices by partaking in applicable training programmes to keep up with the advancing technology is highly recommended (Ahmad et al 2019:211). This is in line with the findings that suggest that continuous participation in webinars, trainings, and networking activities will increase librarian knowledge and skills. As reported by Eberhard et al (2017:53), economic growth and productivity at any institution are supported by skilled staff and to ensure that future librarians are knowledgeable, it is essential that librarians consider the emerging trends that appear with the 4IR and update their skills accordingly. The findings revealed that most of the librarians were adequately skilled

in their current posts. The DUT library cataloguers were advised during their tenure to learn and understand the various new cataloguing standards. The transition from SA MARC to MARC 21 had an impact on the cataloguing section of the DUT library, soon after the cataloguers were once again confronted with another international change from AACR2 to RDA (Resource Description and Access). The cataloguers are constantly reading up on new cataloguing standards and made the transition from AACR2 to RDA seamlessly. New technology impacted on and changed the scope of various roles and functions within the academic library. Librarians had to familiarise themselves with digital trends and be able to navigate their way with digital resources. Raju (2017:751) states that it is crucial for librarians to have and understand technical skills in order to manoeuvre online platforms such as institutional repositories, digitised resources and research data, to name a few. The subject librarians were able to engage and interact with the users via the online platforms, whilst the circulation staff were trained in LibChat as the need arose to draw them to help with user queries. Participants revealed a variety of skills that are relevant to librarians currently employed at the DUT library. The findings revealed that the skills listed in Table 5.1 were some of the skills that librarians needed to possess and were more or less aligned to the skills listed in the World Economic Forum (2020:104-108), as described in Table 2.1. The findings further revealed that communication, technology, and complex problem-solving skills emerged as the most highlighted set of skills that librarians need to possess. Other generic skills identified by the participants as critical skills required for librarians include good listening skills and people skills. The study emphasised the importance of librarians possessing a diverse set of skills and competencies to navigate the 4IR landscape effectively. This includes technological proficiency, information literacy instruction, data analysis, and collaboration skills. Developing and enhancing these skills are crucial for librarians to remain relevant and provide quality services.

Online skills, flexibility, teaching (and training) skills, and customer service also gained notable mentions. Skills that are required for the 4IR, according to Ayinde and Kirkwood (2020:148), are basic cognitive, higher cognitive, social, and emotional skills, physical and manual as well as technological skills. Table 5.1 provides a varied list of skills that emerged from the findings. Participants recognised that the skills listed in Table 5.1 were essential skills that librarians needed to possess to provide quality

services to users in the changing library environment. This is in line with the argument of Kayembe and Nel (2019:90) that 4IR will require a new set of skills for the future. The new technologies require specialised skills and competencies and educational institutions need to be in the forefront for the development of these new specialised skills. The emerging skills listed in Table 5.1 that arose from the findings are consistent with the predicted skills requirements for 2020 and 2025, as shown in Table 2.1. The skills derived from the findings are consistent with the skills required for the future workforce. It appears that the participants are aware that the future job requirements expect them to be versatile, creative, and flexible in their job and be able to think out of the box.

Table 5.1: Basic and cross-functional skills

Cognitive skills	**Process skills**	**Technical skills**	**Interpersonal skills**
Creativity skills	Critical thinking	Quality control	Communication
Analytical skills	Active listening	New technology	Flexibility
Problem solving	Pedagogic competency	Online platforms	Customer service
Organisational skills	Teaching skills	System skills	Team work
Research skills	Planning and executing skills	Software skills	People skills
Publishing skills	Strategic marketing skills	Data analysis skills	Liaison skills
Ethical skills	Collection development	Digital literacy skills	Emotional intelligence

5.2.4 Effects of the 4IR on the roles of academic librarians in the changing information environment

This section will look at how the 4IR affected the regular ways of working of academic librarians. Momoh and Folorunso (2019:7) allude to the changes that the 21st century librarian would undergo with the invention of ICT within the library and information sector. Similar to Momoh and Folorunso (2019:7), the DUT librarians have undergone many changes in this era and embraced many opportunities. The participants made reference to the many opportunities surrounding open access and the openness of data and information. This resonates with the DUT librarians, as the main focus is now on the librarians ensuring that users become familiar with researching and promoting the research ratings of the university. The DUT research office works closely with the

library to promote researchers and to market the researchers' achievements. Similar to what Hamad et al (2020:3) prescribe, the librarians are involved in creating and organising digital content of archived resources to make it discoverable online for users. Authors Bedi and Walde (2017:314) acknowledge that the academic librarian's role is continuously advancing and that the librarians serve as research partners, practitioners, and collaborative participants within the faculties of the respective institutions. DUT librarians are influenced by global technological changes and the demand to produce high-quality research ratings, which, in turn, have affected teaching and research efforts within the university. As Bedi and Walde (2017: 317) explain, academic librarians are much more involved in research aspects and are now research partners with academics and faculties. This aligns with the DUT library, as the librarians are actively engaging with researchers in research services, data analytics and RDM activities. The RDM policy was accepted, and the infrastructure created to house the research data. The library works closely with researchers and faculty to promote the publication of Open Educational Resources (OERS). The DUT library has evolved and is actively involved in promoting the publication of open books and journals. The library has a website[1] for open books and a journal website[2]. This platform is for the publication of DUT's open access monographs, textbooks, and open journals. These open access publications are managed by the Digital Librarian. The role of academic librarians is evolving and advancing with new technologies to embrace new ways of working and providing services to users (Bedi & Walde 2017:314; Force & Wiles 2020:197; Shupe & Pung 2011:409). Participants referred to the numerous online databases and platforms that the library subscribes to and is seamlessly available for users. The DUT library created and employed a post for a marketing librarian. This is in keeping with changes within the library and information services to promote the library. Social media impacted on many libraries and this online platform is assisting in marketing and promoting the library services (Momoh & Folorunso 2019:7).

As Nkuebe and Raju (2020:197) mention that technology affected the academic librarians' traditional ways of working and that they need to adjust to the changes. This

[1] https://openbooks.dut.ac.za/index.php/dut
[2] https://journals.dut.ac.za

is equivalent to how new technologies impacted on the DUT library staff. The use of new technologies affected the way circulation staff interact with users. This is aligned with Krubu and Osawaru's (2011:3) assessment that technological innovations created more learning opportunities and the demand for librarians to learn new skills. Apart from the pandemic and the closure of the university, which affected the number of users physically visiting and using the library, the implementation of RFID tagging of library resources allowed users to self-check in and out of library resources. The users only interacted with library staff if they encountered any issues whilst using the self-check machines.

The library migrated to a new integrated library system called FOLIO. This cloud-based library system is an open-source system that is a collaboration between librarians, vendors, and developers. This system provides core backroom library modules and provides traditional library functionalities (FOLIO 2022). This system changed many roles and processes within the library. The librarians had to learn new ways of working and new terminologies. This is similar to Fernandez's (2020:24) findings that workers had to learn new ways of working to improve productivity levels. This integrated library system allowed many tasks to be done remotely. Librarians that were forced to access the previous systems only on campus and via a confined server were now able to access FOLIO from anywhere as long as there was internet access. This meant that acquisitions, periodicals, and cataloguing transactions that were usually confined to on-campus access could now be done remotely. This allowed technical services staff to continue working remotely during lockdown and allowed librarians to continue providing a service to users, as there were no delays and constraints in providing access to library resources. Without the adoption of the cloud-based library system, this remote work would not have been possible. The new system and enhanced technology allow librarians to be flexible and still be able to provide an excellent service to users. The service delivery to users was more enhanced and faster with the access to information. The DUT library is moving towards purchasing and marketing more electronic resources and moving away from the purchasing of print items.

Although most librarians are content with the new ways of working and the move to adopt more online work, there is a bit of resistance from other staff. Staff who cannot

work remotely and who are restricted to working from the library include the circulation, processing, IT technicians, and the periodicals staff. These staff members need to be physically present on site to continue with their work. Participants expressed concern about the nervousness and fear surrounding their actual jobs. The fear of the unknown and how new innovations could replace them in continuing to provide a service was evident in some of the responses. With circulation, self-check service stations reduced the number of staff that was now required to man the circulation desk. The introduction of robots in some libraries to assist with shelving and shelf reading was another threat to the stack attendant jobs.

As Fernandez (2020:23) suggests, the threat and fear of automation is real, as it can overtake human jobs and disrupt lifestyles, even though the new technologies add more value and efficiency in daily lives. It may be time to rethink the way libraries operate, and as technologies increase, there is always a need for human interaction in providing the technical services for the machines and devices. This implies that affected or redundant staff can learn new skills to help survive in the transforming library world. The main challenge in this is that most of the staff in the redundant jobs do not possess the appropriate library qualifications to move to other jobs. However, it can be argued that these affected staff have more experience in the library environment due to the number of years they have worked in the library. This kind of experience and knowledge can be beneficial to other qualified library staff. As stated by Ayinde and Kirkwood (2020:144), regardless of what many believe, “humans cannot be removed from the day-to-day activities” at any institution or organisation. There will always be a need for people to programme the machines, to synchronise the data, and so on.

5.2.5 Utilisation of continuing professional development to embrace the changing landscape of libraries

As the library profession is constantly evolving, librarians are actively accepting new challenges and adopting new ways of working to enhance their knowledge and skills (Bedi & Walde 2017:323). Participants unanimously agreed that CPD is an important aspect of librarianship and that it improves the professional competence and skills of librarians, which is in line with Brine’s (2005:131) thoughts that CPD is crucial for

librarians to remain relevant in their profession. The willingness of participants to adapt and learn new skills has positively impacted their evolving roles as librarians. CPD encompasses formal and informal learning. Informal learning is what is learnt on the job as one continues to work and by watching and learning from peers, colleagues, and mentors. Formal learning is learning derived from a formal academic study that produces a certificate or a qualification at the end of the course. Ongoing learning is similar to informal learning and is absorbed by observing and emulating colleagues and peers. Nkuebe and Raju (2020:197) raise a relevant point concerning new technologies within the library and information sectors. With new technology, new demands occur, and the changing landscapes forced academic librarians to improve their skills and competencies and to rise to meet the growing needs of the users. The findings revealed that the participants understood that CPD allows them to improve upon their services to their users and continuous engagement with new trends allows them to better understand the impact of 4IR on their discipline. The findings further revealed that the librarians recognised the importance of CPD and developing lifelong learning skills as a way to empower themselves and provide a good service to the users and this is on par with Gleason (2018:7) and Mooko and Oladokun (2021:226) who point out that learning never stops and that it is important to stay abreast of trends in one profession to ensure that service delivery is never compromised. The librarians are encouraged to attend suitable training and CPD activities directly in line with their jobs. At the beginning of each year, the library management is tasked with discussing and drawing up personal development plans (PDP) with each librarian within their ambits. This is in line with the university's strategic and skills development plans to ensure that staff are well developed and equipped with the relevant training to allow them to continue with their duties efficiently.

The literature is clear about the changes brought about with the rapidly changing technologies and the challenges that academic libraries and librarians face (Nkuebe & Raju 2020:199). The librarians at the DUT library are clear that to remain relevant in their discipline, they need to participate in ongoing CPD activities and keep abreast of trends within their areas of interest, which is in keeping with Moonasar and Underwood’s (2018:47) sentiments that CPD is essential to remain relevant and up to date with trends. Chanetsa and Ngulube (2017:191) also suggest that librarians need to continuously develop themselves to remain confident and suitable for their teaching

and research responsibilities, which evolve in a vibrant innovative environment. Nhede (2018:208) emphasises that the 4IR demands highly skilled staff and that staff must continuously improve their knowledge and abilities to remain relevant to changes within the profession. The findings also revealed that the lack of employer support to motivate staff to pursue continuous learning activities due to time, financial constraints, and insufficient training programmes would have a negative impact on librarians and their productivity levels. However, when the employer provides a supportive environment and encourages CPD activities, it contributes positively to the growth and success of the library. Supportive management creates a culture of learning and increases staff productivity outputs, as staff feel more valued and motivated, and this is supported by Kennedy (2014:236). The participants believed that by embracing new technologies and improving their skills, they were better equipped to deliver a service and be confident in their jobs. The participants were on the same level as Ayinde and Kirkwood (2020:143) in that they believed that the 4IR came with both challenges and opportunities. With the 4IR, there was a chance to create new knowledge that allowed the librarians to redefine their jobs, increase their skills level, and be able to deliver better and faster services to their users. People will not be outdated in the 4IR, but will only need to continuously update their skills and training to remain relevant. Although machines and robots are able to outperform humans in productivity levels, they will not be able to display emotional intelligence and judgements, as people are able to, but still require input from humans. Therefore, the robots will need human interaction and the humans will require the 4IR technologies. As Ayinde and Kirkwood (2020:145) clearly state, there can be a "symbiotic relationship between human and smart technologies."

Although the academic libraries strive to rise to the challenge of implementing 4IR innovations, they also face many financial challenges in implementing new technology. It is a challenge to meet the demands of continuously educating existing staff due to budget cuts within the organisations. The DUT librarians need to ensure that they are able to transform with changes so that they will be able to retain their jobs in the future. Many technologies are programmed to take over various functions in libraries and librarians need to ensure that they are able to provide a service together with new innovations. Many librarians usually have basic academic and theoretical training and lack the practical side of librarianship and actually providing a

service for users. The 4IR is challenging, but exciting to embrace the new technology and implement it to enhance library services. The 4IR is a wonderful opportunity to be part of the digital online environment and build lasting new collaborative partnerships all over the world.

5.2.6 Library infrastructure for the 4IR

The university demonstrated its commitment to supporting new technologies by investing in infrastructure and bandwidth. This includes the transition from physical in-house servers to cloud-based technology, which offers numerous benefits. The university's dedication to providing a robust infrastructure is crucial to facilitate 4IR activities and create an environment that fosters creativity and technological innovations. According to Nkosi et al (2020:2121), academic institutions that prioritise and invest in a solid infrastructure to support 4IR initiatives can significantly contribute to the growth and productivity of students. By creating workspaces that encourage creativity and provide the necessary technological resources, universities allow students to thrive in their studies and enhance their overall output levels. Abo-Seada (2019:19) emphasises the importance of having the necessary hardware and software infrastructure to support 4IR advancements. To ensure the success of students and enhance productivity levels, the university must provide a supportive educational infrastructure that promotes effective teaching and learning activities. The library benefits from the robust internet connectivity of the university, which allows the successful integration of new technologies and the continuous development of the library environment. Recognising the need for cloud-based library systems, the library proactively worked towards implementing such systems, ensuring a gradual introduction of new technologies to staff. Although not everyone may. Have realised it, these efforts align with the principles of 4IR technology. It is worth noting that the university as a whole demonstrates a proactive approach to securing the necessary infrastructure to support 4IR initiatives, as highlighted in the Envision2030 report (2022).

Before the lockdown, the library was actively engaged in migrating to a new cloud-based library system and implementing RFID technology. These initiatives served as evidence of the library's commitment to establishing the necessary infrastructure to

support technological advancements. This observation aligns with those of Nkosi et al (2020:2117) who emphasise that infrastructure not only encompasses physical hardware and software, but also includes the librarians and the users. The DUT library recognised the evolving needs of its users and successfully redefined its physical spaces to accommodate new ways of using the library. The library transformed from a traditional silent study hub into a multifunctional environment that included discussion spaces, areas for creativity, and spaces for relaxation. It became a social gathering place that facilitated interactive discussions and fostered a sense of community among its users.

The library's commitment to embracing technology is evident in its efforts to incorporate creativity into its services. One of the site libraries at DUT was being prepared to house a makerspace, which provided an exciting and unique workspace for the new generation of users (DUT 2023). This initiative highlights the library's proactive approach to offering innovative and creative resources and spaces to its users. The library as a neutral space within the university is advantageous, as it facilitates collaborations with various faculties and departments in implementing new technologies in the evolving environment. The library's readiness for the 4IR and its ability to adapt to new technological advancements were commonly acknowledged among the findings. However, it is important to differentiate between library transformation and digital transformation. While the library's current initiatives may appear to align with the 4IR, they are primarily focused on digitisation and the transition of resources to online platforms (Sutherland 2020:237). Participants expressed confidence in the proactive and forward thinking approach of the library, anticipating that the implications of the 4IR on the library would be managed effectively. Additionally, the findings revealed the DUT library management team's creative use of retired staff posts to create new positions that would drive the library forward with new innovations. This aligns with the assertion of Ayinde and Kirkwood (2020:144) that people remain integral to the day-to-day operations of libraries, particularly in coordinating and implementing new technologies.

With new technology comes different responsibilities, as different technologies have different challenges (Goetsch 2008:162; Orick 2000:316). The challenge that

technology provides is that it needs to interact with other systems. There is a need for interoperability between systems and with new systems. Any data saved in one format should be able to be read on a new, more advanced system. The DUT library had systems in place to ensure that there would be no issues in accessing information in the future. It is safe to say that the DUT library is ready for new innovations and 4IR implications. There are many ideas and activities to incorporate into the library. The library team is aware that collaboration and building good partnerships with researchers, faculties, and departments within the university is vital to continue to embrace new initiatives and innovations. Currently, the library IT staff are working closely with the university ICT department to finalise a robot to help users locate information within the library. There are several ongoing projects related to data analytics. It is an exciting time for librarians to evolve and embrace the new opportunities that 4IR produces.

5.2.7 A model to align librarian roles and skills with the 4IR

As long as the librarians understand that there are many changes impacting on the library environment and that they are required to be flexible and adapt to the changes, it will be possible for the librarian roles to be aligned with 4IR implications. As Maimela (2019) mentions, people are the drivers of change as they need to steer the systems and processes that new technology introduces. As outlined in the findings, the librarians have adapted their work to align with the 4IR. The era of pushing forward with open access resources, encouraging researchers to share their data, and the move to publish within the library was highlighted in the responses. The idea of moving staff to new posts that accommodate new ways of working is currently being undertaken at the DUT library. Staff are being reskilled to posts were there is a demand, such as in the library IT section, and this is aligned to Ahmat and Hanipah's (2018:60) sentiments that the libraries need to align their structure to support the changing environmental needs of the profession. New posts were created to assist with data curation. Librarians are identified to help researchers with research data and improve publications. Cataloguing librarians are now involved in cataloguing e-resources such as e-books and adding metadata to institutional repository items. As highlighted in Chapter Two of the literature review, the librarians are actively involved in building the collection development resources to align with online transactions and

the focus is on increasing the online resources for users. Librarians participate in continuous learning activities to improve their skills to comply with advancing technologies.

5.3 Summary

This chapter discussed in detail the interpretation of the findings and the findings were supported by the relevant literature. Data interpretation in this chapter was based on themes consistent with the study research objectives. The findings of this study were consistent with the documented literature reviewed in Chapter Two. The next chapter presents the summary of key findings, conclusions, and recommendations of the study.

CHAPTER SIX
SUMMARY OF STUDY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The previous chapter discussed the findings, analysis, and interpretation of the data. This final chapter presents the summary of the study findings, conclusions, and the recommendations of the study. This chapter focuses on presenting the summary and recommendations based on the study objectives. This chapter is necessary in that it allows the researcher to gather all the data and provide an analysis of what the study derived through the data collection and how it all ties together as alluded to by Leedy et al (2019:2) that the information gathered should lead to an understanding of the research objectives. The study focused on exploring the impact of 4IR on academic librarians and the role of librarians in adapting to the changing information landscape through continuous professional development. The study adopted an explanatory mixed methods approach as the researcher first conducted and analysed the quantitative research and then expanded on the results to describe it in more detail with qualitative research as this enhanced the validity of the research findings. This study collected data related to the specific objectives of the study. Specifically, it looked at:

- determining how the roles and responsibilities of academic librarians have evolved in view of current disruptive technologies that drive the 4IR;
- identifying skills and competencies that will help academic librarians understand and transform with the impact of innovation and technologies;
- establishing the effects of the 4IR on the roles of academic librarians in the changing information environment;
- determining how academic librarians utilise CPD to embrace the changing landscape of libraries;
- assessing whether the current infrastructure of the DUT library supports the 4IR and the changing roles of librarians;
- suggesting a model of aligning librarians' roles and skills with the 4IR.

6.2 Summary of findings

This section presents a summary of the findings for the six research objectives addressed in this study. These objectives served as a framework for the analysis and interpretation of the collected data, enabling a comprehensive discussion of the findings in relation to the study. This aspect of the study provides a summary of the main points of the study findings and not specific findings (Babbie 2013:397). During the pandemic, the DUT library was forced to adapt to online instruction and communication. In a way, it accelerated the 4IR within the DUT library. Although infrastructure and support systems were in place, the change was not easily accepted, and the librarians did not immediately adopt the new systems. However, with the pandemic, the systems that were in place were used and they were provided the support the users required.

6.2.1 The evolving roles and responsibilities of academic librarians

The first objective of the study was to determine how the roles and responsibilities of academic librarians evolved with the onslaught of the new disruptive technologies that drive the 4IR. The study showed that the roles and responsibilities of the academic librarians have evolved at the DUT library, which is consistent with the information of Force and Wiles (2020:197), Momoh and Folorunso (2019:2), and Shupe and Pung (2011:409). Although most of the librarians' usual way of interacting and working with users evolved to different platforms and different ways of communication, some librarians struggled with data connectivity and loadshedding. Although more and more of the librarians were comfortable working remotely and still able to deliver a good service to the users, others struggled and preferred the face-to-face interactions with users. Remote work was activated by the lockdown and transformed the way librarians worked. The results showed that most librarians enjoyed the flexibility of working remotely and were able to interact and communicate successfully with their users. Apart from COVID-19 impacting and causing a decline in face-to-face interactions, technology also improved and evolved to accommodate the new ways for librarians to interact and reach out to their users. The importance of libraries was certainly highlighted during the pandemic. The fact that the librarians took the shift in their work environment in stride and proceeded with online interactions and the provision of

digital information must be acknowledged. Users' needs were prioritised, and the DUT librarians endeavoured to meet their needs via digital content.

Particular attention can be paid to the way that the DUT librarians adapted to the progression of job responsibilities and the new requirements that emerged with the changes, which is similar to Rahmah's study (2020:358). Although, it cannot be said that everything was smooth sailing. There were issues with data bundles and not all staff and users were able to access the internet at all times. The turnaround time for service delivery and responses to users improved with online interactions. The need to expand library services and create new posts was acted upon and a digital initiatives librarian post was created to oversee open scholarly research and publications. Another data curator post was created to assist the Digital initiatives librarian. Cataloguing librarians were drawn into metadata services and assisted with open scholarly works in the institutional repository and with RDM services. A cataloguer was identified to work in collaboration with researchers and involve them in research sharing initiatives, as the cataloguing librarian was identified to be more equipped and organised to work in collaboration with researchers regarding their research plans, which also ensured that the cataloguers kept continuously abreast of the international standards and rules (Han & Hswe 2011:129). Librarians are drawn into the university's strategic plans to increase university research output and increase researchers' visibility in the research arena. The advantage of this is that the librarians have formed good collaborative partnerships with other departments and facilities in promoting research and open research initiatives. The overall findings revealed that even though the ways of interacting with users have evolved the core essence of the librarian remains the same which is to provide access to their users. The emergence of new innovations only adds more value to the shift in the way the librarians work and reach out to users.

6.2.2 Skills and competencies for academic librarians in the new role

The second objective of the study was to identify the skills and competencies that will help academic librarians understand and transform with the impact of innovation and technologies. From the research that has been conducted, it is possible to conclude that the main set of skills the librarian needs to survive in the 4IR includes but is not

limited to technical, creativity, analytical/critical thinking, emotional intelligence, communication, teamwork, people skills, and sound judgement and decision-making skills. Librarians require technical competencies to be able to navigate their way through information storage and retrieval processes (Hamad et al 2020:3).

The results of this study are consistent with other studies, and the literature indicated that the top skills and competencies to survive in the 4IR are similar to the findings of this research. New technological innovations force librarians to constantly learn new ways to work and engage within the library and information environment. Librarians have learnt how to navigate their way through various new platforms such as Moodle, LibChat, MS Teams, Zoom, to name a few in order to reach their users. The new software and platforms are available to provide librarians with a way forward to interact with users. The various platforms ensure that there is a direct communication link between the librarians and the users. In addition to the various skills derived from this study and the literature, an important discovery was made about the ability of librarians. Peiffer (2015:7) believes that in the 4IR, the qualifications and abilities of employees are important and the willingness to engage in continuous learning development in order to remain relevant and provide a good service. Particular attention is paid to the ability of librarians to be flexible and the ability to adapt to changes within their discipline (Tella et al 2018:6). The ability of librarians to transition from one way of working to another projects the resilience of librarians in times of change. Librarians are expected to have an open mind-set and be willing to learn new skills and competencies to reach out to users.

6.2.3 Effects of the 4IR on the roles of academic librarians in the changing information environment

The third objective of the study was to establish the effects of the 4IR on the roles of academic librarians in the changing information environment. The 4IR introduced new innovations in libraries, and this caused a change in the conventional ways of working of librarians. There is a shift from the print collection to an online collection, and librarians need to know and understand the changing needs of users (Raju 2017:751). The increase in digital technologies has transformed the way academic libraries collect, store, manage, and disseminate information. The use of smart technologies is

predominant, and users are engaging with new technologies, which, in turn, forces librarians to learn and understand new technologies.

The DUT librarians clearly understand that big data, IOT, and smart technology is upon them. The 4IR brought about an increase in data and academic librarians are expected to be able to analyse and manage this data to effectively support the university's research outputs. The need for librarians to convince researchers that sharing and saving their data are important to them and the rest of the research world is clear. Data are the future currency and libraries produce enough data that need to be adequately retrieved and analysed (Shao et al 2018:805). The librarians understand that the library is gradually moving towards becoming a smart library, and technology is in place for the library to accommodate the new innovations. The DUT library services and interactions with the users have greatly improved with the new technologies and new ways of working. User needs are addressed and satisfied almost instantaneously.

The results indicated that regardless of the exciting changes and addition of new technologies, there is a growing concern about job losses and that the new technology can replace and reduce the number of staff working in the library. The fear is that robots can replace stack attendants, and the new RFID self-service units make circulation staff redundant (Ayinde & Kirkwood 2020:142).

6.2.4 Utilisation of CPD to embrace the changing landscape of libraries

The fourth objective of the study was to determine how academic librarians use CPD to embrace the changing landscape of libraries. It is imperative that librarians continue to pursue activities that will allow them to remain relevant in their discipline (Postle et al 2002:167). The ongoing learning can be a formal or informal continuous learning. LIASA is continuously marketing and providing a space for new learning activities and encouraging the library professionals to attend and activate their current skills, and this is supported by Mulvey (2013:268) who believes that the relevant professional body should promote CPD activities for the members to encourage active participation. Publishers and other vendors continuously promote webinars and introduce new learning activities that librarians can attend and improve their current knowledge base. Librarians acknowledged that CPD was important and that keeping

up to date with trends increased their skills and level of competence and allowed them to provide better services to their users.

The present findings are consistent with the literature in that continuous education and upskilling is important and beneficial for librarians to stay up-to-date with new changes in the library environment (Engelbrecht et al 2007:580; Gleason 2018:7). The applicability of these results are confirmed when new technology is introduced to the library, it is the librarians themselves who are tasked to learn the workings of the new system and align it to function as required in the new environment. This confirms the notion that there is a symbiotic relationship between technology and people. Librarians will always be required with their unique skills set to provide services to their users. When librarians understand the importance to lifelong learning and ongoing learning, it makes it easier to acquire new knowledge and skills with little resistance. The attitude towards acquiring new skills and understanding that learning never stops is a step forward toward providing a better service to users, as librarians equip themselves with the knowledge to pass on to the users. Gerolimos and Konsta (2008:691) state that librarians need to be able to conform to new technological changes and adapt to new ways of working. It is imperative that the CPD learning initiatives that librarians attend be systematically disseminated to other librarians within the relevant departments and implemented in the daily job functions (Campbell-Meier & Goulding 2021:3). This will streamline the CPD activities and the learning acquired from these activities can be monitored to ensure that CPD activities are effective in the workplace.

6.2.5 Library infrastructure for the 4IR

The fifth objective is to evaluate whether the current infrastructure of the DUT library supports the 4IR and the changing roles of librarians. Overall, the results indicated that the DUT library is ready for the 4IR and continues to acquire infrastructure to support 4IR innovations and accessories. The introduction and acquisition of a space to launch the new MakerSpace facility at the Indumiso campus site is a step in future collaborations and partnerships with various sectors to embrace the new ways of providing a collaborative and creative workspace for users (DUT 2023).

The DUT library was fortunate to be part of a team in the wider DUT community, where there is a wide range of critical thinking and creativity among team leaders. Skilled

staff are also an important part of the infrastructure and adds to the economic growth and development of any institution. Within the library itself, there is an abundance and variety of skills required to drive the 4IR process forward within the library staff. The challenges of the technical knowledge gaps within the library staff were addressed and staff training and development activities were in place to support staff needs. DUT's strategic plan is very clear in their intent, which boldly declares that: "by 2030, **Our people will be creative, innovative, entrepreneurial and adaptive to changes in the world**; Our people will participate productively in the development of our region, country and the world; Our state-of-the-art infrastructure and systems will enhance an ecosystem to achieve this vision" (Envision2030 2022). This intent is clear in that DUT is striving to have a well-developed, 'state-of-the-art infrastructure that will support emerging technological advancements.

It was interesting to note that none of the responses alluded to the impact of power outages or the lack of South African infrastructure and its implications for the DUT as a whole. It can be noted, however, that despite the widespread power outages and effect on the economy, the DUT library and its parent body are striving ahead with 4IR. The university infrastructure provides a good enough support for the library initiatives and systems. This in turn allows the library space to explore adequate systems that can make the learning and information easily accessible for the students. Connectivity infrastructure is a key requirement for 4IR services and innovations. The DUT community has implemented the systems in place and continues to monitor and build on them to ensure that the infrastructure is sufficient to drive 4IR at the institution (Envision2030 2022). Free Wi-Fi on campus and at the student residences is available for all staff and students use. It is clear that the lack of proper infrastructure and staff skills can be a huge obstacle to prepare students for 4IR and the varying disruptive technological inventions.

It is safe to state that the DUT library has undergone a digital transformation during the pandemic. The focus shifted from face-to-face interactions and provision of information to ensuring that the library collections were adequately supported for digital use and retrieval. The purchase of printed materials declined whilst the online subscription packages increased. This was done to ensure that user needs were adequately accommodated and satisfied. The university ensured that all students

have adequate data subscribed to them on a monthly basis to continue with their online studies and the library has ensured that the library collection can be easily accessed by users regardless of their location.

6.2.6 Aligning librarian roles and skills with the 4IR

The final objective of the study was to suggest a model of aligning librarians' roles and skills with the 4IR. As was pointed out and discussed throughout this study, it is important and essential that librarians are flexible and accommodating to changes within their discipline. Librarians must align their structure to evolve with the increasing technological changes that impact the way users interact and access information. From the research carried out, many of the DUT librarians have proven that over time, they are resilient and able to adapt to the technological changes that impact on their work. The librarians adhered to new ways of working and ensured that during the lockdown, they continued to provide a service to the users. The new acquisitions and conversion of old library posts have shown the move to embracing new ways of working and open access initiatives. In summarising the results, it can be concluded that the DUT library has evolved to accommodate the changes in the information sectors and has created new posts in the library to adjust with the changes. The library is in line with the latest trends and is ensuring that the changing needs of the users will be accommodated. Librarians are continuously involved in the redevelopment and reskilling themselves to be on par with new trends and technology. As Ocholla and Ocholla (2020:363) indicate, librarians have shown that they are able to align their roles to changes in the environment with all the new technological innovations and systems.

6.2.6.1 Model to align librarian roles and skills with the 4IR

It is clear that aligning librarians' roles and skills of librarians with the 4IR requires a strategic approach that involves a commitment to lifelong learning and continuous professional development from librarians. It is imperative that librarians invest in continuous development to remain abreast of emerging technologies and best practises in the field. Librarians must understand that technology is no longer an independent system that supports work functions as a neutral sphere. Technology in the 4IR environment is part of an integrated system that co-exists in a cooperative

relationship with librarians. As soon as librarians understand this relationship with technology, it can add value to the storage, provision, and sharing of information. The librarians need to develop a drive to be willing to experiment with emerging technologies and new ways of doing things. The current attention on innovative technologies is growing rapidly, and it is time that it is embraced and utilised to increase productivity levels in the information sector. Librarians should be encouraged to try new things and experiment with technology to enhance their service delivery. The pandemic created a shift in the way information is accessed and retrieved. It is now clear that digital resources and content will dominate as users and librarians realise the convenience and easy accessibility of these resources. The librarians agreed that their roles and responsibilities have evolved due to changes in technology and that most librarians are willing to develop and learn new skills to continue to provide an excellent service to users. The academic librarians need to be proactive and understand the changing needs within the university environment. The process skills that can assist are to be active listeners, to be involved in building a relevant collection of resources for users, and to be active in faculty literacy research and teaching initiatives. The academic librarians understand the need to identify skills and competencies that will assist them in transforming and understanding 4IR technology that can support the teaching and research environment at the university. Librarians must understand the growing trends in research and publishing and play an active role in guiding researchers on ethical issues surrounding policies on publishing and sharing of their research data. The librarians are also familiar with the importance of CPD initiatives on their jobs and the pressure within the profession to remain relevant and updated on trends. It should be clear that this study focused only on the 4IR and the impact it has on libraries. A model that aligns librarian roles and skills with the 4IR is suggested in this chapter.

The DUT library has started the process to move at a pace that is aligned to its financial status, its space requirements, and the current stability of the infrastructure. Librarians must be proactive and willing to learn new skills and new ways of working, embrace challenges as opportunities, and learn from failed experiences. By aligning their roles and skills with the 4IR, librarians can remain an integral part of the growing academic ecosystem and contribute successfully to their institutions visibility.

6.3 Conclusion of the study

The work presented in this study is conceptual in nature and provides a proposal in terms of new innovative ways to adopt and adapt to 4IR technologies within the DUT library. The conclusions of this study are based on the research objectives.

6.3.1 The evolving roles and responsibilities of academic librarians

This study was designed to understand the evolving roles and responsibilities of the academic librarians specifically at the DUT library. The roles of academic librarians have evolved considerably in recent years and will continue to evolve as new innovations emerge. From the findings, it emerged that the roles and responsibilities of librarians are evolving with disruptive new technologies, but in essence, disruptiveness can be seen as innovative and different ways of providing an improved service to the users. 4IR innovations should be seen as an opportunity to learn new and different ways of doing things and regarded as less of a threat. The 4IR allowed the librarians to venture into unknown territory and they realised that it is not as scary as they thought it would be. The librarians need to be realistic and understand that they have to evolve with changes to provide a quality service to the users. The librarians were able to reach out to a wider range of users online than those they encountered within the library space. It is important to note that the library has always been fluid and this can be proven by looking at the transformation of libraries over time. Many librarians have also proved that they are adaptable and open to gaining new knowledge and skills (Ayinde & Kirkwood 2020:145). The most important element for academic librarians to evolve with changes is that they need to ensure that they remain relevant to their key users and continue to be flexible in their approach to learning and experimentation with new trends and technologies.

6.3.2 Skills and competencies for academic librarians in the new role

Emerging technologies, changes in traditional ways of working, and many new skills to learn usually follow the introduction of new technologies. To be effective in the new roles that new technology introduces, librarians must improve their skills and competencies to accommodate emerging technologies. The study identified and discovered that with the 4IR, there were various new skills and competencies that

academic librarians needed to keep up to date to remain relevant in their profession. With the 4IR, libraries are transformed, and librarians are required to be reskilled and retrained on new systems software and technology. From the results of the research, it is possible to conclude that it is important that the university infrastructure is solid for the library to have a good support system to support users, which in turn can maintain good academic results. The librarians understood that to provide a quality service to the users, they themselves had to be skilled and knowledgeable with new trends and technologies. Adaptability, critical thinking skills and problem-solving skills are essential skills in the 4IR and librarians need to ensure that they continue to develop to embrace the changes in their discipline. The librarians are ensuring that they remain relevant and skilled by embracing non-traditional responsibilities such as research data management, scholarly publishing, managing research repositories and supporting the universities teaching and learning initiatives by the involvement with online learning management systems that the university supports. By developing their skills and staying up to date with the latest trends and technologies, librarians can play a significant role in ensuring that their university is well prepared to navigate the challenges and opportunities of the 4IR.

6.3.3 Effects of the 4IR on the roles of academic librarians in the changing information environment

This study objective established that the 4IR definitely affected the roles of academic librarians and affected the traditional way in which they used to work and interact with the users. The 4IR is transforming the information landscape in many ways, and academic librarians need to adapt accordingly to remain effective in their roles. The shift from the print collection to more online and digitised resources has changed the conventional face of the library. The 4IR is an era of smart technologies and various smart devices that are connected in a smart environment to pursue the objectives of institutions or organisations in a smart and efficient manner. The 4IR within libraries has affected librarians and the way they connect and engage with users. Academic libraries need to understand knowledge-driven environments and how to navigate their way through these disciplines. Librarians must accept the ability to transform and learn new skills in order to navigate and survive in the highly acclaimed technological environment. In essence, the 4IR is driven by technological disruptions and increasing

automation of workers and digital connectivity. The vast benefits that accompany the new innovations, such as improved productivity, are reflected in the results as the librarians' response times to help the users. The interconnected systems across disciplines transcend boundaries and makes the seamless retrieval of information for researchers possible. Innovation is a key factor in propelling economic growth and development, and it contributes to increased productivity levels and improving lives. Change is an inevitable part of our future and development, and academic librarians are aware that it is necessary to keep up with trends and remain relevant in their profession to ensure they are able to transform with the demands of technology.

6.3.4 Utilisation of CPD to embrace the changing landscape of libraries

The study established that CPD was an integral part of a librarian's career and allowed the librarian to understand the continuously changing landscape of the profession. Librarians are evolving in response to changes in technology, access to information, and user needs, and it is essential that librarians remain updated with these changes and adapt their knowledge and skills to embrace these new changes. It is imperative that academic libraries understand the need to reshape and reorganise their structures and ways of working. The recent pandemic accelerated the adoption of parts of the 4IR within the academic libraries, as libraries were forced to close and reconsider how they could provide services to users remotely. Academic library leaders must encourage all levels of staff to pursue continuous education and develop new skills and knowledge to meet the demands of technological changes. The DUT librarians are actively involved in CPD initiatives. There are many in-house CPD initiatives that the staff training and development task team plan on a monthly or quarterly basis for the librarians to attend or participate in. The onslaught of COVID-19 brought many changes, with a focus on more online webinars and CPD activities. This allowed librarians easy access to continuously update their knowledge and skills. Librarians are reactive in their response to the changes that accompany the 4IR, and they are attempting to align their skills and knowledge to accommodate changes in the university curriculum and the changing way of teaching and learning by ensuring that library resources are able to serve users. The library infrastructure is transforming to accommodate research, publishing, and various open initiatives. The librarians are continually learning and adjusting to the new trends and focus areas impacting on the

profession. It can be concluded that DUT librarians are proactive in attending various online sessions to keep themselves relevant. Librarians must be adequately equipped in the 4IR to impart knowledge to users. By utilising CPD initiatives, librarians can adapt to the changing landscape of libraries and provide innovative and effective services to their users.

6.3.5 Library infrastructure for the 4IR

The study revealed that the DUT library required a solid infrastructure base to continue with the 4IR implementation projects. The library relied on the university's IT infrastructure to host many systems. Academic libraries must partner with the host institution and ensure that they are compatible and have the appropriate infrastructure to support 4IR initiatives and innovations. It is important for the sector to understand in totality what it means to adopt 4IR innovation. Security and safety measures must be highlighted to prevent cybercrimes, have enough storage space to support data activities, promote skills and training for all levels of staff, and promote an organisational culture where all staff are included in decision-making initiatives. According to the World Economic Forum (2020:27), new technologies are set to steer future developments across all industries and call for a demand for improved skills and a new job role. Although jobs will be lost and affected by the 4IR, it will also create new job opportunities and propose new ways to reskill workers. The academic librarian will evolve with new ways of working and will train to be able to manage and work with big data and other new products and services. As pointed out in the World Economic Forum (2020:35), whilst there is a shortage of skills in emerging professions, opportunities are available for professionals to retrain and reskill with the emerging technologies. Academic libraries are transforming in the era of the 4IR and need to adapt their infrastructure to accommodate and support 4IR initiatives.

6.3.6 Aligning librarian roles and skills with the 4IR

The study identified ways to align the librarian roles and skills with 4IR. Aligning librarian roles and skills to 4IR will require various transformations, up-skilling of librarians, and staff movements into posts that require more human intervention. The transformation of librarians to align with the 4IR leads to the factor of staff reduction within the library. The library is currently overstaffed with an overflow of staff within the

circulation unit. The self-check RFID units and the reduction in the print circulation of materials mean that the use of the circulation desk by students is on a decline. The DUT library is attempting to train and relocate staff to units that require more staff such as the library technical units. The new and innovative MakerSpace is a platform that was created to provide users with opportunities to engage and create intellectual and creative materials with a range of resources such as 3-D printers and computers, editing tools, and various craft materials. The DUT library created a post for a marketing librarian in keeping with the growing trends in the library profession. Libraries are fully engaged in advocacy and marketing of their resources as alluded to by Otike and Barát (2021:20) to encourage maximum use of the library resources and to attract users to the physical space. It is noted that DUT librarians are aware of changes in their profession and are attempting to address the changing needs of users in the various services they provide. The library is ensuring that the focus is on building the online resource collections and continuing with digitisation of other resources.

The conceptual framework model outlined in Figure 6.1 is suggested as a means of aligning librarian roles and skills with the 4IR.

6.4 Recommendations

The recommendations for any study are derived from the analysis of data collection and the findings. The intention of this study is to encourage a conversation surrounding the 4IR and its innovations.

6.4.1 The evolving roles and responsibilities of academic librarians

It is noted that the academic librarians' role and responsibilities have evolved significantly over the years and it will continue to evolve as new technology emerges and the university adapts to the changes.

- Librarians must be more flexible and able to adapt to changes in the profession.
- Librarians must be open and accommodating to new emerging technology and be able to evolve with changes.
- Information literacy instruction will never phase out, as users need to be constantly taught on how to evaluate and sift out relevant sources, use

databases and other online research tools that emerging technology introduces, and these sources still need to be cited correctly.

- As the amount of data generated by academic research continuously increases, academic librarians play a key role in supporting researchers to effectively manage and store their data.
- Librarians can help promote scholarly research and open access resources.
- Librarians can continue to provide assistance for digital initiatives within the university by supporting researchers to create and publish digital content, managing and enhancing institutional repositories, and providing access to online resources.
- Librarians need to partner with faculties and departments to promote library resources and services and participate in community outreach projects.
- Librarians need to explore emerging technologies and find new ways to integrate them into library services to enhance the services to users.
- Librarians need to ensure that the library resources are inclusive and accessible to all members of the university community, including access for differently abled users.

6.4.2 Skills and competencies for academic librarians in the new role

The 4IR impacts all aspects of society, including academic libraries and academic librarians, need to develop a range of skills and competencies to be effective in their role with emerging technologies.

- To be able to impart a quality service to users, librarians will need to sharpen their skills on technical, creativity, analytical/critical thinking, emotional intelligence, communication, teamwork, people skills, and decision-making skills by attending training, workshops, and webinars.
- Librarians need to be able to help users develop strong information literacy and critical thinking skills to be able to evaluate and analyse information.
- Librarians will need to be comfortable with various emerging technologies and digital tools such as data analysis tools, content management systems, open source systems, and digital publishing platforms.

- With the increase in big data and the hype about research data management, librarians need to have a good understanding of the best practises and data management tools in this field.
- It is recommended that the DUT librarians be at the forefront of research and avail themselves to the various trainings that the university provides for staff and the librarians need to stay up to date on emerging technologies such as AI, virtual and augmented reality, robotics and machine learning.
- Librarians will need to possess good collaboration and communication skills to effectively engage with various stakeholders, faculties, departments, and users within the university community.
- Cognitive and interpersonal skills are essential for librarians to effectively manage and facilitate library services, interact with users, and contribute to the research landscape.
- Librarians need to be well equipped and familiar with user experiences to determine the ever-changing needs of the users.
- Librarians must be able to manage complex projects and initiatives, be creative and lead projects that are identified within the library.
- Librarians must understand their own limitations in skills and attend various sessions to remain relevant to users and provide a quality service.

6.4.3 Effects of the 4IR on the roles of academic librarians in the changing information environment

By adapting to changes and embracing new roles and responsibilities, librarians will be able to remain relevant in their profession. The progressive transformation of technology and its impact on service delivery and future thinking applications that can only stimulate and encourage change and development within the library and information services. New technologies and innovations provide new opportunities to initiate new collaboration initiatives in various disciplines.

- The growth of digital technologies has transformed the way the DUT library collects, manages, and disseminates information, and the librarians need to be able to manage and curate digital resources and help users effectively navigate their way with these resources.

- With the proliferation of digital platforms and tools, effective written communication skills are essential for conveying complex ideas, instructions and information through emails and various social media platforms.
- Librarians need to be able to manage the upsurge in academic research data and effectively analyse it to support research outputs.
- The new opportunities for open access and digital resources created by the 4IR need to be supported by librarians. Librarians must promote more open access resources and help users navigate the resources effectively and efficiently.
- Librarians understand that collaboration between them and the new technological systems can increase productivity output and make work a more engaging experience; it will enhance the relationship between humans and machines. Librarians must interact and work seamlessly with users and colleagues from diverse backgrounds and must have the skills to solve complex problems and establish connections with experts from various disciplines.
- The recommendation on the surplus of staff after the self-service installations is that circulation staff can be utilised as roaming librarians within the library. All the new technology will require some human intervention and the circulation staff can be trained to provide assistance to users.
- First-time students and other students who are unfamiliar with technology will require assistance from staff. There are always glitches in systems and the circulation staff can be involved in learning how to sort out common issues with the machines.
- The focus of the 4IR is on user experiences and satisfaction and academic librarians should rise to satisfy user needs by designing services and resources that can meet the expectations of users.

With every new revolution, the fear of job losses is prevalent. However, the people evolved with learning new skills and new ways of working; therefore, with the 4IR, there will always be a need for people.

6.4.4 Utilisation of CPD to embrace the changing landscape of libraries

Librarians must respond to the changes brought about by the 4IR and new innovations by staying up to date with emerging technology and be able to adapt to the changes

and transform with it. LIASA is continually advocating for new learning activities for library professionals, encouraging participation in interest groups, and promoting networking among librarians.

- It is recommended that librarians join the professional association LIASA and support the organisation. In the end, the profession of the librarians is at stake and only the librarians are able to support and ensure the longevity of the association. The professional organisation can provide access to resources, training, and encourages networking opportunities.
- Librarians should attend conferences and workshops, as these platforms provide excellent opportunities to learn about new technologies and trends within the profession.
- Librarians should be encouraged to participate in online courses and webinars as this provides a convenient way for librarians to learn new skills and keep up with the latest trends in the profession. Since COVID-19, many of these initiatives are offered to librarians at no cost.
- Librarians must indulge in reading the professional literature to remain informed about the latest trends and best practices in the profession.
- Librarians must network and collaborate with colleagues from other institutions and this allows for knowledge sharing and exchanging of best practices within the field.
- Librarians should engage in peer learning, as they can learn from colleagues by participating in knowledge-sharing initiatives and joining similar interest groups to network.
- Librarians need to be formally trained if and when they are redeployed to new positions within the unit. The library management will need to ensure that there are programmes in place to support the learning process in the new positions.
- The DUT library should formalise a succession policy that can guide librarians into posts when senior librarians retire or expire. The library currently does not have a formal succession plan in place and this is recommended where junior librarians can understudy the senior librarians for upward mobility and to retain the knowledge when senior librarians retire or resign.

- Librarians must be exposed to basic levels of technical training in software programs and in basic programming languages.

Humans are the only ones that can provide soft skills and the emotional intelligence required to empathise with users of the technology. There is a move for librarians to have more IT-related skills to be able to work in the 4IR era (Ayinde & Kirkwood 2020:144; Shilenge & Telukdarie 2021:473; Wong & Chan 2018:111). The librarians must be brave enough to embrace the 4IR and its technological implications in order to survive it and persevere.

6.4.5 Library infrastructure for the 4IR

The findings revealed that the DUT library had a good relationship with the university Information Technology Services (ITS) department, and it is recommended that this relationship develops and evolves to allow the library to successfully implement new systems that will be supported by the ITS infrastructure. The 4IR impacted on the library field in many ways, which pushed librarians out of their comfort zones. The 4IR is characterised by advanced technologies and infrastructures that can support 4IR initiatives within the academic libraries.

- Digital resources such as various e-resources and databases that can provide a sound collection to support the academic curriculum and the 4IR at the library.
- The DUT library needs to take advantage of the many cloud-based systems that the university subscribes to as this will enable the library to host various new innovative library systems that are available.
- The library should continue to support open-source initiatives, as it is freely available with little or no cost to the institution. Library management will need to be proactive in investigating open-source initiatives that can benefit the library and support the current infrastructure.
- MakerSpace is an initiative that can be hosted at one of the Durban site library to accommodate students within the Durban campuses. Currently, a MakerSpace is only available at the Midlands sites, which can accommodate the Riverside and Indumiso site users.

- Another venture that can enhance the DUT library space is to create collaboration spaces, where users can work together on projects that involve emerging technologies.
- Librarians can be proactive and offer technology training programmes for users and cover common topics such as coding, data analytics and cybersecurity, to list a few.
- The academic library can start a digital preservation strategy to ensure that digital resources are easily accessed and preserved for future use. The DUT library can become a valuable hub of resources for users seeking to navigate the evolving landscape of the 4IR.

6.4.6 A model to align librarian roles and skills with the 4IR

It is recommended that librarians align their skills development with the evolving innovations characterised with the 4IR. To align the librarian roles and skills with the 4IR, the proposed model in Figure 6.1 indicates the relationship with the 4IR and related skills and how it shapes and affects the changing roles of librarians. The model draws on the skills from Table 2.1 in Chapter Two of the literature research and builds on it from Table 5.1 in Chapter Five of the discussions and interpretation of findings. The identified skills that are highlighted in the study derived from Despardes (2020) as future job requirements were listed as analytical thinking and innovation, active learning and learning strategies, complex problem solving, critical thinking and analysis, creativity, leadership, technology, and flexibility skills. The desired skills the librarians listed as essential for survival in the 4IR as listed in Table 5.1 were cognitive, process, technical, and interpersonal skills. The 4IR addresses each research objective and the arrows in Figure 6.1 indicate what each objective requires to satisfy the intention and how the level of skills and new creative posts are interconnected and related to the achievement of the objectives discussed in this study. The visual representation in Figure 6.1 illustrates how the academic library is at the centre of the conceptual framework, where the influence of disruptive technologies from 4IR is shaping librarian roles and skills. The objectives are derived based on the innovative and technological changes that accompany the 4IR. The arrows in the model indicate that the objectives are interlinked and dependent on certain aspects to ensure the success of academic librarians in manoeuvring and surviving 4IR innovations. The 4IR

with technological innovations that are relevant to libraries, such as cloud computing, robotics, expert systems, AI and blockchain, to name a few, can bring about positive changes in libraries.

- Librarians need to be well informed of technology and be able to be proficient in various hardware and software programs. This will include the latest technology trends such as virtual reality, augmented reality, and blockchain initiatives.
- Librarians must be proficient in problem-solving, analytical, critical thinking, innovative, creativity, and leadership quality skills to survive in the 4IR.
- Librarians must be equipped with soft skills such as strong communication and empathy skill. These skills will assist in engaging with users effectively and skills that machines and robots do not possess.
- Librarians must be skilled in managing and analysing data and data-related tools and technology. This will include data statistics, data mining, data security and privacy.
- Librarians must foster collaborations and partnerships within the university community and externally as well as inculcate a culture of knowledge sharing and promote inclusivity.
- Librarians and the library need to promote lifelong learning and encourage CPD. Librarians must continuously learn and adapt to new technologies and trends changing within the profession.
- Librarians need to foster a culture of experimentation and be willing to experiment with emerging innovations and new trends to remain relevant and provide an effective service to users.

The libraries will need to investigate and decide what technology will best suit their individual spaces. The model shows that creativity, analytical thinking, problem solving, interpersonal, and research, among others, are important in navigating through the 4IR and the information world. The model to align the librarians' roles and skills with the 4IR equips the librarians with a framework, a set of initiatives, and perspective going forward. The main objective of the model is to embrace learning with an open mind and to be willing to participate in CPD activities that can help librarians survive and navigate 4IR technologies. The model may not be ideal, but it

can be used as a guideline to navigate a way forward in uncertain times full of challenges and new technology.

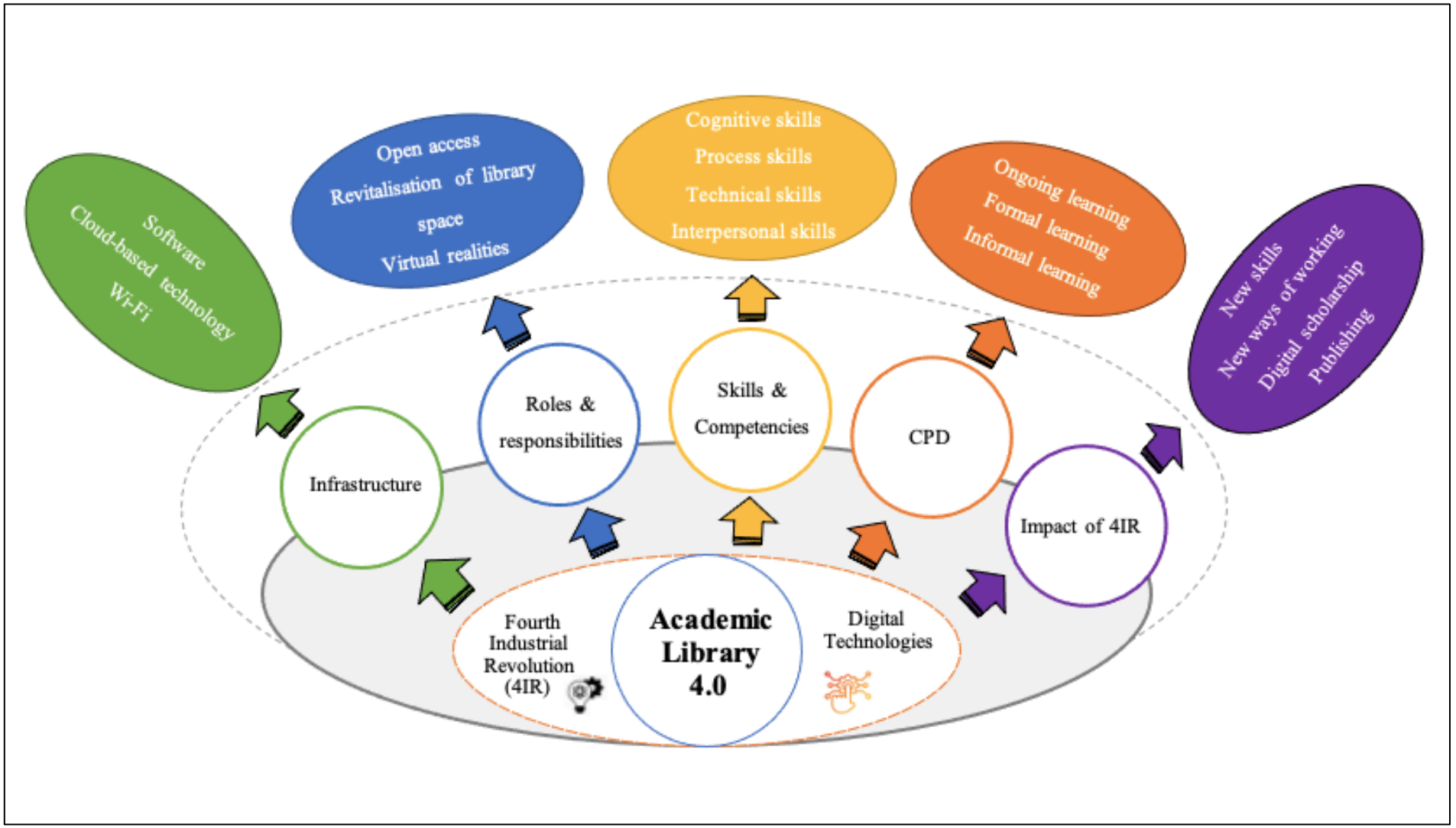

Figure 6.1: Conceptual model to align librarian roles and skills with 4IR

6.5 Suggestions for future research

It should be noted that not all research studies can cover all aspects of research. With any study, the data gathered can open up other areas for further research. In this study, the cybersecurity and risk area was not considered or explored. The impact of the 4IR on people and the ethical issues surrounding people's personal data that are now so easily accessed are something that can be recommended as a future study. Although the DUT library to an extent is using various forms of machine learning and embedded systems within the library environment there is a need for the library to further study AI, robotics and expert systems to determine the best way to integrate these systems in current library workflows. Big data and how to utilise the data that the library acquires are another avenue for further research. Future research can be done from the user point of view and regarding their current needs and how these needs are evolving with the 4IR.

6.6 Limitations of this study

This study was limited to the permanent academic librarians employed at the DUT library. The study did not cover the contract and part-time staff, and neither did it study the users of the DUT library. It should be noted that this study primarily focused on the evolving roles of the academic librarians at the DUT library within the changing innovations incurred by the fourth industrial revolution. The issue of how CPD could influence and enhance the librarians' skills was studied and discussed. It should be clear that the findings of this study may only be applicable to the above institution; however, it may be possible that it could be used adapted and used as a guide for other academic librarians.

6.7 Implications of the study

This study provides suggestive evidence that DUT librarians are flexible in continuing to enhance their current knowledge and skills with further learning opportunities. The model to align librarian roles and skills with the 4IR could be referred to as a guideline in embracing new innovations and changes on the library and information sectors. The academic librarians must embrace and adapt to the 4IR and its implications rather than be overwhelmed and consumed with all that the 4IR encompasses.

6.8 Final conclusion

The study is organised in six chapters. The first chapter discussed the background and set the scene for the research to follow and adopt. The second chapter reviewed and examined the literature related to the objectives of the study. The third chapter presented the research methodology that the study adopted and included the data collection instruments, study population and sampling methods involved in the study. The fourth chapter presented the findings collected from the data collection instruments through an online questionnaire and individual interviews. The fifth chapter discussed and interpreted the findings of the study data. The final and sixth chapter provides a summary of the findings, conclusions, recommendations, and suggestions for further research of the study. A proposed model to align the academic librarian roles and skills with the fourth industrial revolution innovations and disruptive technologies.

It is noted that by developing and improving their skills and competencies and aligning their roles to accommodate 4IR innovations, academic librarians can play a key role in promoting user services, library resources and building on their university visibility by ensuring that the university is well prepared to navigate the opportunities of emerging technologies. By embracing technological advancements and continuously expanding their knowledge, the DUT librarians can remain effective and valuable partners in the information landscape. The librarians play a crucial role in bridging the digital divide, empowering users with the skills and resources needed to navigate the ever-changing information landscape. This study revealed that the academic librarians employed at the DUT library are open to learning and developing themselves to provide a better and more equipped service to their users within the constraints of the DUT environment. Librarians are involved in many CPD initiatives, as and when time and budget permit, to further develop and keep them up to date with the latest trends impacting the library environment. Although the roles and responsibilities of librarians have evolved and changed, DUT librarians have changed with the changes and ensured that they continue to provide an excellent service to users to the best of their abilities. When changes occur in the environment, users' needs are always first, and librarians are attentive to ensure that their needs are adequately satisfied. Librarians must be proactive, adaptable, and open to embracing new technologies and

approaches to ensure their continued relevance and effectiveness in serving users in the era of the 4IR. The DUT library is on the right path in readiness for further technological changes. The infrastructure is in place for the current changes and the institution is further developing the existing infrastructure to cater for future innovations that would impact on the institution's teaching and learning initiatives. The library is also reliant on the university IT infrastructure to meet the technological requirements and needs of the 4IR. In the meantime, the librarians need to continue learning, relearning, and developing to meet the growing needs of their users. By aligning librarian roles with the 4IR, librarians can effectively serve their users and survive in an increasingly technology-driven world.

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APPENDIX A: PARTICIPANT INFORMATION SHEET

PARTICIPANT INFORMATION SHEET

Informed Consent Form

Title of study: Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology

Degree: PHD in Information Science
Institution: University of South Africa (UNISA)
Researcher: Anushie Moonasar (0832361066); anushiem@dut.ac.za
Research Supervisor: Prof. Mpho Ngoepe ngoepms@unisa.ac.za

Dear Prospective Participant

My name is Anushie Moonasar and I am doing research with Prof. Mpho Ngeope in the Department of Information Science towards a PHD at the University of South Africa. We are inviting you to participate in a study entitled **Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology.** The purpose of this study will be to examine how to outline the evolving roles of academic librarians through continuous learning at the Durban University of Technology within the evolving environment on the cusp of the fourth industrial revolution.

The study involves a short questionnaire and it should not take more than 20 minutes to complete. I may follow-up with a short interview, should I require any further clarification on questions. Your participation would contribute in addressing the importance of CPD in an evolving environment for academic librarians within academic libraries.

It is however important that I remind you, that anything you will be writing down is:

- Confidential as only my research supervisor and I will have access to the questionnaire responses on an individual level (that is this questionnaire) and
- Anonymous - as you are not required to place your name on this questionnaire
- Your participation is voluntary. You have the right to withdraw from participating at anytime.

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The questionnaire should not take more than 20 minutes to complete. Place a cross in the appropriate box that corresponds with the answer that you feel is most appropriate to you.

If you have any questions or contributions regarding this research, please feel free to ask me, you are also welcome to contact me or my supervisor.
Thank you for taking time to read this information sheet and for participating in this study.

Thank you
Anushie Moonasar

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APPENDIX B: PARTICIPATION CONSENT

CONSENT TO PARTICIPATE IN THIS STUDY

Consent to Participate in the Research Study:

I, _____, hereby confirm that I have been informed by the researcher, Anushie Moonasar, about the nature, conduct, benefits and risks of this study. I have also received, read and understood the above written information regarding the study.

The nature, objective, possible safety and health implications have been explained to me and I understand them.

I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially.

I am aware that the results of the investigation may be used for the purposes of publication.

Upon signature of this form, you will be provided with a copy.

Signed: _____ Date: _____

Witness: _____ Date: _____

Researcher: _____ Date: _____

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APPENDIX C: INTERVIEW GUIDE SCHEDULE

Questionnaire

Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology

Section A - Demographics

1. What is your current position at the DUT Library?

2. How long have you been employed at the DUT Library?

3. How long have you been in your current position?

4. What is your highest level of a completed LIS qualification?

Section B – Fourth Industrial Revolution (4IR)

5. Describe what is 4IR in your own words or opinion?

6. What effect will 4IR have on academic libraries?

7. What academic library jobs are most likely to be impacted by 4IR and technological changes?

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8. What academic library jobs will be least likely to be affected by 4IR?

Section C – Roles and responsibilities of Academic Librarians in the Fourth Industrial Revolution

9. How has 4IR changed the way that librarians now work?

10. Has the traditional ways of operating changed in anyway?

11. What services are provided to the users in readiness to 4IR?

12. How do the academic librarians respond to the changing environment?

Section D – Skills and competencies for Academic Librarians

In your opinion:

13. Is it necessary for librarians to be knowledgeable in current software and information technology packages?

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Yes, Please explain reason

No, Please explain

14. What skills do librarians need to survive in an academic library?

15. What new skills did you as a DUT librarian have to learn in order to provide an effective service to users?

16. What skills should the DUT librarians have in order to survive in 4IR?

17. What skills are needed for 4IR?

18. What is the biggest challenge now faced in your library?

Section E – CPD

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I believe that:

19. CPD is an important aspect of librarianship

Yes	
No	
Maybe	

20. CPD improves the professional competence and skills of the individuals?

Yes	
No	
Maybe	

21. CPD improves the effectiveness of services rendered within the library?

Yes	
No	
Maybe	

22. CPD allows one to better understand 4IR and its impact on libraries?

Yes	
No	
Maybe	

23. CPD benefits the employer, the institution and the individual?

Agree _____

Explain

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Disagree _____

Explain

24. How often should an individual learn a new skill related to their job?

25. Is it necessary to continuously partake in library related activities?

Yes	
No	

Explain

Yes	
No	

Explain

26. What do librarians need to do to keep with the changes of time?

Section F – DUT Library Infrastructure

27. How effective was the DUT library services to users before technology impacted on services?

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28. Has technology improved the DUT library services to the users and community?

29. How has information technology affected libraries?

30. Why is technology important in libraries?

31. What has the DUT library done to support new information and communication technology within the DUT environment?

32. What are the 4IR technologies used in the DUT library?

33. What are your thoughts on the new library management system in supporting 4IR?

34. Does the current library infrastructure support 4IR?

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35. Is the DUT library ready for 4IR?

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APPENDIX D: FOLLOW-UP INTERVIEW GUIDE

Interview questions

Following up on the objectives of the research question, the following questions was put to the interview participants.

Q1. What are the main impacts of the Fourth Industrial Revolution?

Q2. Has 4IR impacted on the DUT Library?

Q3. Do you believe more could be done to encourage staff to participate in CPD activities in relation to 4IR?

Q4. How has the DUT Library preparing itself for 4IR?

Q5. Do you believe that the DUT Library can handle or cope with 4IR implications?

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APPENDIX E: LETTER SEEKING PERMISSION TO CONDUCT RESEARCH AT DUT

Letter seeking permission from DUT

To: The DVC: Teaching and Learning (Academic)
Director of Research and Postgraduate Studies
Director: Library Services

From: Ms Anushie Moonasar (Librarian: Cataloguing & Classification)

Date: 25 September 2021

Permission and consent to undertake research at your university for a Doctoral study.

Dear Deputy Vice-Chancellor and Directors: Library and Research

I seek your kind permission and consent to undertake research for my PHD study entitled:
Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology.

I am a Library staff member at the Durban University of Technology currently pursuing a Doctor's degree in Information Science. The study is being undertaken at the University of South Africa (UNISA).

The purpose of this study will be to examine how to outline the evolving roles of academic librarians through continuous learning at the Durban University of Technology within the evolving environment on the cusp of the fourth industrial revolution. The focus will be on permanent academic librarians at the DUT Library.

I plan to invite the librarians to participate voluntarily in an online survey at your university in March-June 2022. Confidentiality is assured in terms of research ethics and all responses will remain completely anonymous.
The researcher will abide by the ethics and code of conduct as pledged to the University of Pretoria research department and ethics committee.

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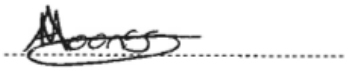
Please feel free to contact me telephonically on 031 3735354 or 0832361066, e-mail: anushiem@dut.ac.za should you have any queries. I would appreciate a written response from your office.

Thanking you for your kind permission and co-operation.



Anushie Moonasar

University of South Africa
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APPENDIX F: LETTER OF PERMISSION TO CONDUCT RESEARCH AT DUT

Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946

3rd February 2022
Mrs Anushie Moonasar
c/o Department of Information Sciences
College of Human Sciences
University of South Africa

Dear Mrs Moonasar

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Full Permission** for you to conduct your research "Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology" at the Durban University of Technology.

The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

We would be grateful if a summary of your key research findings would be submitted to the IRIC on completion of your studies.

Kindest regards.
Yours sincerely

_____
DR LINDA ZIKHONA LINGANISO
DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT DIRECTORATE

APPENDIX G: LETTER SEEKING PERMISSION FROM DUT LIBRARY

Letter seeking permission from DUT

To: Director: Library Services

From: Ms Anushie Moonasar (Librarian: Cataloguing & Classification)

Date: 24 February 2022

Permission and consent to undertake research at your university for a Doctoral study.

Dear Dr. Phaladi

I seek your kind permission and consent to undertake research for my PHD study entitled: **Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology.**

I am a Library staff member at the Durban University of Technology currently pursuing a Doctor's degree in Information Science. The study is being undertaken at the University of South Africa (UNISA).

The purpose of this study will be to examine how to outline the evolving roles of academic librarians through continuous learning at the Durban University of Technology within the evolving environment on the cusp of the fourth industrial revolution. The focus will be on permanent academic librarians at the DUT Library.

I plan to invite the librarians to participate voluntarily in an online survey at your university library in March-June 2022. Confidentiality is assured in terms of research ethics and all responses will remain completely anonymous.
The researcher will abide by the ethics and code of conduct as pledged to the University of Pretoria research department and ethics committee.

Please feel free to contact me telephonically on 031 3735354 or 0832361066, e-mail: anushiem@dut.ac.za should you have any queries. I would appreciate a written response from your office.

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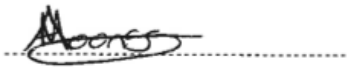
Thanking you for your kind permission and co-operation.



Anushie Moonasar

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APPENDIX H: LETTER OF PERMISSION FROM DUT LIBRARY

PERMISSION LETTER

25 February 2022

Ms Anushie Moonasar
Durban University of Technology

PERMISSION TO CONDUCT RESEARCH AT THE DUT LIBRARY

Dear Anushie Moonasar

This letter serves as authorisation for you to conduct the research study entitled, *"Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology."*, at the DUT Library.

Upon review of the associated documentation submitted to us by yourself, we are glad to offer you an opportunity to conduct the said study in the Library. The administering of the survey questionaire is approved and will be duly supervised by the Manager: Academic Services. If you have any concerns or require additional information, feel free to contact Mr David Thomas (davidt@dut.ac.za).

Thank you

Yours faithfully,

Dr M. P. Phaladi (Library Director)

APPENDIX I: UNISA ETHICAL CLEARANCE LETTER

UNISA university of south africa

COLLEGE OF HUMAN SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

29 November 2021

NHREC Registration # :
Rec-240816-052
CREC Reference # :
6779433 _CREC_CHS_2021

Dear Anushie Moonasar

Decision:
Ethics Approval from 29 November 2021 to 29 November 2026

Researcher(s): Name: Anushie Moonasar
Contact details: anushiem@dut.ac.za
Supervisor(s): Name: Prof M Ngoepe
Contact details: ngoepms@unisa.ac.za

Title: Shaping the evolving role of academic librarians in the fourth industrial revolution through continuous professional development at the Durban University of Technology

Degree Purpose: PhD

Thank you for the application for research ethics clearance by the Unisa College of Human Science Ethics Committee. Ethics approval is granted for five years.

The ***low risk application*** *was reviewed by* College of Human Sciences Research Ethics Committee, in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the

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confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.

5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No fieldwork activities may continue after the expiry date **(29 November 2026).** Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **6779433_CREC_CHS_2021** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature: pp

Prof. KB Khan
CHS Research Ethics Committee Chairperson
Email: khankb@unisa.ac.za
Tel: (012) 429 8210

Signature: PP

Prof K. Masemola
Exécutive Dean: CHS
E-mail: masemk@unisa.ac.za
Tel: (012) 429 2298

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APPENDIX J: EDITING LETTER

696 Clare Road
Clare Estate
Durban
4091
5 September 2022

To: Whom it may concern

Editing of PhD: Anushie Moonasar

Shaping the evolving role of academic librarians in the Fourth Industrial Revolution through Continuous Professional Development at the Durban University of Technology

This letter serves as confirmation that the aforementioned thesis has been language edited.
Any queries may be directed to the author of this letter.

Regards

MP MATHEWS
Lecturer and Language Editor
Mercimathews4@gmail.com
083 676 4778