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The role of libraries in support of academic research: A study of Chemistry and Chemical Engineering at the Cape Peninsula University of Technology and the University of Bologna

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Abstract

Research being fundamental for the growth and competitive advantage in higher education institutions, this study focused on the perception of librarians' role in supporting and conducting research, versus the researchers' perception of the librarians' role in supporting research in Chemistry and Chemical Engineering departments. Higher education institutions such as the traditional university and university of technology are organisations with strategic goals which includes increasing research output and throughput rates.

The research process consists of many stages, each requiring a different kind of assistance to achieve the research goal. Although academic libraries are constantly adapting to the changing needs of researchers and the university community as a whole, it should be realised that perhaps the role of the library is not to support each and every step or phase in the research process. On the other hand, are researchers expecting the academic library to support the whole research process, and if so, how do academic libraries change their role in moving towards achieving this expectation and what the implications would be, was the focus of this study. The purpose of this qualitative case study was to explore the position of communication and science academic libraries supporting chemistry and chemical engineering research at the Cape Peninsula University of Technology (CPUT) in South Africa, and the University of Bologna (UNIBO) in Italy.

The method of collecting data has been conducted in two phases. Firstly a Bibliometric study of Chemistry and Chemical researchers at UNIBO and CPUT was conducted using the Scopus bibliographic database. Based on the results of the bibliometric study, a sample of Chemistry and Chemical Engineering researchers was selected in an attempt to create a balanced representation of these departments at CPUT and UNIBO. In the second phase structured interviews were conducted with a total of 42 participants which comprised of 12 Chemistry researchers, 11 Chemical Engineering researchers, 9 PhD students from third year level in these departments (some are supervised by researchers who participated in the interview), and 10 librarians supporting Chemistry and Chemical Engineering departments at CPUT and UNIBO. This way, the study addressed views from a diversified spectrum of researchers' and PhD students' perspective, as well as the librarians' perspective. The main findings were:

- 'Library as space' still remain an imperative at both institutions in the digital age.

- There is a clash between the academic library promoting the Open Access movement and researchers being under pressure to publish in high impact factor journals, which to a large extent are still closed access. The stigma that Open Access journals are of far lower quality came out strongly from Chemistry and Chemical Engineering researchers' responses at UNIBO and CPUT.

- Heavy workloads and staff capacity issues in both case studies was revealed as prohibiting factors among librarians and researchers to keep up with trends.

- That the utilisation of social media and Web 2.0 tools for research is a direct result of researchers being prosumers, was found not to be the case. Instead, social networking sites like ResearchGate that some researchers indicated they had profiles on, only increased the visibility of their publications.

- The communication gap that exists came out strongly in both case studies.

- There is a need for librarians to shift the focus more towards supporting postgraduate students with research

Therefore the research communication framework is recommended for both higher education institutions to create a better research environment. Overall the enthusiasm revealed by librarians to keep relevant to provide state of the art research support services which speaks to the trends show promise for the future role of the academic librarian. However, in working towards shifting the attention to postgraduate students, calls for a time to consider the increase of academic librarian capacity in organisational structure. Further qualitative research in the area of research support services across all disciplines will make a stronger contribution in the field of Library and Information Science.

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List of Acronyms

AIB:	Associazione Italiana Biblioteche
ALA:	American Library Association
ACRL:	The Association of College & Research Libraries
BYOD:	Bring your own device
BYOT:	Bring your own technology
CILIP:	Chartered Institute of Library and Information Professionals
HELIG:	Higher Education Libraries Interest Group
IATUL:	International Association of Technological University Libraries
ICT:	Information Communications Technology
IFLA:	International Federation of Library Associations and Institutions
IL:	Information Literacy
LIASA:	Library and Information Association of South Africa
LIBER:	Ligue des Bibliothèques Européennes de Recherche – Association of European Research Libraries
LIS:	Library and Information Science
OA:	Open Access
RDM:	Research Data Management
SCOT:	Social Construction of Technology
SNS:	Social Networking Sites
SPARC:	Scholarly Publishing and Academic Resources Coalition

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Chapter 1

1 Introducing the study

1.1 Introduction

Science policy scholars unanimously argue that Science and Technology research has played an important role in the development of countries (Fagerberg, Landström, & Martin, 2012: 1121; Mihram & Mihram, 2012: 1; Rasul & Sahu, 2011; Sharma, 2008). Foray (2005: 20) claims that knowledge "has been at the heart of economic growth", which is vital in social development through innovation and creation of new knowledge within organisations. In South Africa, emphasis has been placed on building the economy and knowledge economy through research, particularly in the area of Science and Technology. Therefore the future function of libraries has to be aligned to support research especially in the dissemination and preservation of research output (Weingart, 2017: 108). Mihram and Mihram (2012: 1) stated in their report on the AAAS 2012 Annual Meeting on new discoveries and challenges in the world that the focus is on bridging the knowledge gap between the developed world and the developing world. What came out strongly in their report is that science, technology and research played an important role in building a global knowledge society (Mihram & Mihram, 2012: 1). Today, higher education institutions rely heavily on technology to meet their strategic goals, such as teaching and learning, research, and community engagement. Therefore universities have moved towards implementing a blended learning approach where online learning environments are embraced to facilitate e-learning, complements the physical classroom teaching. Thus technology facilitates knowledge sharing through academic staff and student interaction, anywhere in the world (Foray, 2005: 23). In building and sustaining knowledge societies, especially in higher education, there is a need to shift from "knowledge is power" to "knowledge sharing is power" (Choy & Suk, 2005).

There is a new trend called "institutional convergence" bringing together universities and industry or businesses, as both types of organisations realise that the core business, producing and disseminating knowledge complements each other, meaning that they no longer work in silos (Conceição & Heitor, 2002:1). The value of these organisations is realised, the two parties look to one another for inspiration in the production of knowledge and creation of wealth (Conceição & Heitor, 2002:1). There is however a risk involved if universities fail to retain their integrity, as Conceição and Heitor (2002:2) further explains:

> The universities we know today, despite their long historical inheritance, are relatively new institutions, namely in the way they relate to their surrounding social and economic context. And universities have defined themselves almost as *non-firms*, in the sense that they produce

> knowledge that is publicly available. To do this effectively, a complex set of incentive structures and organizational features has emerged, which are relatively easy to destroy, despite the long time it took for them to evolve.

In analysing "institutional integrity" of universities in the knowledge-based economy, it becomes risky where activities involves society and where universities consider privatising ideas and knowledge produced. Therefore the authors found it important to form a conceptual framework to understand how learning takes place in the process of "knowledge accumulation", at the individual, organisation and economy level. Their focus is exploring how universities promote learning for the production of knowledge (Conceição & Heitor, 2002:2). Although Conceição and Heitor (2002:6) claims the two main pillars of universities in Europe are teaching and research, another activity that has been introduced is "linking to society", or recently termed by universities in Europe as the "third mission" (Casella, 2017). In South Africa on the other hand, higher education institutions like CPUT (2014) have three pillars: teaching and learning, research and community engagement.

The breaking down of working in silos and moving towards more collaborative research, and the maintaining of invisible colleges (Crane, 1972; Servos, 1993: 7) in higher education institutions is key. However this idea remains challenging in the learning environment as in some cases individuals hold on to their knowledge, and are not keen on sharing what they know to contribute to the knowledge culture. Especially where research has commercial value, scientists tend to remain secretive until publication, as competition is tight. It has been pointed out that the process of knowledge creation and knowledge sharing has been occurring in higher education institutions, organisations and businesses since the "academies of science in the seventeenth century" (Foray, 2005: 201). As Rosenbaum (2017: 37) stated "in academia, publishing is of utmost importance…" in the "communication of knowledge" but that formal publication is also "a central part of the reward system for science". However it was realised that the learning method for Chemistry in the 21st century need to be interactive, through a 'systemic approach' (Fahmy & Lagowski, 1999: 859). Considering the historical background, Chemistry[1] is not only the oldest discipline, but also described as the "central science" (Lagowski, 1999: 845).

The purpose of this qualitative case study is to explore the position of communication and science academic libraries supporting chemistry and chemical engineering research at the Cape Peninsula

[1] Even though chemistry has been anchored in society for a life-time, no historical analysis has been reported on in the literature. However, the book: "*Providing effective library services for research*" gives an historical background of library research support services, which formed the basis of the research project conducted in 2009 (Kleinveldt, 2009), and sets the scene for the current research.

University of Technology (CPUT) in South Africa, and the University of Bologna (UNIBO) in Italy. This chapter introduces the study, giving some insight on the aspects such as the research questions, the literature review which explores three main areas namely; the current state of academic libraries supporting research, perceptions of academic librarians supporting research versus researchers' perception of the academic librarian supporting research, and the role of the researcher as a prosumer. The methodology used and an outline of chapters are summarised briefly to give the reader insight leading to the findings of the study.

1.1. Background

The purpose of universities needs to be discussed with regards to their role in the world being transformed into a learning society which to a large extent is being influenced by political and economic force, where research is placed high on the agenda (Schmitt, 2015; Patterson, 2009; Caraca, Lundvall & Medonca, 2009: 863). So too academic libraries have a vital role to play, being at the heart of the higher education institution, to support the strategic goals of its university. Research support provided by academic libraries is a growing topic as Chapter 2 presents. The main findings where researchers were asked about their perceptions and experiences of the academic library in supporting their research indicates that current awareness of new publications in the field, training on using databases, inter-library loan services, and book acquisitions are still highly regarded. However, librarians lacking the subject knowledge to support researchers on their topic has been highlighted as well in the literature (Kleinveldt, 2009; Hart & Kleinveldt, 2011). The research process consists of many stages, each requiring a different kind of assistance to achieve the research goal. Although academic libraries are constantly adapting to the changing needs of researchers and the university community as a whole, it should be realised that perhaps the role of the library is not to support each and every step or phase in the research process. On the other hand, are researchers expecting the academic library to support the whole research process, and if so, how do academic libraries change their role in moving towards achieving this expectation and what the implications would be is the focus of this study.

Higher education institutions such as the traditional university and university of technology are organisations with strategic goals which includes increasing research output and throughput rates. Each institution has a unique identity and usually they are characterized by having a high profile in particular niche areas in which it leads (Conceição & Heitor, 2002:1), making it a competitive advantage. Organisational change, which is very complex (Jacobs, van Witteloostuijn & Christe-Zeyse, 2013: 722) also has an impact on universities reaching their goals, their vision and mission, especially where mergers and integration takes place, which is the case of CPUT formed in 2005 by

the merging of Cape Technikon and the Peninsula Technikon. Jacobs, van Witteloostuijn & Christe-Zeyse (2013: 722) further suggest that "scholarly quality and practical relevance" are key points to consider in practicing organisational change. Emphasis is placed on the importance of looking at individuals as well as the organisation as a whole when studying organisational change, taking into consideration the internal and external factors. What also needs to be taken note of is that organisations differ, what works for one organisation might not work for another, and that a theory could probably play out completely different when put into practice (Jacobs, van Witteloostuijn & Christe-Zeyse, 2013: 724). Universities can be described as being a special type of learning organisation dealing with the production and dissemination of knowledge. However, it is pointed out that there is a need for a diverse organisational change to take place on higher education level in order for universities to prosper and maintain institutional integrity (Conceição & Heitor, 2002:1).

Innovation has been placed on the map due to Research and Development (R&D), contributing to the rapid knowledge production. The emerging trend in conducting research has shifted more from the traditional way of researchers working in isolation as previously mentioned by Servos (1993) and Crane (1972), towards online learning and working together with other researchers as a team in the same field (Foray, 2005: 22). Thus there is a culture of building new knowledge, as Foray (2005: 22) further claims that "the 'need to innovate' is growing stronger as innovation comes closer to being the sole means to survive and prosper in highly competitive and globalised economies". Although research remains the "cornerstone of knowledge production", it has been discovered that ordinary individuals come up with innovative ideas which contributes to building scientific knowledge within organisations (Foray, 2005: 23). Research is not an activity limited to special environments; which to some extent fits in with the practice of prosumerism and how researchers adopt the prosumer role in the university context, which is discussed further in Chapter 4. Fagerberg et al. (2012: 1122) claims that "science renews itself" through the emergence of scientific disciplines such as entrepreneurship studies, innovation studies and Science and Technology studies at universities. These new disciplines thus contribute to building new knowledge societies in higher education.

As already mentioned, one of the strategic goals of universities, which to some extent is brought on by external influences, is to increase the research output, as research plays an important role in building a knowledge culture, and contributes to the universities' competitive advantage. By increasing research output universities position themselves on the map and this is vital in university ranking. Universities benefit from conducting research. In building a university's knowledge base, research activities constantly needs to take place (Fagerberg et al., 2012: 1121). Therefore academics and researchers at higher education institutions face the pressure and many challenges

that goes along with conducting research. Academic libraries have over time transformed to keep relevant to the changing needs of the university community.

A previous study conducted by the researcher investigated what researchers need and want from the library in terms of research support at the Cape Peninsula University of Technology. The 2009 Masters thesis (Kleinveldt, 2009), as well as the publication that followed the research (Hart & Kleinveldt, 2011) formed the foundation for this PhD study. To briefly summarise the focus of the master's thesis, three themes were discussed, namely (Kleinveldt, 2009: 10):

- Information needs of researchers to be met by their institutions' libraries
- Library services to support research in their institution:
- Competencies of the research librarian:

Being a fairly new University of Technology, the roles and responsibilities of academics changed, where previously the main task was to teach, they now found that one of their key performance areas is to conduct research. The role of the academic library therefore also needed to change to remain relevant, including supporting research (Hart & Kleinveldt, 2011). The outcome of this project led to the researcher, who is a faculty librarian, to implement a process of building academics and researchers' profiles to assist with improving library research support. This profile also assists in supporting teaching and learning. However, some of the key findings of this study left the researcher with additional questions, which led to the current PhD thesis expanding on this project.

Therefore the main research question in this study is: to what extent new modes of communication and the academic library is used in chemistry and chemical engineering research. What is the gap between what researchers need and want from the library to support research and what research support they are currently receiving, and how faculty librarians perceive their role in supporting research? The research question leads to the following research sub-questions:

- What is the role and current state of science academic libraries in research?
- What is the role of the researcher as a prosumer in the contemporary university?
- How do the researchers perceive the role of the library in supporting research?
- How do the librarians perceive their role in supporting research?
- How does research output (publications) inform policy and programmes in universities?

- Where do the library fit into the research cycle in the digital age?

The practical implication of the study is to explore in a particular field of science and technology research such as Chemistry and Chemical Engineering researchers, what they need and want from academic libraries to support their research, the present role of academic libraries and the prospects for the future. The study will give insight into the 21st century research needs and practices and the evolution of academic libraries in the digital age.

1.2 Scope and Limitation

This study draws on a variety of scholarly approaches: science and technology studies, social sciences, library and information science. A comparison is made between two very different academic institutions; one being a well-established traditional university (UNIBO) with claim of being the oldest university in Europe, and a fairly new university of technology (CPUT), which comes from a purely teaching-orientated background, and moving towards a more teaching and research orientated institution. These two higher education institutions selected for the study to some extent represent a traditional knowledge society (UNIBO) versus an emerging knowledge society (CPUT). In order to achieve an in-depth analysis and a better understanding of the attitudes, expectations and practices of the actors and agencies involved, it has been decided to adopt a qualitative approach. Hence the study initially focused on a limited number of Chemistry and Chemical Engineering researchers at UNIBO and CPUT who are listed on the Scopus database. The sample for conducting interviews has been selected on the basis of the criteria indicated in the methodology section for the three groups per department: librarians, researchers and PhD students.

1.3 Overview of the literature

In framing this investigation the review of the literature is divided into three parts namely:

1. the current state of academic libraries supporting research,
2. perceptions of academic librarians supporting research versus researchers' perception of the academic librarian supporting research, and
3. The role of the researcher as a prosumer.

As higher education institutions differ, their libraries will play different roles in meeting the demands of its community. It has already been identified in the literature that there is no specific, set model in place for supporting research (Fourie & Bakker, 2013). This is perhaps so due to the complexity of research, and discipline specific research needs, as well as established traditions and practices, not

disregarding ever-changing technology driving or impacting research activities which makes it more challenging for academic libraries to support research. Thus the literature review starts to explore the current state of academic libraries supporting research. Some aspects, linked to the library association, IFLA (2014, 2015, 2016, 2017) trends in highlighting hot topics among other, which includes the following aspects:

- The role of Library Associations driving the library profession in supporting research but also to conduct LIS research for developing the field and improve services
- The librarian embedded in the research process – embracing virtual learning / research environment (VLE, VRE), Web 2.0 and social media as tools supporting changing role of researchers as prosumers.
- Library as 'space / place' – Research Commons
- Library resources including Institutional Repositories and Electronic Resources
- Open Access and the new role of academic libraries becoming Publishing agents
- Research Data Management
- Embracing emerging technologies: robotics in libraries enhancing research support

New areas of supporting research especially by university libraries have emerged, such as research data management (RDM), Open Access (OA) leading to academic libraries taking on the function of becoming publishing agents (Raju & Schoombee, 2013). Fagerberg et al. (2012: 1121) studied the relationship between science, research, and the knowledge societies at universities through reviewing the literature with their aim to contribute to implementing science policies and governance. They made use of two methods to collect data, namely: an "object-oriented" approach, where they focused on analysing the literature on three emerging scientific disciplines (entrepreneurship, innovation, science & technology studies), and a "subject-oriented" approach, where researchers in these emerging fields were surveyed. This study follows a similar approach, in an attempt to answer the research question and sub-questions, it is important to explore what previous research has already been conducted on these aspects discussed in the literature review.

In higher education, the focus is shifting towards multicultural knowledge societies, where language, culture and social behaviour play an important role. A study at a technical university focused on teaching engineering students English using an interdisciplinary approach to "enhance knowledge, creativity, motivation to learn, open-mindedness and understanding of other cultures and

civilisations", integrating literature and "literary theory-based" discussions (Catana, 2014a: 158). Moreno-Jimenez et al (2014: 410) claims that the human factor plays an important role through lifelong learning and education, contributing to the progress of knowledge societies.

The university thus have a responsibility to ensure that students graduate with knowledge in their discipline together with knowledge on cultural values to be equipped for the 'multicultural social and work environment'. It is through this cultural knowledge combined with knowledge in the field of study that a university graduate is able to contribute to the knowledge society. A study investigating Engineering students in an English foreign language course at a technical university found that the students' perception of contributing to the knowledge society was only through their technological knowledge acquired. There is a need for students to understand communication strategies. Therefore an English Language Syllabus was designed which aimed at enabling students to learn how to build professional working relationships across cultures, thus contributing to a multicultural knowledge society (Catana, 2014b: 345). The English language course was adapted for students to learn independently and introduce awareness about cultural values through a communication strategy which Catana (2014b: 347) explains being:

> Preparing group-work tasks which ask students to ponder on their own culture, to acknowledge cultural differences and to tell their opinions on the ways of promoting and strengthening relations in a multicultural environment, we stimulate their independent thinking and broaden their understanding of other cultures.

The second section of the literature review focused on what the perceptions of librarians were in supporting research, versus researchers' opinion of the librarian supporting research. The third part describes the role of the researcher as a prosumer in higher education institutions. The prosumer notion, which refers to the combination of consuming and producing became more prominent with the rise of Web 2.0. In fact there is claim that people have always been prosumers in life, and that Web 2.0, social media have made the practice more visible and interactive, especially in the consumer behaviour studies. However, what the author tried to investigate during the case studies, is whether the prosumer concept is practiced among the target audience in this study, which chapters 6 and 7 will reveal.

1.4 Research Design and Methodology

It is not always easy to randomly select or use stratified sampling of a population beforehand when conducting exploratory interviews as it could lead to contrasting responses (Dexter, 2006: 43). However, for the purpose of this study, a purposeful sample selection was used in order to understand the views, experiences and research needs of the experienced, the average and

emerging researchers through conducting interviews, which Miller and Dingwall (1997: 4) claims to be very effective, and Czarniawska (2004: 50) further states that qualitative research gathers "a rich source of knowledge about social practice". Therefore the method of collecting data has been conducted in two phases. Firstly a Bibliometric study of Chemistry and Chemical researchers at UNIBO and CPUT was conducted using the Scopus bibliographic database taking into consideration specific criteria for the purposive selection process. Based on the results of the bibliometric study, a sample of Chemistry and Chemical Engineering researchers was selected in an attempt to create a balanced representation of these departments at CPUT and UNIBO. In the second phase structured interviews were conducted with a total of 42 participants which comprised of 12 Chemistry researchers, 11 Chemical Engineering researchers, 9 PhD students from third year level in these departments (some are supervised by researchers who participated in the interview), and 10 librarians supporting Chemistry and Chemical Engineering departments at CPUT and UNIBO. This way, the study addressed views from a diversified spectrum of researchers', PhD students' and librarians' perspective. A voice recorder was used during the interview sessions. Interview responses were analysed using Creswell and Clark's (2011) content analysis technique.

It is hoped that this study will make a contribution in the area of Science and Technology research, academic librarianship and how academic libraries at CPUT and UNIBO support research.

1.5 Clarification of terms

This section describes the working definition of terms used in this study.

1.5.1 Knowledge Societies

The knowledge society focuses on the community, values and democratic gains whereas the knowledge economy focuses on markets, performance indicators and economic benefits (Dick, 2011: 1). However, Marin and Ioana (2012: 1736) claims that "the development of a society can be illustrated not only by economic indicators, but also by the quality of education, by means of organising knowledge and learning through the performance expected, through the quality of education and its reflection on society".

Knowledge societies can be defined as a "space oriented to the talent, intelligence, ingenuity, imagination and creativity of the human being, the true protagonist of this new society" (Moreno-Jimenez et al, 2014: 410). The knowledge society is said to be a learning society (UNESCO, 2005: 99).

As mentioned earlier, for the sustainable development of a country, research is essential. The transition to a knowledge society to an extent is dependent to the research output from science and technology, social sciences and humanities (Kleinveldt, 2009: 2).

1.5.2 Prosumer

A prosumer is defined as a combination of consuming and producing (Toffler, 1980; Figaredo and Álvarez, 2012: 255; Ritzer et al, 2012; O'Neill, Gallego and Zeller, 2013: 6-7). The Internet together with the Web 2.0 evolution, is said to be the main cause for the rise of the prosumer (Tapscott and Williams, 2007; O'Neill, Gallego and Zeller, 2013), and the term prosumer is often referred to "a user interacting with web content" (Figaredo and Álvarez, 2012: 255).

1.5.3 McDonaldization

The term "McDonaldization" is defined as the process of organisations all over the world adopting the fast-food restaurant concept, in other words, the customer contributes to the services of a business or organisation through "self-service" activities. The McDonaldization concept consists of four principles, namely: Efficiency, Control, Predictability, and Calculability (Ritzer, 2004: 42).

1.6 Outline of chapters

The thesis is divided in two parts. Part 1 focus on giving the reader an overview of previous research on the academic libraries supporting researcher, the role of the researcher, setting the scene for Part 2, which introduces the two higher education institutions selected for the two case studies reported on in the thesis.

PART 1

Chapter 1 introduces and describes the purpose of the study.

Chapter 2 describes the current state of academic libraries supporting research, which includes the trends, challenges, and competencies of academic and research librarians.

Chapter 3 reports on previous research conducted on the researchers' perception of the library supporting researcher versus the librarians' perception and experience of supporting research.

To end Part 1, the role of the researcher as prosumer is discussed in Chapter 4, giving some insight into information-seeking behaviour of researchers and exploring the role Web 2.0 and social media play in current research practices.

PART 2

Chapter 5 begins with the author describing the method used to collect the data for the two case studies, CPUT and UNIBO, in an attempt to answer the main research question and sub-questions.

Chapter 6 presents the case of UNIBO, reporting and discussing interview responses from librarians, researchers and PhD students in Chemistry and Chemical Engineering departments.

Similarly, Chapter 7 presents the case of CPUT reporting and discussing interview responses from the same target audiences as in the UNIBO case.

Chapter 8 is the final part of the thesis, and discusses any similarities or vast differences between the two cases, and concluded the study with some recommendations for each case and for future research.

The thesis contributed to two main target groups in the higher education institutions studied, researchers and librarians. Ethical clearance to conduct the research was obtained by the CPUT Research Committee. Therefore the findings reported on in the thesis will give insight to other learning organisations on the role of academic libraries and librarians' perception at two different higher education institutions, and what researchers in the 21st century say about academic libraries supporting their research.

PART 1: Role of librarians and researchers in research

Chapter 2

2 The current position of academic libraries in research

2.1 Introduction

The rapid growth and changes in technology today drives decision-making, operations, leadership and innovation at higher education institutions and their libraries. Thus what is more evident today is the transition from print to electronic collections, meaning that print collections have become smaller, and electronic collections much bigger. This resulted in changes taking place, such as the redesigning of libraries' physical space to accommodate the tech-savvy user and growing demands of the university community today. What has already occurred in academic libraries could thus be described in the globalisation context as becoming more "liquid" (Bauman, 2012; Ritzer, 2011), which Ritzer (2011: 5) further explains in this metaphor of how the global world moved from 'solid' to being 'liquid' as follows:

> Of course, people were never so solid that they were totally immobile or stuck completely in a given place (a few people were able to escape East Berlin in spite of the Wall and many will be able to enter the US illegally even when the fence on the Mexican border is completed), and this was especially true of the elite members of any society. Elites were (and are) better able to move about and that ability increased with advances in transportation technology. Commodities, especially those created for elites, also could almost always be moved and they, too, grew more moveable as technologies advanced. Information (because it was not solid, although it could be solidified in the form of, for example, a book) could always travel more easily than goods or people (it could be spread by word of mouth over great distances even if the originator of the information could not move very far; it moved even faster as more advanced communication technologies emerged [telegraph, telephone, the Internet]). And as other technologies developed (ships, automobiles, airplanes), people, especially those with the resources, were better able to leave places and get to others. They could even literally move places (or at least parts of them), as, for example, when in the early 1800s Lord Elgin dismantled parts of the Parthenon in Greece and transported them to London, where to this day they can be found in the British Museum. However, at an increasing rate over the last few centuries, and especially in the last several decades, that which once seemed so solid has tended to "melt" and become increasingly liquid. Instead of thinking of people, objects, information, and places as being like solid blocks of ice, they need to be seen as tending, in recent years, to melt and as becoming increasingly liquid. It is, needless to say, far more difficult to move blocks of ice than the water that is produced when those blocks melt. Of course, to extend the metaphor, there continue to exist blocks of ice, even glaciers (although even these are now literally melting), in the contemporary world that have not melted, at least not completely. Solid material realities (people, cargo, newspapers) continue to exist, but because of a wide range of technological developments (in transportation, communication, the Internet, and so on) they can move across the globe far more readily. Everywhere we turn, more things, including ourselves, are becoming increasingly liquefied. .

Bauman (2012) describes 'liquid modernity' as being in a phase where the only concrete state of affairs is change, and that 'uncertainty it the only certainty'. In other words, society today is constantly striving for self-actualisation. However this 'liquid' phase could mean that self-actualisation is never reached, because enough is found to be never enough. "Flexibility has replaced solidity as the ideal condition to be pursued of things and affairs" (Bauman, 2012). However, not all agree that things in general flow more easily today as pointed out by Telegina and Schwengel (2012) who claim that the Bologna Process [2]is going completely against globalisation, especially where there is resistance to change. On the other hand, it could be argued through evidence these days that more collaboration and consortiums are formed between libraries, expanding access to information through the sharing of resources, which is directly linked to Ritzer's (2011) explanation above, and later the sharing of resources for research are discussed in the findings of the two case studies (chapters 6 and 7). There is also the movement from closed-access to open access, which led to the introduction of new models of Open Access (OA) publishing (Raju et al, 2012) and that libraries are taking on the role of publishing houses. The focus has shifted from the traditional function of an academic library managing information and knowledge, towards providing new research support services (ALA, 2014: 36) such as Research Data Management (RDM) which to some extent, is still very much new to many academic libraries worldwide. It is perhaps thought provoking that OA and RDM have been listed as hot topics discussed at the International Federation of Library Associations and Institutions (IFLA) conferences for the past four years (IFLA, 2014; 2015; 2016; 2017). Therefore, the rapid advancement of technology and the paradigm shift suggests that libraries over time adopted more and more the McDonaldization phenomenon (Ritzer, 2004), where the user has become more of a prosumer, which is further discussed in Chapter 4. An example of McDonaldization in libraries, are the self-service checking in and out of books which have taken place for quite some time already, as well as the indispensable remote access to electronic resources offered by libraries which is more prominent today. Examples of the self-check–in services rendered successfully and eliminating long queues was observed by the researcher at the Sala Borsa Public Library in Bologna, Italy and at the University of South Africa's (UNISA) main campus library in

[2] As there were many debates occurring in Europe about 'internationalisation', which later moved to 'globalisation' due to the Erasmus programme allowing international student mobility at higher education institutions in Europe, Teichler (2010: 263) suggests that the Bologna Process emerged since 1990, which received the highest priority to discuss debates policies and trends in internationalisation at higher education institutions in Europe. Teichler, U. (2010) Internationalizing higher education: debates and changes in Europe. In: D. Mattheou (Ed) *Changing Educational Landscapes* (Springer Science & Business Media B.V).

Pretoria, South Africa. Compliments to the librarian is perhaps in order due to Information Literacy (IL) training provided, aimed at the user or researcher becoming more independent information seekers and users, i.e. the practice of a prosumer[3]. Then there is also the emerging mobile technologies that libraries are embracing, such as mobile applications, customisation of library websites and advancing IL training through mobile technologies. It is needless to say that the role of the library and librarian, in all library sectors as a whole has changed. From the South African perspective, many developments in the area of libraries have taken place in the last 21 years of democracy and freedom to improve the well-being of society through reading and literacy. The Minister of Arts and Culture, Mr. Mthethwa stated during the 2015 IFLA Conference which took place in Cape Town, South Africa that due to funding, libraries are able to transform into learning spaces (Department of Arts and Culture, 2015: 4). The National Librarian and CEO of South Africa, Prof. M.D. Rocky Ralebipi-Simela added that new possibilities arose to link and develop society through the utilisation of ICT (Department of Arts and Culture, 2015: 4).

Recently in Italy, librarians expressed their mixed feelings regarding their role in the future due to the changing demands especially in the area of supporting research, and the question of whether the aging cadre of librarians battling to keep abreast of trends and resisting change is leading to a situation of becoming 'useless' was raised at the "La Biblioteca Aperta" (Open Library) Conference that was held in Milan 16-17 March 2017, (Cavaleri, 2017; Rasetti, 2017). As much as librarians realise how their role in the digital age is now more than ever crucial to the user community, many challenges exist. The purpose of this chapter is to give insight into the current position of academic and research libraries which exist within universities, specifically in the area of research support. The main aspects discussed in this chapter are:

- The role of the academic library in supporting research
- The role of the academic librarian in supporting research
- Current trends in academic libraries
- Challenges in academic libraries
- Competencies of the academic librarian supporting research
- Future research

[3] The prosumer concept, which refers to being both a consumer and producer, is discussed in great length in Chapter 4, within the research community context.

Taking these abovementioned aspects into consideration, sets the scene for the chapter that follows, which discuss the views from the academic librarian conducting research as well as supporting the research community in research, versus the perceptions of researchers on the role of the academic librarian supporting their research. As a point of entry, Chapter 2 begins with the function and role of an academic library supporting research.

2.2 The role of the academic library supporting research

The academic library is said to be at the heart of the academic institution. It functions as a transformative role to meet the ever-changing needs of society (ALA, 2014). The main function of academic libraries according to Eister (2015: 18) "is to facilitate access to information that meets the teaching, learning and research information needs of institutions' communities". Therefore their strategic goals and directions are to a greater extent aligned to those of their parent institutions (Kleinveldt, 2009; ALA, 2014; Eister, 2015; Saunders, 2015). Library Associations being the professional body of the LIS sphere, also play a fundamental role in library transformation. Their role in supporting the library profession specifically in the area of research is discussed in detail later in this chapter.

The role of the academic library has transformed from being a traditional storehouse of books, to digital / virtual libraries, while the academic librarian now have new roles such as curriculum planning, media specialisation and involved in using a variety of computer generated programs (Oyeji, 2015: 266), which led to the creation of new library positions such as data curator, digital content managers and scholarly communications specialist (ALA, 2014: 36) to mention but a few. Technology being the main cause for drastic change, is perhaps the reason why the role of the academic library and librarian has become so unknown to the user, which is later discussed in the two case studies. It is indeed worth noting that the views about ICT differs from country to country. ICT infrastructure is still very much lacking in some African countries. In Nigeria for example, academic libraries are still today the depository of books. This is one of the main challenges facing academic libraries in Africa. Other challenges that academic libraries in South Africa face are (Eister, 2015: 20):

- A drop in enrolment figures led to the phasing out of LIS programmes
- Many experienced librarians are retiring[4] soon

[4] The issue of 'an aging cadre of librarians' was highlighted as critical in the Master's thesis (Kleinveldt, 2009): "Academics' experience of and perceptions of the role of the academic library in research at the Cape Peninsula University of Technology".

- Budget cuts limit e-resource subscriptions
- "South Africa is still plagued with a high rate of illiteracy, emanating from inequalities of the past. Making time for reading is always secondary to achieve basic physiological needs".

Similarly, resistance to change, and reluctance to adapting to new technologies due to the age and formation of librarians are very much still a reality in the developed world. As mentioned earlier, two librarians recently raised the issue about how computers, library automation among other new developments, were not anticipated by retiring librarians, whom at the time of obtaining their library qualifications, emerging technologies did not exist in Library and Information Science Education (Cavaleri, 2017; Rasetti, 2017) which they further pointed out make it very difficult for them to adapt to the new expectations. They further stated that they did not want to learn new things or be trained at their age, that the younger generation of library professionals should handle this. In a way what these presenters suggest is in line with ALA (2014) and IFLA (2017) reports on new jobs created in the library which are aligned to the research trends. On the other hand, due to technology advancement, academic libraries were at the forefront of providing online services since the 1980s, which started with email reference services (Gross, McClure & Lankes, 2003: 172). The changing role of academic libraries since 2012 being proactive research partners, becoming publishers and providing RDM services were highlighted in the report by the American Library Association (ALA) (2014: 36). As previously mentioned, Research Data Management and academic libraries taking on the function of publishing houses among others, were placed high on the agenda for discussion at the IFLA 2017 conference, which also featured the University of Cape Town in South Africa's publishing model (Raju, 2017). There is thus a growing need for international collaboration to deal with these new responsibilities for academic libraries.

With special reference to research support, many studies report on the role that the academic library plays in supporting research (Onyancha: 2015; McEwen & Li: 2014; Brown & Tucker: 2013; Corrall, Kennan & Salo, 2013; Fourie & Bakker: 2013; Prokopcik & Kriviene, 2013; Raju & Schoombee, 2013; Du & Evans: 2011; Hart & Kleinveldt, 2011; Daniels, Darch & de Jager: 2010; Patterson: 2009; Hulse, Cheverie & Dygert: 2007).

Prokopcik and Kriviene (2013) conducted a five-year period literature review preceding 2013 to explore the role of the Vilnius University Library (VUL) as a partner in the research community of the Vilnius University (VU) in Lithuania. The aim of the study was to see to what extent the role of the library has changed to contribute to the research community. They report that the VUL supports research through being actively involved in implementing Open Access Publishing, Research Data

Management support, conducting Bibliometric studies and promote the university's research output (Prokopcik and Kriviene, 2013: 192). The future role of academic libraries are predicted to be a more collaborative effort involving the university community, an example of pushing this initiative is in the form of grant awards for library associations in the States to run a program called "Assessment in Action: Academic Libraries and Student Success" to assess academic library impact (ALA, 2014: 37).

In light of this, the views by the authors in this section express that the academic library overall plays a fundamental role in the functioning of universities in building a knowledge culture and a stronger society. They argue that by working together, both the library and the university can achieve their goals successfully.

It is also important to note that higher education institutions differ (Conceição & Heitor, 2002:1), and their libraries will play different roles in meeting the demands of its community. It has already been identified in the literature that there is no 'one-size-fits-all' model in place for supporting research (Fourie & Bakker, 2013). This is perhaps so due to the complexity of research, and discipline specific research needs. Therefore the case studies in this thesis will reveal whether the role of research in a traditional university versus a university of technology is different due to for example the culture and nature of these higher education institutions which make them unique. It is crucial though to discuss how or where academic libraries fit into the research world.

Great emphasis have been placed on universities worldwide to drive the research agenda which is core in knowledge societies (Patterson, 2009: 87). This was possible through development plans and huge investments in research by governments and funding agencies to grow the economy. In Ireland, the focus shifted in recent years to PhD training at universities and the need for better research infrastructure, which was found to be lacking to support research due to research grants not necessarily considering 'top-sliced' budget allocation to improve library services for research (Patterson, 2009: 88-89).

Furthermore the study by Patterson (2009) focused on resource sharing and the potential of resource discovery tools such as COPAC and WorldCat to support research in Ireland. Although resource sharing is not new, with Inter-Library Loan and Document Delivery Services being traditional library services, the purpose of the study was to find ways of optimising Inter-Library Loan services, as there were still some challenges faced especially in the digital age. Patterson (2009: 90) reported that a high percentage of Arts and Humanities researchers make use of many libraries outside their parent institutions, "thus confirming the maxim that the library is the laboratory of the Humanities". This links to findings in the 2009 study which showed that Humanities and Social

Sciences disciplines placed a much higher rating on academic libraries in supporting research than the natural science disciplines (Kleinveldt, 2009).

In Australia, some academic libraries have shifted their attention to supporting E-research (Thomas, 2011: 37). According to Thomas (2011: 37) e-research can be defined as: "the merging of information and communication technologies (ICTs) with traditional research practices has created a new movement of e-research, which generates new research methods emerging from increasing access to advanced networks, services and tools". Some of the activities involved in e-research are described as embracing a combination of social media such as ResearchGate to better facilitate collaboration between researchers (which steers towards the prosumer behaviour of researchers discussed in Chapter 4), using new techniques like data mining and software packages for analysing data. Surprisingly e-research also includes RDM, bibliometrics and altmetrics, and referencing tools such as Mendeley to conduct research (Thomas, 2011: 38-39). The author further claims that in order for the university to become a competitive research institution, it is imperative for researchers to develop their skills in conducting e-research, as well as receive quality support from the academic library for e-research. Although this case study focused only on one university in Australia, after benchmarking against other academic library support services for e-research elsewhere in the world, the aim was to develop a model for academic libraries to customise existing practices to suit the needs of their own university community (Thomas, 2011: 38). The project at The Queensland University of Technology (QUT), included key stakeholders, namely all QUT researchers, PhD students, and academic librarians, as well as Information Technology staff members. The goal of the project was to create data management systems for researchers, to get insight into the research needs of researchers at QUT (Thomas, 2011: 38).

Another aspect that is very important in the research landscape, is the building and sharing of knowledge cultures through more collaborative research (Renn, 2014; Inkster, 2009; Holmner, 2008). Academic libraries' resources play a pivotal role in facilitating knowledge flow. However, developing countries still face challenges with infrastructure resulting in information poverty, and the digital divide (Holmner, 2008: 1-2). Inkster (2009: 207) talks about the concept of the 'mindful hand' and how it has caused intimidation in distinguishing between "the 'them' and 'us' of the material world", which led to the controversy about how different societies scrutinize similar aspects of knowledge (usually science) and its applications. Renn (2014: 2) talks about the importance of knowledge management services through "tools such as SharePoint and electronic lab notebooks" to facilitate the flow of knowledge. Benchmarking against universities have become more important in building a knowledge culture. He further states that "librarians need to be able to communicate

and make researchers excited about the possibilities of today's information and knowledge management solutions" (Renn, 2014: 2). Digital projects can add value to scholarly communities and contributes to a university's competitive advantage through the smart use of technology (Linz et al, 2014: 115). Borgman (1999: 239) claims that "research libraries and universities engaged in reinventing themselves for a digital age will need to draw upon the best research, theory and practice from a myriad of disciplines". There is a need for partnerships to be built with institutions to conduct research on the issues such as social, behavioural and economic aspects of digital libraries. These partnerships should include archives, museums and schools which will add value to digital library research (Borgman, 1999: 239).

The overall role of academic libraries supporting the university community cannot be overlooked. As the authors in this section may agree or argue many points, the success of the university globally depends on good collaboration between all stakeholders. There is indeed very much the need for academic libraries to support research, as the keynote speaker at the opening of the IFLA 2014 conference stated that "the time for academic libraries is now" (Stiegler, 2014)!

2.3 The role of the academic librarian

Following the important role of academic libraries in supporting research discussed in the previous section, it could be said that this is perhaps so because of the library profession which makes a significant contribution to building the knowledge economy (McDermott, 2012: 14). The role of the academic librarian is constantly changing as the demands of users change. The academic librarian role could be described as an ongoing realignment with changes in the university setting. Academic librarians are working more closely with faculty especially with the rise of OA and RDM, and as already mentioned, led to new library positions like data curator being introduced to provide trendy services. There is no doubt that academic librarians form part of the stakeholders involved in research. One example of playing a crucial partnership role in the digital research world is dealing with copyright which McDermott (2012: 17) elaborate on further:

> As librarians, we must curate and defend the creative property of the established, while fostering the innovative spirit of the next generation. As information, literature, and other creative works move out of the physical world, and off the shelves, into the digital realm, librarians need to do their part to ensure legislation is aligned with this new reality. If we do not, our profession may suffer first, but it will not be the last casualty of the copyright wars.

It is thus observed that academic librarians are more and more taking up the role of a researcher. As is prevalent in the United States, in some cases faculty librarians hold academic status, and in order to maintain it, they need to conduct research (Pickton, 2016: 108). The culture of practicing

academic librarians conducting Library and Information Science (LIS) research is picking up momentum and also encouraged in the UK, Australia (Pickton, 2016: 108) and South Africa (Raju, 2017). A study investigating the most cited journals by academic librarians revealed the fields of American science, medical, engineering and agricultural librarians dominant in the area of research. However the study also revealed that most of these research output are coming from higher education institutions that offer the course Library and Information Science, with the most popular journals being *Science and Technology Libraries, Issues in Science and Technology Librarianship, Journal of Agricultural and Food Information, Journal of the Medical Library Association*, and *Medical Reference Services Quarterly* (Hardin & Stankus, 2011: 143). With regards to reference services to support research at universities, it is important that librarians have the intellectual understanding of research, and therefore re-skilling and constant updating of knowledge and expertise is an imperative (Gunning, 1978: 216). In the master's project (Kleinveldt, 2009) which this PhD thesis is expanding on, interview findings revealed that academic and research librarians should hold a PhD degree (in which discipline remains unclear) to fully support research at universities. This way, the optimal research support can be provided when academic librarians gained the experience themselves of PhD level research. Whether possessing a PhD will be a minimum requirement for academic librarian positions in the future, may not be so far away considering the new roles and services for supporting research. Another question raised is whether librarians really need to possess an additional qualification in a specific field in order to support research? In some countries, and some institutions, academic librarian positions require librarians to have a degree in that particular field, together with a library science qualification (CILIP, 2016; Prospects, 2017), for example, a Law Faculty Librarian should possess an LLB and a PGDipLIS (Postgraduate Diploma in Library and Information Science). The issue of academic librarian's subject knowledge to support research are discussed in detail later on in the two case studies where views from both academic librarians and researchers could possibly lead to new developments in LIS education in the future. It is also important to note that research publications in the field of Library and Information Science have increased tremendously over the years (Lopez, 2007: 194). The dissemination of Library and Information Science research output is essential for developing the field and society (Kleinveldt, 2009; Ngulube, 2007). Lopez (2007: 194) found that in the history of research publications on books and libraries in Spain, there are three groups that publish on the subject, namely the librarians, academics in Library and Information Science at universities, and historians of education.

Murphy and Boden (2015: 73) add that Canadian academic librarians in health sciences traditionally played both a theoretical and practical teaching role for researchers and users to construct search

strategies and database training in order for them to construct an independent literature review. However, these support services are found not to be sufficient in the digital age considering the research trends that force academic librarians to take on more new roles. One of these new roles which has become common practice in some universities, are academic librarians conducting systematic reviews for researchers especially in the science and medicine disciplines, which to a large extent makes the academic librarian a partner in the research process, to the point of being co-authors with researchers (McDermott, 2012; Crum & Cooper, 2013; Murphy & Boden, 2015: 74). This was the case for academic librarians in Canada where their new role of being an active partner in the research process by conducting systematic reviews has become fundamental for supporting research (McDermott, 2012). Murphy and Boden (2015: 74) further points out that faculty members welcome the partnership with academic librarians conducting systematic reviews, as well as becoming co-authors, educators and critical appraisers. This could however have implications for academic librarians who are already facing challenges with heavy workloads, doing more with less (Schroeder and Boughan, 2018) being the norm worldwide. What this means for academic librarianship and international librarianship in the future could or should therefore be pondered. During an interview Barbara J. Ford, a distinguished professor emerita of the University of Illinois Library Mortenson Centre for International Library Programs, was asked what international librarianship meant to her, and she responded as follows (Merli, 2015):

> The increasing effects of globalization on societies and institutions everywhere and the increasingly interconnected and interdependent world mean that library and information science professionals have a responsibility to their clients to provide services with a global perspective. Librarians around the world have much in common and can learn from one another by sharing insights and expertise.

This response ties in with Bauman's (2012) and Ritzer's (2011) explanation in the introduction to this chapter about the liquidity of affairs globally and therefore the role of the librarian being the link to connecting and facilitating the flow of research is key. Latching on to this, a new term 'critical librarianship', was recently created as a new subject heading in academic librarianship, which Gracia (2015) described as being the practice of academic librarians for some time and further elaborates:

> Critical librarianship has always been embedded in the library profession. It is the inflection of critical theory in library and information science. Librarians have engaged with critical librarianship within professional organizations and outside of it. Critical librarianship includes the development of critical thinking, information literacy, and lifelong learning skills in students, as well as engagement with diversity, information ethics, access to information, commodification of information, labor, academic freedom, human rights, engaged citizenry, and neoliberalism.

As mentioned earlier, in order for academic librarians to improve research support services, it has become crucial for academic librarians to conduct LIS research (Kleinveldt, 2009; Pickton, 2016). According to Pickton (2016: 105) 'practitioner research' [which refers to academic librarians conducting research in the Library and Information Science field] "provides the evidence to improve services and that the likelihood of it occurring will be increased if a strong organisational research culture exists". Academic libraries are gradually moving in the direction of making decisions based on research findings.

Considering the views raised by the authors in this section reflect that academic librarians play a fundamental role in supporting research at higher education institutions, and contribute tremendously to building the knowledge economy. Ranging from information provision in digital format, to Information Literacy training which contribute to the researcher becoming a prosumer, to being an active partner in research data management practices and co-authorship, forms a crucial part of the new role of the academic librarian in facilitating scholarly communication. There is no doubt that the role of the academic librarian in research shows promise for the future. What the literature portray to be the new roles of academic librarians could not be solely accepted for decision-making purposes without considering the perceptions of the academic librarians currently facing the dilemma. Literature on the perceptions of academic librarians are therefore discussed in Chapter 3.

2.4 The role of Library Associations for research support

Library Associations, the professional bodies of the Library and Information Science profession, plays a pivotal role in the Library field as a whole. The purpose of Library Associations is to ensure libraries and librarians develop, acquire the knowledge, skills pertinent to today's information and knowledge society. Over and above assisting with development in the field, Library Associations play a leading role in taking the profession forward, by presenting statements, declarations, policies to government and the community relating to issues such as literacy, access to Information, knowledge, data, and technology affecting society. In response to trends, library associations provide guidance for the future role of the library and librarians. Therefore it is beneficial both for libraries and librarians to be members of the library association to better support their users. However, not all librarians feel this way, which is later highlighted in the findings of the two case studies in this thesis. For the purpose of the study on the role of academic libraries in research in Italy and South Africa, this section focuses on the role and functions of seven library associations: IFLA. ALA, CILIP, LIBER, IATUL, AIB and LIASA, setting the scene in particular for the current state of academic and research libraries, and what the library trends are. As Thomas, Satpathi and Satpathi (2010: 8) further states,

“library associations do commendable jobs and, thus, help management and personnel of different libraries to do their work systematically.” Its function as a professional body is to focus and participate through collaborative efforts to contribute to the development goals of a country, towards a more knowledgeable society. However, the role of the library association should expand beyond developing the traditional services of libraries, by also being “progressive forces for change, protect freedom of expression, and can promote community organization for enhancing the quality of life” (Kagan, 2005: 66). Barbara J. Ford, who was at one stage the president of the American Library Association mentioned during an interview that “It was a privilege to provide leadership for the development, promotion and improvement of library and information services and the profession of librarianship to enhance learning and ensure access to information for all” (Merli, 2015). Therefore it is worth looking into the historical background of some of these professional bodies to understand the role they play in supporting librarians with research trends, which the following section will discuss.

2.4.1 Historical Background of Library Associations

For the purposes of the thesis, the historical background of the seven library associations is described briefly to give the reader an understanding of the current state and direction of these professional bodies who lead the library profession. The first library association namely the American Library Association (ALA) was founded on October 1876 in Philadelphia, and is the largest library association in the world (ALA, 2015). The division of ALA which specifically focuses on guiding academic and research libraries in supporting their university communities, is called The Association of College & Research Libraries (ACRL) and was founded in 1940 (ACRL, 2015; ALA, 2015). The leader of all library associations is the International Federation of Library Associations and Institutions (IFLA), founded in Edinburgh, Scotland, on September 1927. IFLA is “the global voice of the library and information profession” (IFLA, 2015). The two divisions of IFLA (2015) which relates specifically to this research project are the Science and Technology Libraries section, and the Academic and Research Libraries section. The Italian library association, Associazione Italiana Biblioteche (AIB) was founded in 1930, and the focus is to “enhance and protect the dignity and specificity of the professional librarian; promote, support and develop all actions necessary to ensure a qualified vocational training; provide its members with scientific and technical support for continuing education” (AIB, 2016). AIB also guide the library profession through workshops, conferences and mailing lists. The International Association of Technological University Libraries (IATUL) founded in Düsseldorf, Germany, on May 1955, initially presented the interests of university of technology libraries throughout the world, but since 2015 have expanded its interest to include all academic

libraries (IATUL, 2016). In Europe, The Ligue des Bibliothèques Européennes de Recherche – Association of European Research Libraries (LIBER) was founded in 1971 and represents the interests of research and academic libraries (LIBER, 2016). The Chartered Institute of Library and Information Professionals (CILIP) in the UK advocates for the recognition of library professionals in policy-making especially in the area of academic and research libraries, where a huge contribution is made in supporting teaching and learning (CILIP, 2015). The Library and Information Association of South Africa (LIASA) founded on 10 July 1997, represents library sector in South Africa (LIASA, 2016). The Higher Education Libraries Interest Group (HELIG) is a division of LIASA focusing on academic and research libraries (LIASA, 2016). These library associations, although founded at different times, and representing the world or specific countries, all have a common goal, to improve library services, update the knowledge and skills of librarians in the rapidly changing world, to best support their organisations and communities. The focus is also to emphasise the important role that libraries play in the quality of life, and library associations have the responsibility to ensure that officials making decisions at a global level take into consideration the contribution libraries make in society. Table 2.1 illustrates the aims, missions, and core values of the seven library associations, giving insight into their focus areas. The six library associations representing specific countries, all adhere to IFLA.

Table 2.2.1 Library Association aims, mission, core values (AIB, 2016; ALA, 2015; CILIP, 2015; IATUL, 2016; IFLA, 2015; LIASA, 2016; LIBER, 2016)

Library Association	**Aims, Mission, Vison, Core Values**
ALA	"Mission: to provide leadership for the development, promotion and improvement of library and information services and the profession of librarianship in order to enhance learning and ensure access to information for all. Core Values: Extending and expanding library services in America and around the world, All types of libraries - academic, public, school and special, All librarians, library staff, trustees and other individuals and groups working to improve library services, Member service, An open, inclusive, and collaborative environment, Ethics, professionalism and integrity, Excellence and innovation, Intellectual freedom, Social responsibility and the public good" (ALA, 2015).
IFLA	"Aim: Promote high standards of provision and delivery of library and information services, Encourage widespread understanding of the value of good library & information services, Represent the interests of our members throughout the world. Core Values: the endorsement of the principles of freedom of access to information. ideas and works of imagination and freedom of expression embodied in Article 19 of the Universal Declaration of Human Rights, the belief that people, communities and organizations need universal and equitable access to information, ideas and works of imagination for their social, educational, cultural, democratic and economic well-being the conviction that delivery of high quality library and information services helps guarantee that access the commitment to enable all Members of the Federation to engage in, and benefit from, its activities without regard to citizenship, disability, ethnic origin, gender, geographical location, language, political philosophy,

	race or religion" (IFLA, 2015).
AIB	"Aim: play the role of professional representation in all cultural, scientific, technical, legal and legislative, for all that may concern the exercise of the library profession and the organization of library services and documentation; say, enhance and protect the dignity and specificity of the professional librarian; promote, support and develop all actions necessary to ensure a qualified vocational training; provide its members with scientific and technical support for continuing education; promote the ethical principles of the profession and to assure compliance; contribute in every seat orientations and choices of library policy and in the area of intellectual property and access to information; promote the organization and development in Italy of libraries and of a library service that takes into account the needs of citizens" (AIB, 2016).
IATUL	"Aim: Value to members, Communication and advocacy, Project development, Collaboration. Vision: To be the acknowledged international association for the academic library community, contributing to future developments in scholarly information through a co-operative network of senior library directors. Purpose: IATUL promotes effective co-operation among university libraries by providing an international forum for library directors and senior managers to exchange views on matters of significance to all domains of knowledge and research, and by encouraging collaborative approaches to strategic issues through a portfolio of services and projects" (IATUL, 2016).
LIBER	"Aim: Increase the provision of services and resources that meet the changing profile and increasingly high expectations of users based in LIBER institutions, Serve existing users and engage new audiences, using best of our collections, expertise and spaces, Strengthen partnerships with the EU, European University Associations and a number of cognate organisations and consortia, Increase advocacy activity on behalf of European libraries to the EU, LIBER member institutions, research funders, sponsors, Help build a workforce in LIBER member institutions whose skills continue to keep pace with change. Core Values: **High-quality services** for all users of library and information services, **Intellectual freedom** and access to scholarship**, Collaboration** with campus, local, national, European and global partners, **Stewardship** of collections and institutional resources, in the most appropriate format, **Leadership**, innovation and a willingness to embrace opportunities for change, **Inclusivity**, equality of opportunity and fulfilment of potential" (LIBER, 2016).
CILIP	"Vision: A fair and economically prosperous society is underpinned by literacy, access to information and the transfer of knowledge. Mission: Promote and support the people who work to deliver this vision. Be the leading voice for information, library and knowledge practitioners, working to advocate strongly, provide unity through shared values and develop skills and excellence" (CILIP, 2015).
LIASA	"Vision: Dynamic association of excellence for Library and Information Services sector. Mission: The Association that connects the LIS sector and promotes the development of South Africa through access to information. Core Values: Providing leadership excellence to the LIS profession, nationally and internationally; Engaging in the highest ethical practice; Ensuring professional conduct; Acknowledging and respecting the diversity and individuality of all people; Promote freedom of access to information as enshrined in the Constitution of South Africa; Leading the development and growth of the LIS profession through excellence; Championing the culture of reading and life-long learning to build an informed nation; and Committing to the development and growth of South Africa through excellence in librarianship" (LIASA, 2016).

The 2014 IFLA Annual Report (2014) somewhat sets the scene in terms of the current state of libraries and the direction of libraries. Sinikka Sipilä, IFLA President for the term 2013-2015, reported that the main focus in 2014 was promoting the IFLA Trend report, library advocacy, the launch of the 'Lyon Declaration on Access to Information and Development' at the 2014 IFLA World Library and Information Congress (WLIC) which was held in Lyon, France. The IFLA President's theme: Strong Libraries, Strong Societies, was the focus and many discussions took place with stakeholders on the role of libraries and impact on society. There was good collaboration between IFLA members in 2014, to formulate "an advocacy toolkit to support library associations and institutions in response to the United Nations post-2015 Sustainable Development Goals (SDGs)" (IFLA Annual Report, 2014:3). What is important about the president's report, is that the successes of 2014 would not have been possible without the contribution of all stakeholders from different countries which include the people on the ground who need to deal with the day-to-day challenges, and by sharing experiences and best practices, brings the pertinent issues to the table to ensure that libraries, together with their communities are not excluded in decision making. The advocacy toolkit responding to the UN SDGs is just one of many examples where the library association respond with ways of how the LIS profession provide assistance to improving society.

LIASA has shown promise and proven in many ways to be a leader on the African continent. Through a flourishing membership and active participation in interest groups and maintaining the *South African Journal of Library and Information Science* as an accredited LIS journal are but a few examples of how this library association is positioned in the dissemination of research. LIASA has been actively involved in providing librarians with guidance to promote OA initiatives, RDM, the institutional repositories through training workshops, webinars which have shown to be efficient in the digital age, as well as the annual conference where library professionals share best practices and discuss the future of librarianship. Contribution to the library profession is also provided by LIASA in the form of grant sponsoring and awards (Ngulube, 2007: 131).

With special reference to academic and research libraries, IFLA provides the platform at the annual conference to discuss hot topics in this particular field that librarians need to deal with in keeping relevant and updated. The list of current hot topic presented and discussed at IFLA in 2015 conference which spoke directly to research were (IFLA, 2015):

- *"Riding the "cycle": Librarians facilitating research"*
- *"Collections and content centered stewardship as an important paradigm in library services supporting the changing research practices in Humanities and Social Science"*
- *"Open Access publishing support in South Africa"*
- *"Collaboration and Cooperation in RDM"*

In its aim to lead the direction of the library profession, IFLA publishes the Trend Report regularly. The 2015 IFLA Trend report: "shaping the future information ecosystem" listed the following five key trends, which give insight into the LIS direction (IFLA, 2015):

- *"New Technologies will both expand and limit who has access to information".*
- *"Online Education will democratise and disrupt global learning".*
- *"The boundaries of privacy and data protection will be redefined".*
- *"Hyper-connected societies will listen to and empower new voices and groups".*
- *"The global information environment will be transformed by new technologies".*

Considering the transition from the Millennium Development Goals to the UN 2030 Sustainable Development Goals, IFLA (2016) has responded by publishing a report clearly stating how libraries contribute to each of the 17 SDGs. This is evidence of the role that the library association plays in promoting the value the library field as a whole to society.

The most recent focus is the IFLA Global Vision Initiative, which opens up the opportunity for all stakeholders involved in all sectors of libraries to participate in the vision. In 2017, all library staff globally were encouraged to vote and have a voice in the future direction of libraries. This initiative shows how IFLA being the leader in the library profession, is inviting all voices, so that together library professionals and there library can pave the way forward, through collaboration from different parts of the world. This section gave an overview of the library professional body's role in developing the library profession, and set the scene for the next section which discusses further the trends in academic libraries supporting research.

2.5 Trends in academic libraries supporting research

There is a significant growth in library trends with regards to research in the 21st century. Considering the current role of academic libraries and librarians, this section discusses the trends in academic libraries supporting research, which will lead to identifying the challenges that the library profession face and librarian competencies needed to keep up with trends and remain relevant.

2.5.1 Technology and Higher Education

Through emerging technologies and the use of Information Communications Technology (ICT) to access information brought about the movement from an information society towards a knowledge society which furthermore led to enhancing the quality of people's lives (Greenberg, 2005: 13; Sandys, 2005: 2). ICT plays an important role in the sustainable development of communities (Nkanu & Okon, 2010). With the rapid advancement in Science and Technology, knowledge societies have

developed (Rasul & Sahu 2011). Thus communication technologies have contributed to developing social behaviour. Moreno-Jimenez et al (2014: 410) further states that communication allow a smooth interconnection between human and technologies to occur within a knowledge society.

It is claimed that Technology providing access to electronic resources is an enabler to building knowledge. However, it is important for students to be motivated to learn, and this culture of learning to learn need to be encouraged in the curriculum to prepare students for a global knowledge society. The challenge for academics is to develop and encourage the culture of learning among students through the use of Technology to acquire reliable sources and to use them effectively. Blended learning thus play an important role for students to build knowledge (Catana, 2014a: 159). Due to the rapid developments in Technology, higher education institutions can no longer function without it. Higher education institutions, together with their libraries therefore embrace Technology to remain relevant.

The use of Web 2.0 tools facilitates foreign language learning amongst students, creating knowledge creation and sharing through interaction and collaboration. A study conducted at the Mersin University in Turkey focused on non-English speaking students who were enrolled for the English Language course to use a Web 2.0 tool called “Showbeyond” which allowed students to type stories and share with the foreign language class community. The data collected was through studying stories students typed as well as conducting interviews with eight students to find out what their experience was of using “Showbeyond”. The study found that students were able to learn from their peers, and build new knowledge by working together (Yaman et al. n.d.). This concept of using Web 2.0 tools to create new knowledge relates to the role of the researcher as a prosumer which is further discussed in Chapter 4.

2.5.2 Libraries and Technology

To begin, it is worthwhile noting that *The NMC Horizon Report[2]: Higher Education Edition* (the reports from 2015 to 2017 were consulted for the purposes of the thesis) focused on three specific areas: technology trends that are ideal for incorporating in higher education, difficulties experienced that restrict implementation, and educational technology advancements, in an attempt to plan strategically over a five-year period to achieve optimum performance through embracing technology in teaching and learning (Johnson et al, 2015: 1). Although the focus of these reports are on teaching and learning, they impact on research activities at higher education institutions as well, and libraries need to be aligned to the new goals set.

The NMC Horizon report (Johnson et al, 2015: 6) categorised the key trends, challenges and developments ranging from short to long term. The model also looked at three dimensions which impact universities and colleges, namely: policy, leadership and practice. The rise of Open Educational Resources impacting on teaching and research practices has brought about the need for new policy developments for higher education institutions (Johnson et al, 2015: 6). "Learning analytics" which is the measurement of learning through data-driven assessment, is said to be on the rise in universities in the developed world, with the Open University in the UK already having policies in place, and in the US at the Asilomar Conference, policy framing was also taking place (Johnson et al, 2015: 6). With regards to leadership, two key trends have been identified which has an impact on higher education, namely: redesigning learning spaces and the rapid growth of collaboration between universities driving innovation (Johnson et al, 2015: 6). With regards to practice, blended learning has been identified as the trend enhancing technical and pedagogical methods. Blended learning can be defined as combining face to face classroom teaching with online teaching which is beneficial for students and the higher education institutions (Johnson et al, 2015: 7).

So too at UNIBO and CPUT, the practice of blended learning has increased through the Online Learning Environments. A study (Kleinveldt, 2015) investigated whether the Online Learning Environment, Blackboard, could be used as a knowledge management tool at CPUT. The results show that although interaction between students, academics and librarians increased and found to be successful in teaching and learning, there is still room for implementing more knowledge management practices as Blackboard provides many features for more collaboration between researchers and librarians (Kleinveldt, Schutte & Stilwell, 2016; Kleinveldt, 2015). Therefore, Online Learning Environments also have the potential to facilitate e-research practices in the future. Turning the attention to the technology trends and how it impacts academic library services for research, there is a growing movement from traditional functions such as cataloguing print materials to metadata generated for electronic resources. Park and Brenza (2015) studied semi-automatic metadata generation tools as a solution for libraries dealing with the digital age. Because of data and information overload, libraries who already face the challenge of budget cuts, no longer have the staff capacity to manually classify and create metadata for electronic resources. Implementing semi-automatic metadata tools has been found to save academic libraries time and money. There are however aspects to consider which could cause problems such as unstable networks and systems, as well as the Information Technology competencies needed by librarians to maintain these tools. An integrated system would be beneficial when implementing semi-automated metadata generation

tools (Park & Brenza, 2015: 40). It can be seen, that technology is becoming more and more the driving force of academic libraries in South Africa. Core elements of the technology landscape in South African academic libraries include implementing integrated systems where library systems and university systems talk to one another, introducing more wireless technologies and shifting attention towards networked-based information resources (Eister, 2015: 18). The views of the authors expressed in this section regarding the technology trends in higher education institutions and their libraries emphasise the important role academic libraries play now and in the future, the constant transformation from traditional support services to dynamic, innovative support services are further discussed in the sub-sections below.

2.5.2.1 Web 2.0

Academic libraries have been integrating various technologies into their services to remain relevant to the changing demands of tech-savvy users, as well as supporting their parent institutions in teaching with technology, moving to a more blended learning approach as discussed in the technology trends above. Web 2.0 have given academic libraries the opportunity to make themselves more visible on the web, getting into the virtual space of the user, allowing increased interaction to take place between faculty, students and the library. It is therefore important to define Web 2.0, which was first discussed by O'Reilly (2005). Web 2.0 is comprehensively described by Hicks and Graber (2010: 622) as follows:

> Web 2.0 allows us to participate in this cloud, through five main characteristics, collaboration, creativity, conversation, community and control. It is a read and write web…The participatory and open nature of Web 2.0 gives us the capability to collaborate with new knowledge and to create empowering connections and community between people. It allows us to creatively use and reuse material in novel ways because there is not one centralized power controlling the web. Finally, and most importantly, Web 2.0 changes us from passive to active information consumers, allowing our online voice to be part of the conversation. The way we produce, store and consume information has changed, and we need Web 2.0 in order to interact with and to direct the future of scholarship.

According to Birdsall (2007) Web 2.0 is also a social movement, "a basic human right to communicate for everyone". Thus Web 2.0 has changed the information-seeking behaviour of users, in particular researchers, which brings to mind the concepts of e-research and prosumerism. It was therefore important for academic libraries to embrace Web 2.0. Best practices of academic libraries successfully embracing Web 2.0 to support the university community as a whole have been shared through conferences and many publications (Frumkin, 2005; Holvoet, 2006; Birdsall, 2007; Curran *et al.* , 2007; Kesselman, 2008; Levy, 2009; Serantes, 2009; Ram, John, & Kataria, 2011; Tyagi, 2012; Blummer & Kenton, 2014; Isfandyari-Moghaddam & Hosseini-Shoar, 2014; Kleinveldt, 2014). As

Tyagi (2012: 439) pointed out, Web 2.0 enabled librarians to become creative in providing support to library users. In a study exploring 100 US College libraries' websites, the authors found that most popular Web 2.0 tools used by these libraries were: LibGuides, social networking tools, chat technology, photo video sharing sites and RSS updates (Blummer & Kenton, 2014: 75). The most popular Web 2.0 tools adopted by 87 top African universities was found to be social networking sites (Wordofa, 2014). At the Cape Peninsula University of Technology (CPUT) Libraries in South Africa, the Web 2.0 tools used to enhance library orientation are Facebook, Libguides, Screencasts, Podcasts, and QR codes. The Online Learning Environment, Blackboard, is the platform at CPUT hosting most of these library integrated Web 2.0 tools as a means of supporting blended learning (Kleinveldt, 2014). The use of Web 2.0 by researchers has changed the practice of conducting research, changing the role of the researcher to the prosumer, which is in line with the e-research practices. With regards to the academic librarians' perception and experience of using Web 2.0 to support research, a survey conducted with 47 academic and college librarians in Hamedan, Iran, revealed that "job conditions, changeability, skills, competitiveness, and saving time" were the main reasons why librarians embraced Web 2.0 (Isfandyari-Moghaddam & Hosseini-Shoar, 2014). From the user perspective, students have responded positively to the integration of Web 2.0 into the academic library services (Lwoga, 2014: 183). A study has also found that the use of web 2.0 through academic library websites are on the rise (Academic library websites show heavy use of web 2.0 applications, 2014).

2.5.2.2 Mobile Apps

With the emergence of mobile technologies, brought about a new practice of using web applications, also called mobile apps in research. In addressing the need to remain relevant in the rapid advancement of technology, academic libraries have started embracing mobile technologies by introducing mobile services. Many universities have customised their websites in the form of a mobile app compatible for mobile devices of the university community for easier access and navigation of university websites. Academic libraries have also embraced mobile technologies in different ways to support their users, making users able to access information via their university library in the palm of their hands. Liu and Briggs (2015: 135) studied the current state of mobile services at the top 100 universities' libraries in the United States, listed on the World Report's national university ranking in 2014, through evaluating websites and conducting a questionnaire to investigate best practices for librarians and library experiences of mobile services. They define mobile services being customised mobile-friendly university library websites, apps, QR codes, library catalogues, databases, e-book platforms, as well as Information Literacy modules accessible by users

on their mobile devices which include smart phones and tablets (Liu & Briggs, 2015: 135). Academic libraries implementing mobile services have increased access to library resources, adapting to the technology trends in higher education (Johnson et al, 2015-2016) to enhance student learning and experience. However, it is argued that there is no one approach for the provision of mobile services, leaving the option open to any academic library wishing to offer these services to accommodate their users' needs (Liu & Briggs, 2015). These findings are in line with the NMC Horizon Reports from 2015 to 2017, which highlighted one of the short-term trends of technology in higher education as being "BYOD (Bring your own device) or BYOT (Bring your own technology) to the classroom or learning environment" (Adams et al, 2017; Johnson et al, 2015: 36). This means that there is a growing movement of staff and students who bring their own mobile devices and connecting to the institutions' network. It was found that this practice has increased productivity among staff members in organisations (Johnson et al, 2015: 36). Whether the outcome of BYOD or BYOT among students leads to enhanced learning, higher throughput rates or increased research output at universities needs to be investigated. Saunders (2015: 290) supports this as she found in her study evaluating strategic plans of academic libraries, that technology, especially mobile technology have not been placed high on the priority list of academic strategic plans, which is surprising considering the NMC 2015 Horizon Report. Furthermore, the author found it strange that no specific plans are mentioned in the academic library strategic plans evaluated regarding implementation or testing of new technologies, even though embracing new technologies is mentioned (Saunders, 2015: 290).

The researcher collaborated in a study in 2015 to explore the top 20 universities ranked in the Times Higher Education ranking website, and found that they all had a mobile app available for their university community to download onto their mobile devices, which in most cases needed a university login to access library resources, the Online Learning Environment and faculty specific content (Booysen & Kleinveldt, 2015). The Harvard University Library have made available mobile apps on their website specifically supporting research, in particular, various stages in the research process which includes but not limited to reading, note-taking, literature searching, data collection methods and so on (Harvard Library, 2017). This innovative initiative has shown how librarians can embrace mobile apps to support the new role of the researcher.

2.5.2.3 Robotic Technology

Robotics is a fairly new area that academic libraries are venturing into as a way of embracing emerging technologies. Robotic technology is said to be the "next industrial revolution" which has been called by the chief executive of Microsoft, Satya Nadella, as the "fourth industrial revolution". He predicts a huge growth for the economy, but on the other hand the UBS Group AG report raised

concern that companies investing too much into robotic technology could widen the wealth gap between developed and developing countries (Hirschler, 2016). However, it is taking academic librarianship to another level, especially in the area of enhancing reference services, and research support. Collaborative efforts which involved the researcher based in Bologna, Italy, collaborating with library staff at the Western Michigan University (WMU) in the United States tested the operation of Alex (the robot librarian) on 16 January 2016. The pilot project involved the researcher[5], through Internet connection and in collaboration with the library and IT staff at WMU to control Alex remotely from Italy, to test providing a remote reference service to students in the Learning Commons of the WMU Library. The researcher was able to navigate the robot around the library and interact with users and answer basic reference queries. The only challenge faced during the session was the intermittent Internet connection between Italy and the United States, which means that for such an initiative to be implemented in future, strong connectivity is an imperative. Reporting on the experience which was published in the February 2016 Waldo Library Newsletter (Western Michigan University Libraries, 2016), Kleinveldt mentioned that:

> "*The aim is not to replace the academic librarian with robotics, but instead robotic technology complements the new role of the librarian. Through robot technology, academic librarians can now extend their services and expertise from virtually anywhere… Overall, it was a great experience to explore how international collaboration can enhance reference services for the benefit of users. This innovative initiative will drive the direction of academic libraries in the future, extending information and research support beyond the boundaries of its parent institutions".*

It is a means of building stronger networks with academic libraries all over the world. As Jiang et al (2015:14) stated: "academic libraries should take on this opportunity of repositioning technology services to provide and promote technical applications, becoming a central point for library users to share ideas and collaborate on projects". It is hoped that this pilot project, exploring collaborative initiatives with robotics in academic libraries will create future opportunities for enhancing library services and in particular, research support. Therefore, in contrast to UBS Group AG report raising concern about widening the wealth gap between developing and developed countries (Hirschler, 2015), robotic technology has the potential to 'bridge the gap' through information and knowledge sharing as well as support to continue building a knowledge culture.

[5] The researcher is a faculty librarian in Applied Sciences and Health & Wellness Sciences faculties at the Cape Peninsula University of Technology in Cape Town, South Africa

2.5.3 Library Collections

Collection development, a traditional library function, is still very relevant in today's network and web society. There has been a tremendous paradigm shift from print to electronic resources. Many collection development policies in academic libraries encourage acquisition of electronic resources, with a huge increase in subscriptions to electronic databases, journals, and books. Hasenay, Susak Lukacevic, and Mokris (2013) calls electronic resources provided by the library as "e-education", and further states that for academic libraries to understand Science and Technology, traditional library services and spaces need to change to accommodate today's users. Although on the one hand, the shift to electronic resources was a solution to dealing with space, and making collections more easily available and accessible to the university community, it also has its challenges with regards to budget constraints and publisher restrictions. The recent case of Germany, Peru and Taiwan taking a stance to cancel all Elsevier subscriptions this year, is just one example of the extent of exorbitant subscription fees and restrictive models. Outsourcing has been a practice that academic libraries have been doing for a long time as a way of dealing with budget constraints and under-staffing issues, but also as another way of sharing resources and expertise (Sharma& Gupta, 2012; Gunning, 1978). Collection development for libraries in specific subject areas or disciplines can be a challenging task, especially where there is no collaboration between the library and the faculty. It is an area which remains quite high on the priority list of academic library strategic plans (Saunders, 2015). What is key for building science collections more successfully, is for librarians to obtain both theoretical and technical competencies (Leach, 2008: 11). Initially the focus has been on ensuring that the collection is adequate at undergraduate level. However, building a collection to support the diverse research niche areas of universities is virtually impossible, especially when the issue of budget cuts is the reality of libraries. Oyeji (2015: 265) pointed out the challenges faced with regards to the state of folk music libraries in Nigeria, and the battle to obtain funding to build a collection for a discipline that is perceived to be not important enough compared to science disciplines for example.

Trends in Collection development, information, knowledge and data management that affect academic libraries according to Thomas, Satpathi and Satpathi (2010: 3) are:

1. "End of digital information as an additional format and its emergence as the only format"
2. "Ownership vs Holding"
3. "Prominence of Open Content"
4. "Emergence of Informal Learning"
5. "Sense Making"

6. “Cloud-based Technology”
7. “Emerging Predominance of E-books”
8. “Strong Surfacing of Resource Sharing” – “Consortia movement” and “Interdisciplinary nature of studies/works”
9. “Application of Web 2.0 and 3.0”
10. “Virtual Reference”
11. “New Form of Scholarly Corroboration”
12. “Growing importance of Mobile Technology and Simple Augmented Reality”
13. “New Technologies – The Horizon Report: 2010 Edition has singled out two technologies to watch in the near future. They are Gesture-based Computing and b) Visual Data Analysis.”

They further claim that these trends are the challenges that academic librarianship faces today. Considering the constant budget cuts, the notion of ‘doing more with less’ (Schroeder and Boughan, 2018: 28) seems to be the norm in a profession where there are few librarians and the demands are higher. The expectation remains that academic librarians need to keep up with these trends to remain relevant in the university community (Thomas, Satpathi and Satpathi, 2010).

Based on these trends in collection development presented above, it is worth noting that digital libraries play a vital role in supporting and keeping up with new trends. The following section therefore discuss digital libraries’ role in supporting research.

2.5.4 Digital Libraries and its role in supporting research

The concept of digital libraries emerged with the evolution of the Internet. The Internet, World Wide Web and ICT opened up a new world to society. This resulted in a change in perception that everything can be accessed via a search engine like Google, making a visit to the physical library seem old fashioned. Many authors claimed that libraries and the printed book will become extinct. However, libraries are at the forefront of incorporating new technologies, adapting to change to remain relevant in the ever changing society. As Darnton (2014) stated that in the “digital future, libraries and the book is still very important, if we get it right”. Technology has resulted in society being connected all the time, a time where nobody sleeps anymore. Thus the “time of the book and reading is now, the time for libraries have just started”. There is also the debate regarding the World Wide Web not being a library or digital library, as it does not have organised content, catalogued and classified and the selection is not for a specified user community. Therefore the argument arises that electronic databases on proprietary services are organised collections selected for specific scholars or research communities (Borgman, 1999: 238). The future of digital as Borgman (1999: 239) points

out, shows that “digital libraries are themselves becoming enabling technologies for many other applications”. This section focuses on digital libraries and the impact it has on the knowledge society by looking at the historical background, digital library projects in different countries, the perceptions of users and library staff with regards to using digital libraries in research.

First of all, it needs to be pointed out that there are many definitions for digital libraries. Digital libraries are seen as an institution or organisation. There are also different concepts used interchangeably to describe digital libraries such as virtual libraries. Borgman (1999: 237) talks about the issue of digital content and how one need to define or distinguish between “print libraries, digital libraries, film libraries and audio libraries”. The term digital library was found not to be the ideal term to use amongst librarians to describe the future of libraries (Borgman, 1999: 237). There is also the issue of whether databases could be said to be digital libraries. Some proprietary services such as Lexis/Nexis claim to be digital libraries. Databases however remain a grey area (Borgman, 1999: 238). ‘The President’s Information Technology Advisory Committee (PITAC) Panel on Digital Libraries’, as quoted by Goncalves et al (2004: 2) defines digital libraries as “the networked collections of digital text, documents, images, sounds, scientific data and software that are the core of today’s Internet and tomorrow’s universally accessible digital repositories of all human knowledge”. Due to the digital age that we find ourselves in, academic libraries continue to develop digital collections. One example is the institutional repositories which places university research output on the research landscape, which is discussed later in the thesis. For the purposes of the thesis a digital library is discussed within the academic library context. Although it should be noted that digital libraries are in abundance and also exist outside of academic libraries, for example in public libraries and museums.

It has been realised that digital libraries is a complex concept and needs to be unpacked in order to understand its function. There is thus a need for new models and theories to deal with the complexities of the “globally distributed digital library” as stated in the ‘Joint NSF-European Union (EU) Working Groups on Future Directions of Digital Libraries Research’ report (Goncalves et al, 2004: 8). However, there has been no progress in formulating a theory or model for digital libraries. A theory or model for a digital library is vital in understanding the functionalities, characteristics, structure and behaviour of such complex information systems. As mentioned earlier, systems need to talk to one another in order to get the optimum results, and so too it applies to digital libraries (Gonclaves et al, 2004: 3). It is claimed that digital libraries are serving the needs of society (Darnton, 2014). However, societal issues such as language barriers, access and use of information should be taken into account when designing digital libraries (Goncalves et al, 2004: 8). One way of addressing

societal digital library issues are investigating new innovative ideas such as library applications. With the budget cuts situation that many libraries face, library applications create opportunities to maintain services. The task for academic libraries is to decide on which library application will best suit researchers. It is thus vital to engage with researchers to investigate what they need and want from a library application that will support their research (Bishop, 2012: 270; Harvard Library, 2017). The Novo Nordisk Library designed a new mobile website to support research. The aim was to get researchers directly to the resources relating to their research area, claiming that the catalogue is no longer the entry point. The library established "a more intuitive approach where users narrow down to the right database or tool by selecting their research area and their research area" (Renn, 2012: 2). Learning and innovation is said to be at the heart of the knowledge economy, through social networks between various stakeholders (Cooke, 2002: 2).

The kind of digital library quite common in higher education institutions globally and showing much promise in contributing but also to a very large extent the answer to the Open Access movement for some time, are institutional repositories. Institutional repositories increase the visibility of research output of universities, playing a fundamental role in university ranking in the research landscape worldwide (Lagzian, Abrizah & Wee, 2015; Raju & Schoombee, 2013; Doctor, 2007). Through institutional repositories, more options have become available to the research community to disseminate their research openly, which is discussed in more detail in the following section below on Open Access.

2.5.5 The Open Access Movement

The transition from print to electronic resources, pointed out earlier in this chapter, is the biggest change obvious to the users of academic libraries. As much as the academic library tries to adapt to the technological advancement and changing demands of users, the biggest challenge faced by academic libraries worldwide, is budget cuts. Yet subscription fees to electronic resources have increased tremendously by the years, to a point that it is out of control, forcing academic libraries to cancel subscription fees. Although collection development still remains a priority in planning strategically, academic libraries are unable to maintain electronic collections, which means that, instead of building collections, electronic collections in particular are getting smaller. These have huge implications for researchers who need access to scientific research which unfortunately perhaps, are accessed via expensive subscriptions which academic libraries are unable to bear any longer. Recently, consortiums in Germany, Peru and Taiwan took a stance to cancel all their Elsevier subscriptions since January 2017, as they could not reach an agreement during subscription

negotiations late in the year 2016. Due to the subscription crises faced by academic libraries globally, there is a huge cry out for the Open Access Movement.

The stigma attached to OA journals remains a heated debate among researchers (Grotshel, 2017; Rosenbaum, 2017; Weingart, 2017). Why this seems to be the case when there is an increase in hybrid journals remains questionable. The recent news on the Directory of Open Access Journals (DOAJ) addresses the point of following a rigorous selection criteria to ensure high quality OA journals are listed, is the answer, and solution for the uncertainty or stigma around OA publishing (DOAJ, 2016). Furthermore, DOAJ (2017) states that "all articles must go through a quality control system (editorial or peer review) before publication and the exact type of review must be stated clearly on the web site. This is a basic requirement for entry into DOAJ". Librarians therefore, play a crucial role in proclaiming this good news to the university community, as the library associations are updating librarians on the latest information regarding Open Access. Nevertheless it remains an area that needs to be discussed with all stakeholders involved, to put an end to the stigma attached to Open Access being low quality research because the author pays to publish. OA publishing is seen as a solution to the challenges that academic libraries are facing worldwide with regards to budget cuts versus the constant increasing subscription costs which links to the recent situation where Germany, Peru and Taiwan opted to back out of Elsevier subscriptions (Schiermeier & Mega, 2017). The Gottingen State and University Library (SUB) announced on 3 January 2017 on their website, that they, together with more than 60 major German research institutions have cancelled all their Elsevier subscriptions since October 2016. This means that since January 2017 they no longer have access to full-text Elsevier journals. The stance was taken to "improve negotiating powers" as Elsevier continues to increase subscription fees and said to be not complying with the Open Access principles (Gottingen State and University Library, 2017). Following this, an updated news article published in *Nature* on 9 January 2017 states that Peru and Taiwan also stopped their Elsevier subscriptions, and since the article was published, Elsevier has granted access until the end of January 2017 (Schiermeier & Mega, 2017). This really proves the reality of the challenges that academic libraries are facing worldwide regarding the constant budget cuts versus the constant increase of subscription fees, and the need for Open Access content. Having the courage to challenge a big publisher like Elsevier is exactly in line with what the researcher suggested on 27 November 2014 during a roundtable discussion conducted in the CIS Department at the University of Bologna on the "E-resources dilemma at academic libraries", to cancel subscriptions as a way of dealing with the current challenges, which at the time the idea sounded bizarre to faculty members who were participating in the discussion. Nevertheless, the then 'bizarre idea' has since materialised

in Germany, Peru and Taiwan as drastic measures are put in place to deal with this crucial issue that libraries face. As much as alternative access through Inter-Library Loans was mentioned as one of the "legal ways of obtaining scientific papers" in Germany, the situation in Peru has encouraged researchers to access papers illegally through Sci-Hub website, with one scientist saying as quoted by the authors: "I'm not worried. Downloading papers is rather easy now with Sci-Hub", and another comment later: "I'm 30 years old, and I would say that around 95% of my generation uses it". At the same time there are researchers in Peru that are not happy with this decision to cut subscriptions, which is similar to the reaction of academics at the UNIBO roundtable discussion that took place in 2014. Some disagree with the idea of, as the authors quoted another researcher, of "begging for papers through social media groups or from colleagues in foreign universities". This particular researcher in Peru further commented that access to databases are crucial, that cancelling subscriptions "is a step backwards" (Schiermeier & Mega, 2017). Thus there is a need for all the stakeholders involved to discuss the way forward, as access to information in order to conduct further research, to create new knowledge and science as Crane (1972) pointed out, is an imperative. Whether Open Access publishing is the solution to this problem remains open for further debate.

Open access initiatives would be beneficial for all libraries battling with budget cuts and providing information. With regards to universities' research output, institutional repositories provide researchers a model to make their work visible to the public, which is becoming an important practice in the evaluation of research (Patterson, 2009: 90).

The Scholarly Publishing and Academic Resources Coalition (SPARC), promote Open Access publishing through the Open Access Week initiative that takes place every year in October to increase visibility of publication. OA is beneficial to the scholarly community as it facilitate the creation of new research through free access to a wider spectrum of publications, and research funders are supporting the movement, optimising research investments. In order to see the real effect or benefit of research output on society, scientific research needs to be open and accessible to all (SPARC, 2015).

The National Research Foundation (NRF) in South Africa, is an "independent statutory agency, the organisation promotes and supports research in South Africa largely through the country's Higher Education Institutions (HEIs), National Research Facilities and Science Councils with a view to generating knowledge and promoting high-level research capacity within the National System of Innovation (NSI)" (NRF, 2015). The NRF published a statement on 6 February 2015 emphasising that

all NRF-funded research publications be made openly available via institutional repositories. This illustrates how funders of research have played their part in the Open Access movement, which to a large extent assist librarians with promoting OA (NRF, 2015). Tenopir et al. (2017: 824) makes the following crucial point about researchers moving towards the Gold Open Access publishing route:

> The viability of gold open access publishing models into the future will depend, in part, on the attitudes of authors toward open access (OA)…. Understanding the range of perceptions, opinions, and behaviors among academics toward gold OA is important for academic librarians who must examine how OA serves their research communities, to prepare for an OA future, and to understand how OA impacts the library's role.

Therefore, the reasons for a fairly low number of OA publications existing in the Chemistry and Chemical Engineering disciplines are later revealed in chapters 6 and 7.

Academic libraries, together with the support from the library associations encourage the Open Access movement. In the world of being inter-connected, there is a need to bridge the knowledge divide by inclusion through a global scientific community, collaboration playing a key role in the research landscape. The question is, what role does the academic library play in supporting research, and on the other hand, do the scientific community agree with the OA movement? There is claim that the Open Access movement has made a major difference in the 21st-century academic library supporting research, their new role including "engaging in the publishing processes". Raju et al (2013:44) further states that the open access movement:

> …will radically improve access to the world's scholarly output; it will also serve as the impetus for networking the world of scholarship. One of the significant outcomes of this networking is the capacity to draw the 'south' (the 'developing world') to the epicentre of the world's knowledge production and facilitate the cross pollination of knowledge to and from the 'north' (the 'developed world') and south. In the current knowledge economy, open access presents Africa with opportunities to transform from a consumer of knowledge to a contributor to the world's knowledge production.

This has led to the Stellenbosch University in South Africa, to develop the African Open Access Repository Initiative (AOARI) as a means of addressing the challenges that Africa face in the distribution of research, through bridging the digital divide by sharing research output (Raju et al, 2013: 44).

However the uncertainties remain quite high among researchers worldwide with regard to Open Access publishing. There is a stigma attached to publishing in open access journals among researchers, that the quality and impact factor is too low, due to the researcher paying the authors

fees. Many researchers do not feel happy about paying the high costs required for OA publishing. There is also the issue of hybrid journals. These are but a few issues mentioned which are inhibiting researchers from publishing in open access journals (Taubert & Weingart, 2017: 1; Rosenbaum, 2017: 37). Therefore, academic librarians face the challenge of promoting the open access movement to the university community. There is a need for a shift in mind set of the entire research community. Findings about the librarians' versus the researchers' perception of OA are discussed later in the case studies.

2.5.5.1 Open Science

Then there is new developments, the shift from Open Access to Open Science. Where open access to a large extent focused on free access to scientific research, Open Science refers to the entire stages of a research project being 'open' (European Commission, 2017; Grotschel, 2017: 238). The Horizon2020, the driver of scientific research in Europe, encourages Open Science, which could be described as the umbrella term for 'open content', 'open access' and 'open data'. The practice of open science is encouraged especially in public-funded research so that communities can access research findings that are beneficial to improving lives (European Commission, 2017). Therefore a decision was made to take action to support open science through training initiatives to deal with the knowledge gap identified among researchers that hinders open science activities. Funding to the amount of 900 000 euro was provided to encourage researchers to conduct Open Science projects (European Commission, 2017: 20). The purpose for encouraging the practice of open science, is elaborated by The European Commission (2017: 20) as follows:

> Open Science describes the on-going transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organised. It is driven by digital technologies, the globalisation of the scientific community, and the need to address grand societal challenges.

Presentations at the *International Conference on SIS-RRI: Science, Innovation and Society: Achieving Responsible Research and Innovation* that took place in Rome during 19-21 November 2014 claims that some Open Science activities have already started in a few H2020 projects (Pulverer, 2014; Swan, 2014; and Winfield, 2014). One of the Open Science best practices claimed by Winfield (2014) is using a three-level approach which is: a project website, writing regular project blogs, and best practice Open Science through "rich virtual environments for processes of social learning and innovation i.e. extending open science to citizen science (to help you interpret your results)". However, in the life of a researcher, the concept of open science is still new, and many remain

sceptical about adopting this practice. Nevertheless, open science activities are becoming more visible.

2.5.6 Research Data Management

The concept of research data management (RDM) has been rapidly incorporated in academic libraries, who are taking up the challenges of providing support to the university community. At the University of Bristol, the aim of providing RDM services is crucial for sustainable growth, "a core university service" (Hiom, et al., 2015: 475). However there is growing concern by many academic libraries worldwide with regards to providing research data management support, as well as the training required by librarians (Jones, 2015). In 2015, four library associations listed research data management as a hot topic in academic libraries supporting research (IFLA, 2015; IATUL, 2015; CILIP, 2015; LIASA, 2015). Many workshops, seminars and webinars are being arranged to provide technical training for repositories, ensuring that it complies with Horizon 2020 framework and standards. In a study of RDM policies at 37 higher education institutions in the UK, Higman and Pinfield (2015: 364) found that:

> RDM policy formation and service development has created a complex set of networks within and beyond institutions involving different professional groups with widely varying priorities shaping activities. Data sharing is considered an important activity in the policies and services of HEIs studied, but its prominence can in most cases be attributed to the positions adopted by large research funders.

Due to development in ICTs, and increased e-research practices, there is a need for incorporating RDM best practices (Thomas, 2011: 38).

In the OpenAire webinar held by Principe and Schirrwagen on 26 November 2015, guidelines were presented for making universities' institutional repositories compatible and compliant with the Horizon 2020 Open Access mandate. Since the start of universities' institutional repositories, the focus was solely on information resources. Now, the focus has shifted to data, and the aim of the OpenAire project is to ensure that information in the form of publications together with the datasets are stored in an interoperable system for access and reuse. OpenAire according to Principe and Schirrwagen (2015) is the platform that collects:

- All global Open Access research outputs
- Funding information which supports FP7 OA pilot projects and the Horizon 2020 OA mandate
- Non-open access content
- Research data sets

There are also a content acquisition policy for publications and data in OpenAire. The changes that are occurring with information systems and institutional repositories led to the Current Research Information Systems (CRIS) platform which deals with the linking of publications and datasets. There is a need to consider future directions with regards to research data management and the compatibility of systems, especially as there are issues raised regarding metadata (Park and Brenza, 2015). In order to provide Innovative Scholarly Services, metadata quality needs to be improved (Principe & Schirrwagen (2015). This is in line with what Park and Brenza (2015) addressed about academic libraries considering the implementation of semi-automated metadata generation tools to assist with the quality of metadata, which could be beneficial for institutional repositories now incorporating research data management to support research.

In the area of chemistry in particular, a pilot study at the University of Michigan focused on creating a manual Data Type Profile (DTP) for each chemist in the Chemistry Department by extracting data from publications for the period 2012-2013 indexed in the Web of Science (McEwen and Li, 2014: 976). McEwen and Li (2014: 976) proposed that "researchers and educators in the academic environment refer to three sub-groups, namely chemists, chemistry librarians and cheminformaticians, each performing different but complementary actions over data and information". Focusing on the role of the librarian in chemistry research data management, librarians are becoming "more involved with organising, manipulating, and even mining chemical data, traditionally considered cheminformatics activities" (McEwen and Li, 2014: 976). The idea of research data management practices and data re-use for chemistry researchers is fairly new. Some challenges include pressures from research funders, the quantity versus quality situation where researchers are evaluated on number of publications per year, the compatibility of systems versus the various formats of data also play a part in implementing this into their research activities. There is also uncertainty regarding the kinds of data that researchers need to manage, preserve, share and re-use (McEwen and Li, 2014: 977). Moving towards a digital research workflow for chemists, it is crucial that collaboration takes place between the research stakeholder; the chemistry researcher, the cheminformatician, information technologist and the library to build a network of expertise supporting the research cycle. It is further stated that librarians play a pivotal role in linking all stakeholders, and competencies in providing RDM services by academic libraries continue to develop (McEwen and Li, 2014: 987). Academic libraries have moved beyond the traditional metadata functionality towards managing wider range of data through the tools and techniques used. The rise of linked data has for example, allowed Library Catalogues to integrate links in bibliographic records that direct users and researchers to data. The usage data generated by these systems that academic

libraries use are becoming more important in decision-making and strategies for supporting research (IFLA, 2015).

In South Africa, incorporating research repositories like Figshare into academic library research support services is showing promise as it provides researchers with a variety of features to suit their needs. One of the benefits for researchers is that their research data can now be cited as well. Another important area where academic libraries are providing support, is with data management plans that are required by research funders (European Commission, 2017).

2.5.7 Library as 'space'

The role of the academic library as a physical space has changed as the needs of users changed over time. More and more space projects, some funded by private organisations have taken place to revamp, or redesign the academic library physical space to support research. There is a growing trend in creating virtual and physical spaces for research. These new spaces have been named the Research Commons, expanding from the concept of the Learning Commons which have existed in many academic libraries (Hulse, Cheverie, & Dygert, 2007). In South Africa, a few university libraries, including UCT Libraries in Cape Town, received funding from the Carnegie Corporation of New York to build the Research Commons. The Research Commons can be described as a 'dedicated space' which include various state of the art equipment, ICT infrastructure and services specifically catering for the needs of researchers. In order to ensure that the Research Commons accommodated contemporary research practices, the UCT Libraries conducted interviews with the research community during the planning phase, to find out what the researchers need and want from a dedicated research workspace. The purpose of the Research Commons is to create an atmosphere where researchers can experience a community, something different from the office or home environment (Daniels, Darch, and de Jager, 2010). However, at CPUT, the research librarian claimed during an interview that RISC space was created long before the rise of the Research Commons in South Africa (Kleinveldt, 2009). Although the Research Commons have been developing in academic libraries over time, not all academic libraries are adopting this model. For example, the setup of the academic libraries at UNIBO, makes it complex to design a dedicated research space. The concept of the Research Commons was seen as a means of sustaining the future of academic libraries (Wilson, 2012: 73). Besides the concept of the Research Commons, academic libraries have also transformed their existing physical space to accommodate the Net Generation of users, which fits in with the technology trend at universities reported on in the NMC 2015-2017 Horizon Reports for higher education (Adams et al, 2017; Johnson et al, 2015, 2016) which was discussed earlier in the chapter.

Another change which occurred in academic libraries was the virtual space, introducing institutional repositories, which are platforms such as Dspace and the DigitalCommons, which hosts the research output of the university community, making it freely accessible to the public, an answer to the Open Access Movement discussed earlier (Raju et al, 2013: 44; Tenopir et al.,2017: 824). Collaboration between academic libraries in the form of agreements are also becoming more popular, such is seen with The Washington Research Library Consortium (WRLC) which "provides a shared digital institutional repository for its member institutions, known collectively as the ALADIN Research Commons (ALADINRC)" (Hulse, Cheverie, & Dygert, 2007: 158).

Academic libraries have also designed its space to accommodate disabled users, making facilities available for the visually impaired for example. There is also the demand for meeting and teaching workspaces in academic libraries as reported on in the planning phase of revamping the Walker Library in 2011 (Groves & York, 2013: 526).

Academic libraries have also become social spaces, incorporating cafeteria spaces within the library (Myhill, 2013: 4). Therefore, 'library as space' remains high on the agenda of forums, seminars and conferences such as the IFLA World Library Congress, where discussions continue among library professionals on how best to use the physical academic library space in a digital world (IFLA, 2017).

2.6 Challenges in academic libraries supporting research

Following the trends in academic libraries supporting research, it is worth noting that these trends lead to some of the challenges faced in order to keep relevant. The digital age brings with it a number of challenges for academic libraries. Based on the trends discussed in this chapter, some of the challenges identified for academic libraries include staff capacity and new librarian roles required, copyright laws, research and ICT infrastructure, predatory journals and fake news that academic libraries have to face will be discussed.

Therefore there is no doubt that Intellectual Property laws and copyright remain a complex topic in the digital age. McDermott (2012: 8) advised librarians to build their knowledge base on copyright law so that they will be able to provide users with innovative advice. The implications of copyright law on libraries and librarians with regard to digital content in the US is described as being the "quiet crisis", and the three main challenges being "the problem of ownership and licensing of digital content or collections; the librarian as de facto copyright expert; and copyright law as it relates to library digitization programs generally, and the Google Book settlement in particular" (McDermott, 2012: 10). In the movement to digitizing collections, the hindering factor clashing with librarians to provide access, remain copyright laws. The dilemma that is now facing society is "self-censorship",

the battle between rapid technological developments versus intellectual property law (McDermott, 2012: 14). Darnton (2014) also remarked that in the digital age, censorship is very much a reality. However, library associations play an important role in guiding librarians with copyright issues. In South Africa, the Copyright Bill is in the process of being amended, and LIASA played a vital role in communicating to library professionals to play an active part by giving their input. One point that will benefit academic libraries, is section 13B (4) (a) which focus on assisting authors to upload their post-print into the institutional repository. Another point that academic libraries battled with for some time, is converting formats of information or material accordingly as technology changes, which the 2017 draft of the Copyright amended Bill makes provision for (Nicholson, 2017).

The issue of 'predatory journals' have huge implications on academics and their research profiles and their reputation in the world of academia. As previously mentioned in this thesis, research is fundamental for the development and growth of the knowledge economy and society. Therefore, universities have a competitive advantage based on where they are ranked in the research landscape through its research output. Thus it comes back to the academics and researchers at universities to publish more, and fast, with increased pressure which is discussed later in the case studies. This is what ultimately led to the dubious practice which in some cases occurred unintentional by authors as predatory journal publishers manipulate the situation by providing attractive publishing models in a world where the publishing competition is tight. The term 'predatory journals' was first used by Jeffrey Beall, who is an associate professor and librarian at the University of Colorado Denver. He is also the founder of 'Beall's List of Potential, Possible, or Probable Predatory Scholarly Open-access Publishers' (Coan, 2017). Coan (2017) reported further that Professor Johann Mouton, "director of the Centre for Research on Science and Technology, or CREST, and the DST-NRF Centre of Excellence in Scientometrics and Science, Technology and Innovation Policy at Stellenbosch University, South Africa", defined 'predatory journals' as being:

> those published with the sole goal of profit…They are in the business of making money…Of course, there are reputable journals that are non-predatory which make money but these do so to break even financially in order to continue publishing. With predatory journals the sole intention is to make money out of authors.

Dealing with this huge problem that now exists once again needs the co-operation of all stakeholders involved. As mentioned in this University World News article, in South Africa, the incentive scheme by the National Foundation of Research (NRF) together with the Department of Higher Education is working hard to ensure that predatory journals are removed from the accredited journal list. Current awareness of predatory journals are posted on university websites to guide researchers (Coan, 2017). Therefore the academic library plays an important role in supporting the

university community as a whole with regards to advice on reputable journals to publish in, as there are measures in place to evaluate journals and act as a guide in choosing journals to publish in. These measures include checking the journal against platforms like Sherpa Romeo. Many academic libraries provide guidance to the university community via the Libguide, which was mentioned earlier in the chapter to be one of the popular Web 2.0 tools used in academic libraries (Blummer & Kenton, 2014: 75).

Another challenge faced by academic libraries are having proper research infrastructure in place. According to Patterson (2009: 88-89) there is concern for research infrastructure and lack of library budget allocation at universities in Ireland to enhance research support as the focus has been mainly on undergraduate support services, and now the attention need to be shifted to supporting postgraduate students.

With regards to new services such as academic librarians needing to conduct systematic reviews Murphy and Boden (2015: 74-76) pointed out in their research findings that "the current number of requests for Canadian university health librarians to participate in SRs is impacting their capacity to accommodate these requests." This impacts on the staff capacity situation, which was pointed out earlier in this chapter that academic libraries worldwide have an aging cadre of librarians, and the number of library schools have reduced over time. Librarianship thus can be said to be moving towards a scarce skill.

One of the challenges that was discovered in exploring the role of supporting e-research, is that many researchers did not have data management plans, and that data were kept on unreliable storage accessories such as USB's and CD's, and researchers had no knowledge about retaining or 'long-term preservation of research data'. Therefore "the Building e-Research Support Capabilities and Capacity" project was introduced to support researchers at QUT to acquire e-research skills (Thomas, 2011: 41).

As mentioned earlier, academic libraries are now supporting researchers in the area of data management plans which is one of the 'new' requirements by research funders (European Commission, 2017). Although in the United States, Mirowski (2011: 303) claim that funder requirements are due to the 'Data Quality Act'. Perhaps the main challenge that academic libraries face is getting the buy-in of academics and researchers. The approach to introducing these new services by the academic library should be considered.

With regards to the digital age and technological advancements that contribute to the new practices such as e-research and prosumerism, there is the issue of Fake News, which have become a major challenge globally. IFLA has listed Fake News as one of the hot topics for academic libraries supporting research during the 2017 IFLA Conference (IFLA, 2017). Librarians play a crucial role in alerting and also training researchers on processes to follow to identify fake news. Once again, the library associations are supporting librarians through guidelines and statements on how to train and support users. An infographic was published by IFLA (2017) to assist librarians in training users on how to spot fake news. Some of the guidelines include prompting users to "consider the source" and to "read beyond" when evaluating a source (IFLA, 2017). In South Africa, LIASA has started a crowdsourcing initiative to collaborate with all librarians to collate a resource which can assist in training. One example is the LibGuide designed by the University of Witwatersrand, Johannesburg (2017) on dealing with Fake News, which form part of the *Journalism and Media Studies* LibGuide.

Considering these challenges raised, there is a need for all stakeholders involved to work together in finding solutions for realising best practices for the future of research support. It is therefore fundamental to explore what competencies academic /research librarians need to possess for supporting research successfully.

2.7 Competencies for academic and research librarians

Following the 2000 competencies for a research librarian published by the American Association of Southeastern Research Libraries, which included research collection building, to possess specialised subject knowledge to support researchers, knowledge of the research process, and good ICT skills, which were highlighted in the 2009 study (Kleinveldt, 2009), this section explores what is currently the core competencies expected of academic librarians to support research. The works of Pickton (2016) formed a good foundation for this section as she discuss the importance of academic librarians' competencies for conducting LIS research which complements the competencies needed to support research. She further pointed out that library associations since 2009 (i.e. ALA, 2009 and CILIP, 2014 among others) acknowledged that a core competency for a professional librarian is to possess research skills. This is in line with the previous research findings that in order for an academic librarian to support research, must have experienced conducting research in the form of formal qualifications such as a masters or doctoral degree (Kleinveldt, 2009). Three key reasons for practicing librarians to conduct LIS research is for lifelong learning purposes, to make informed decisions about improving service provision and to please an inquiring mind (Pickton, 2016: 105).

Of these types of practitioner researcher, the most common reason librarians conduct research is to inform and improve current practices in the workplace which is beneficial for the university community as a whole (Pickton, 2016: 105). Some benefits of academic librarians conducting research that stood out are advancing the profession, impact on knowledge culture and innovation especially in scholarly communication, provides evidence for decision-making in the university, and increase collaboration with professionals around the world (Pickton, 2016: 106).

According to Raju (2017: 12-13), the following 18 competencies, which speaks directly to the research trends, are an imperative for South African academic librarians supporting research:

1. Understand the institutional and macro research landscape, particularly policies, funding structures and other services relating to knowledge production
2. Understand the research needs of academics, researchers, postgraduate students and other user groups requiring research support
3. Understand the knowledge structures of the particular discipline and its changing patterns of scholarly communication, including open scholarship
4. Know and understand the research life cycle
5. Know and understand the research proposal structure
6. Know and understand research approaches, designs and methods (quantitative, qualitative and mixed)
7. Know and understand literature reviewing
8. Know and understand systematic review of literature as a research methodology
9. Know and understand research data management (RDM) (e.g. policies, mandates, frameworks) as well as practise RDM (e.g. evaluation of data, ingesting, preservation, curation, sharing, re-use, RDM planning, policy development)
10. Provide bibliometrics (quantitative analysis of citations and content of scholarly literature) services to ascertain research impact of published work as required by researchers for grant proposals, research rating applications, performance reviews, etc.
11. Provide altmetrics (analysis incorporating social media, news outlets and scholarly commentary) services to supplement traditional journal metrics in reflecting research impact
12. Provide research landscape analysis services using research evaluation tools (e.g. SciVal, Web of Science) to identify the following for use by researchers: disciplinary experts, research areas, potential collaborators, supervisors, publishing avenues, funding sources, etc.
13. Know and be skilled in the use of referencing management tools such as Mendeley
14. Know and understand plagiarism and its implications in research as well as plagiarism check software (e.g. Turnitin, iThenticate)
15. Know and understand research ethics and their role in scholarship
16. Know and understand intellectual property (IP) and copyright legislation as these pertain to knowledge production
17. Build strong relationships with researchers and other campus professionals such as those in Information Technology (IT) and in the Research Office for collaborative initiatives in the promotion of research
18. Know and understand computer software applications (e.g. Excel, SPSS, NVivo, Atlas.ti, Provalis QDA Miner) for data analysis, text mining and other research related activities

On the other hand, the challenges facing academic librarians to conduct LIS research according to Pickton (2016: 107) are, lack of confidence due to no training or experience in conducting research, the heavy workloads of academic librarians, no incentives and motivation for conducting research, where it is not included in the job description there is hardly support from the top provided, and there are limited funding available for LIS research. Taking these factors into consideration, there is a need for a solution as the demand for conducting more LIS research is fundamental for the future of academic libraries.

2.7.1 The way forward to encourage academic librarians to conduct research

Taking into consideration the pros and cons facing academic librarians and the need to conduct research in their field, some solution to support has been realised. As Pickton (2016: 108) recommends, both top-down and bottom-up approaches are needed for the development of research output from practicing academic librarians. The top-down approach refers to management support, where research activities and incentives are incorporated in the strategic planning and performance management objectives of academic librarians are key for building a research culture in the academic library. One example of commitment to research is building it into the job descriptions and alignment with academic library policies. The bottom-up approach refers to peer-support, mentoring and participating in collaborative research among colleagues as a way of encouraging academic librarians to conduct research in the LIS field (Pickton, 2016: 108-110). The benefits of collaborative research among academic librarians include building a 'synergistic relationship' between diverse experts, the transfer of tacit knowledge, increased network building and visibility of best practices (Pickton, 2016: 110).

It could be said that a transformation has taken place from "academic librarianship" towards "research support librarianship" (Raju & Schoombee, 2013: 28). Therefore, Raju and Schoombee (2013: 29) pointed out the need to define a research librarian as going beyond the traditional support services, becoming a partner in "increasing research productivity and scholarship", where a shift occurs from supporter to contributor.

Following this, concluding remarks by Patterson (2009: 92) is perhaps worth pondering on for the future of academic libraries in supporting research. The gap between practice and research among academic librarians have been found to be common, where librarians do not publish their library research. However, based on trends, decision-making in organisations in the future will rely on research findings more than ever before. Although the focus of Patterson's study was on Ireland, academic library research conducted in a particular geographical area which is disseminated in

scholarly publications, give insight to other academic libraries on various aspects, and useful for adapting to their context, and for new research production (Patterson, 2009: 92).

One area that stood out in particular at VUL was that they play two roles namely promoting and conducting scholarly research which is the direction of best practices for academic libraries worldwide (Prokopcik & Kriviene, 2013: 192). It was recommended, that in order for successful research support services to be offered at VUL, organisational structure as well as physical library space need to change to become innovative in the research partnership through active involvement in Open Access initiatives, and Research Data Management (Prokopcik and Kriviene, 2013: 194).

In light of the views expressed in this section, the future role of academic librarians as researchers could be seen as a new trend in academic librarianship. What need to be investigated is the views from practicing librarians regarding this. The literature on the perception of academic librarians both conducting and supporting research is discussed in Chapter 3.

2.7.2 Current debate on the restructuring of LIS curricular for the future generation of librarians

As trends in academic libraries supporting research has been highlighted earlier as one of the hot topics among library associations and professionals, it is essential to review the LIS curriculum to equip the librarian of the future. As the aging cadre of librarians pointed out at the Open Library Conference held in Milan in March 2017, the traditional LIS curriculum did not prepare them for digital age, and this was the main reason there is resistance to change(Cavaleri, 2017; Rasetti, 2017). However, the technological advancements forces librarians to upskill in order to remain relevant. Therefore restructuring of the LIS curriculum is an important topic being discussed, as predicting change in the future of research and technologies are challenging in itself. Some library schools have already started to introduce new modules in the LIS curriculum, one example being the systematic review course to support research is now offered at the University of Alberta (Murphy and Boden, 2015: 74-76). However emphasis is placed on life-long learning, continuing professional education through short courses offered by library schools or library associations and mentoring in the academic library are said to be the only possible solutions for practicing librarians to keep up with trends (Kleinveldt, 2009; Murphy and Boden, 2015: 74-76; Pickton , 2016: 109). Online resources such as those provided by the *Library and Information Science Research Coalition*, together with social media alerting professionals to updates and newsletters, are beneficial for supporting academic librarians as well. Skills development is key for academic librarians to conduct research successfully (Pickton, 2016:115). Corrall, Kennan and Afzal (2013: 636) made the following recommendations which could assist in handling the trends and challenges discussed in this chapter:

> Gaps in knowledge, skills, and confidence were significant constraints, with near-universal support for including bibliometrics and particularly data management in professional education and continuing development programs. The study also found that librarians need a multilayered understanding of the research environment.

As previously pointed out in the 2009 masters thesis (Kleinveldt, 2009), academic librarians working towards obtaining doctoral degrees are becoming more important for facilitating a research culture in the academic library, and to enhance research support services. By having more practicing librarians obtaining doctoral degrees will also encourage an increase of research production in academic libraries (Pickton, 2016: 110). For the future role of academic librarians, conducting research and becoming actively involved in applying for research funding are becoming more crucial to better support the research trends of the university community, especially with regards to research ethics. This involvement will help academic librarians understand better the challenges of conducting research faced by academics (Pickton, 2016: 114). Nolin (2013: 508) further states that:

> It is possible to identify a wealth of new services that can, if put into practice, substantially redefine the relationship between academic librarians and researchers. This entails a turn from service aimed at novice users to sophisticated end-users. Such ideas also carry implications for LIS education programs and the need to build on special librarians who uphold competence in distinct knowledge domains. Two forms of domain-specific meta-services are explored: as support for collaboration and support for presentation.

The importance of having a research methodology module in LIS education is key for preparing academic librarians for the future (Luo, 2011: 194) especially since the literature states that academic library support services should be geared more towards postgraduates (Raju, 2017: 12-13; Nolin, 2013; Patterson, 2009: 88-89). However Fourie and Fourie (2014: 164) argue that the focus for academic libraries should remain focusing on support for undergraduate students as they are the future researchers. Although the web increases the threat on LIS education, a study at the United Arab Emirates University found that researchers have not yet acquired the skill of retrieving and utilising electronic resources for research efficiently. Therefore the opportunity arises for academic librarians to incorporate e-research training, also known as e-literacy, to support researchers in the digital age. The “web e-research consultation” model incorporated at the UAE University library shows promise for the future role of the academic librarian supporting research (Taha, 2013: 108).

2.8 Further Research

Considering the aspects raised in the literature which impact academic libraries in the area of research support, it is worth noting what recommendations were made by authors regarding future research. Murphy and Boden (2015: 74-76) suggested that there is a need for further research in the area of librarians taking on the role of conducting systematic reviews which make them partners

in the research process, and what this will mean for the academic library supporting research in the future considering the challenge with library staff capacity.

Something worth noting here is academic librarians conducting more LIS research in the future, to develop a research culture in their working environment. Dissemination of LIS research by academic librarians will have greater impact on support services. However the challenges such as few developmental opportunities in the workplace, lack of time and sufficient research writing skills, together with the heavy workloads of academic librarians cannot go without notice. There is a need for rethinking the changing roles and responsibilities of the academic librarian (Pickton, 2016: 120). To enhance research support services, there is a need to conduct research on the aspects of RDM service provision by academic libraries (Thomas, 2011: 45). In the case of Vilnius University (VU) in Lithuania, the following areas were identified for exploring in the future: "the library as 'space' for communication", "professional assistance in research events organization" and "Information / Media Literacy training" to support research (Prokopcik and Kriviene, 2013: 192). Following the contrast in the literature regarding there being no research support model in place for academic libraries (Fourie & Bakker, 2013) versus a successful e-research consultation model for support (Taha, 2013: 108), it remains an area flagged for further investigation. There is a need for future research to focus on qualitative longitudinal studies expanding to include more countries, in order to get a deeper understand that will add value to the body of knowledge in academic librarianship (Corrall, Kennan & Afzal, 2013). Recommendations from the master's thesis (Kleinveldt, 2009) which were taken into consideration which this PhD thesis expands on, was the need for a qualitative study of academics, researchers and include postgraduate students, to get a deeper meaning of what the perceptions are regarding academic libraries supporting research.

2.9 Conclusion

The chapter focused on the current position of academic libraries and librarians with regards to research support. The main aspects discussed in the literature are Technology trends, collection development, Open Access movement, RDM, the challenges that academic libraries are currently facing and the role of the academic / research librarian in supporting research. The research process consists of many stages, each requiring a different kind of assistance to achieve the research goal. Although academic libraries are constantly adapting to the changing needs of researchers and the university community as a whole, it should be realised that perhaps the role of the library is not to support each and every step or phase in the research process. On the other hand, are researchers expecting the academic library to support the whole research process, and if so, how do academic libraries change its role in moving towards achieving this expectation and what are the implications

involved? The literature reveals that the academic librarian of the future will need to be an active partner in the research process, and that conducting LIS research is essential for improving research support services, and crucial for developing the profession. Academic librarians also need to possess core competencies in order to support research. However the perceptions of the academic librarian both conducting research and supporting research, together with the perceptions of researchers towards the academic librarians supporting research is worth taking into consideration, which is discussed in Chapter 3.

Chapter 3

3 Perceptions of academic librarians supporting research versus researchers' perception of the academic librarian supporting research

3.1 Introduction

As already mentioned, research is fundamental for the growth and development of society on the one hand, as well as beneficial for the academic standing of universities. Apart from the contribution to society, now research is a value in itself, a "product" which gives more academic standing not only to the researchers but also to the universities where they work – and as a result more attractiveness, in terms of enrolments and financial support. Social benefits might well be important, but now academia entered a vicious circle. Research is the new disease of institutions of higher education. Therefore, more emphasis is placed on universities to produce more research output for competitive advantage. For both groups, that is, researchers and academic librarians in particular, additional roles and responsibilities to ensure the continuous building of the knowledge culture in universities are on the rise. For researchers, they have the responsibility of conducting more research and disseminating the research, while academic librarians have the responsibility of supporting researchers with their research, but also conducting LIS research to improve library research support services and keep up to date with trends. Following the previous chapter which focused on the current state of academic libraries supporting research, and competencies of the academic librarian required to support research, Chapter 3 discusses the following two aspects:

- Perceptions of academic librarians supporting research
- Researchers' perceptions of the academic library / librarian supporting research

In Chapter 2, a question was posed whether academic librarians should be focusing their attention on supporting research, or rather remain with the traditional core focus to support teaching and learning. However the projects highlighted in the chapter indicate that the shift in focus has already occurred. The fear of academic libraries becoming irrelevant is the driving force for adapting to the trends and changing demands of users. Therefore this chapter turns to the perceptions of the librarians and the researchers in terms of what are their views on the topic of research support.

3.2 Librarians' perception of supporting research

This section attempts to delve into the literature on academic librarians' perception on supporting research, what their views are on their role.

Chegwe and Anaehobi (2015) conducted a study at 12 higher education institutions in Delta State, Nigeria, to investigate librarian's perception and attitude of marketing the academic library services for research through a survey questionnaire. 138 academic librarians responded to the questionnaire. Results show that the majority of academic librarians had a positive attitude towards marketing, and open to acquiring marketing techniques that will enhance current awareness of library resources and services in the future, which ties in with the statement by Webb, GannonLeary and Bent (2007: 130), that librarians need to find innovative ways of making the research community aware of current research support services. However, there are still some challenges that academic librarians face in marketing. It was recommended that academic librarians need to be trained on customer services and marketing of library services, as this is key in retaining good working relationships with the university community (Chegwe and Anaehobi, 2015: 25). A study by Nolin (2013) confirmed how crucial it is to promote library services to researchers.

A survey of 130 Canadian academic librarians in the health sciences was conducted in 2014 to investigate the librarians' knowledge, training requirements and challenges faced in meeting the new researcher demands to conduct systematic reviews. Librarians indicated that proper training in conducting systematic reviews as a research support service is fundamental. Murphy and Boden (2015: 74) pointed out that the librarians' role now included being "disseminator, critical appraiser, report writer, project leader, project manager, data extractor, and data synthesizer in order to conduct a successful systematic review service to researchers". However due to time constraints which results in rushed training, contribute to challenges faced in providing a thorough systematic review service to researchers. Role clarification of the librarians' involvement in conducting systematic reviews was crucial, and some of the institutions had policies in place that assisted librarians with supporting research. (Murphy & Boden, 2015: 74-76).

3.2.1 Librarians' perception of conducting LIS research

Woods and Booth (2013: 2) conducted a literature review for the period 2010-2012 to identify the current state of practicing librarians conducting research across library sectors. Practicing librarians at university libraries dominated from the pool of studies focusing on LIS research production from librarians, which the authors did not find as a surprise since universities are the main producers of new research. The findings reveal that the literature is more geared to the role of academic

librarians training research skills to students to support their research, than is found on academic librarians developing skills for themselves to produce research. However a study of academic librarians' experience of conducting LIS research at the University of Saskatchewan, found that there is a good research culture and learning environment among academic librarians that has been developing over time in the library (Schrader et al., 2012). One of the main areas of interest in conducting research for academic librarians is relating to what impact their research outcomes have on the LIS practice and profession (Woods & Booth, 2013: 9), which is very much linked to recent discussions at the 1st Social Impact of Research Conference held in Barcelona in 2016 where researchers are forced to indicate what impact their research will have in grant applications. With regards to what academic librarians have to say about conducting research, there is a constant 'push-and-pull' situation, the motivation and interest to conduct research versus the challenges that academic librarians face in conducting research (Woods & Booth, 2013: 10; Pickton, 2016: 120). Librarians revealed that if research is not placed on the agenda in library strategic goals, it makes it difficult to receive support for practicing librarians to venture into this avenue (Pickton, 2016: 120). One important aspect to note that although 'practitioner research' is frowned upon due to the nature of the research being mainly on small case studies that cannot be generalised, it is found to be far more important to learn from case studies in the practice (Woods and Booth, 2013: 10). Librarians revealed that support from management in the form of dedicated research writing time during work hours will create more willingness to conduct research. Collaborative research between colleagues in the library will also be beneficial for librarians as peer-support tend to create a more pleasant research culture (Pickton, 2016: 108-110).

Academic librarians' perception about collaborating with LIS academics to conduct research revealed to be beneficial with regards to "gaining academic standing" as well as gaining knowledge to interpret research results. McNicol and Dalton (2004, 175) as cited by Pickton (2016: 111) described the benefits of practicing librarians collaborating with LIS academics to be combining "the 'inward looking' tendency of practitioners with the 'divorced from the real world' nature of some academic research". A point worth noting is that practicing librarians were found to be more actively involved in presenting best practices at conferences, than disseminating their work in scientific publications (Pickton, 2016: 115).

3.3 Researchers' perception of the academic library / librarian supporting research

With regards to faculty perception of the role of the library, the ITHAKA S+R report revealed that the academic library is seen more as a consumer, and less of supporting teaching and research (Housewright, Schonfeld, & Wulfson, 2012). However, it has been found that faculty responses differ

by discipline, with the humanities ranking the academic library's role far higher than the academics in the natural or applied sciences (Saunders, 2015; Schwartz, 2013; Kleinveldt, 2009). There is a need for academic libraries to incorporate assessment in their planning (Saunders, 2015), in order to "offer real value without retreating into the stock defences of our role as the gatekeepers of quality, guarantors of access, and the sole possessors of the true knowledge of cataloguing" as Dillon (2008: 54) pointed out.

Previous research revealed that academic librarians providing current awareness of new publications in the field, training on using databases, inter-library loan services, and book acquisitions are still highly regarded by researchers (Kleinveldt, 2009; Webb, Gannon-Leary & Bent, 2007).

Researchers perceive the library services to be "invisible" due to the shift from print to electronic resources (Corrall, Kennan & Afzal, 2013: 637; Bent, Gannon-Leary, & Webb, 2007: 82). Corrall, Kennan and Afzal (2013) conducted a survey questionnaire across 140 academic libraries in Australia, New Zealand, Ireland and the UK to investigate to what extent 'Bibliometrics and Research Data Management services' are being offered in support of research. They found that Bibliometrics Services have shifted from a practice used for collection development purposes to more research evaluation purposes for academics and researchers (Corrall, Kennan and Afzal, 2013: 636) which is in line with the trends discussed in Chapter 2.

Nolin (2013) investigated how, in a contemporary university setting, academic librarians, also known as 'special librarians' can re-connect with researchers. He claims that over time, academic librarians' focus have shifted more towards supporting students in teaching and learning and that there is a need to focus the attention on the research community of the university.

A survey of library users at the University of British Columbia in Vancouver, Canada, was conducted to find out student preferences for library communication using Social Media. Students were asked to rank three Social Networking Sites (SNS) namely: Twitter, Facebook, and the Blog: WordPress. Students ranked Facebook as the preferred site as it was found to be more convenient and easier to access information from the library. However, because only a small sample size of Education faculty students were selected for the study, no generalisation can be made, and the authors recommended the study be expanded to the wider university community in the future. It is also mentioned that social media as a communication mode for academic libraries is high maintenance, which is a challenge on the small staff capacity (Winn, Groenendyk & Rivosecchi, 2015).

Oravet (2014) conducted a study at the Ralph Brown Droughon (RBD) Library at Auburn University, introducing gaming events to determine whether it had any influence on users' increase in library use or visits. The strategy involved a user survey on user perceptions of the library. Students participated in the games evening, "Humans vs Zombies" which took place in the library, and afterwards completed a questionnaire. A follow-up questionnaire was distributed to the same group of students two weeks after the event to determine whether they had the same perceptions. Although the game had no relation to library orientation or Information Literacy, the aim was to get students to familiarise themselves with the library and staff, that this event might lead to students visiting the library more often for study and research purposes. The outcomes of using the games evening as a different approach to invite users to the physical library space revealed that utilising the library space for research increased (Oravet, 2014: 134).

Opoku (2013) conducted a study at the University of Ghana to investigate graduate research students' perception and experience of the Research Commons (RC) through a survey questionnaire. 95 % of RC students responded. At the time the questionnaire was distributed, the RC space was in operation for only six months, a fairly new facility provided in support of research. The results revealed that the RC is a successful research support service provided, and led to placing the academic library back on the map in terms of supporting the university community.

3.3.1 Researcher's perception of Digital Libraries supporting Research

With the growth in online resources and the ever increasing information overload, it becomes a complex situation for the information-seeking environment. To ensure optimum performance of digital libraries as a research support service, users' experience and feedback in terms of what they need are fundamental (Maceli, Wiedenbeck & Abels, 2011; Garibay, Gutierrez & Figueroa, 2010; Tammaro, 2008).

In Italy, a number of digital library projects were conducted since 1990. However, most of the investigations regarding digital libraries in Italy according to Tammaro (2008) focused on collecting quantitative data such as the surveys conducted by *Istituto e Museo di Storia dell Scienza* (Museum of the History of Science – IMSS) and the *Biblioteca Nazionale di Firenze* (National Library of Florence – BNCF). It was pointed out in the study by Tammaro (2008: 130) that there is a gap in the literature on user perceptions about digital library services. She claims that quantitative and qualitative methods of investigation are vital when evaluating the quality of digital library services. Therefore the main goal of the study by Tammaro (2008) was "to stimulate a culture of excellence for digital library services with the user as the main focal point".

Three phases were used in this study to collect data which included using data from the Fondazione Rinascimento Digitale survey and a user survey. It was found that users have different information needs with regards to their expectations of digital libraries. Users also rely on resources from other institutions in their research. Current awareness of digital library services and library resources in general needs to be improved as users are not aware of all the resources available. This also highlights that Information Literacy training is vital. The interface of digital library tools was highlighted as important, making it more user-friendly for users to access information. This study pointed out how vital it is to give users an opportunity to say what they need and want from digital library services. The users' contribution together with cooperation with other digital library institutions can add value in improving digital library services, especially benchmarking and regular user surveys (Tammaro, 2008: 136).

Garibay, Gutierrez and Figueroa (2010) talks about the importance of "voice of the customers" (VOC) in evaluating digital libraries. They conducted a study at the University of Guadalajaro (Mexico) in which they used a combined method, the "Quality Function Deployment (QFD) – Kano model" to develop a questionnaire to determine the quality of the digital library service through user expectations and requirements (Garibay, Gutierrez and Figueroa, 2010: 125). The aim of the Kano model according to Garibay, Gutierrez and Figueroa (2010: 130) was to "re-prioritise customer requirements in order to have an order of priorities showing which customer requirements to tackle first". Overall the results from the survey revealed that users were satisfied with the quality of the digital library service. Users found the following, listed from highest priority, to be a quality digital library service: quality content, website searching, links maintenance, answer speed, search engines, website organisation, coverage, and help desk support (Garibay, Gutierrez and Figueroa, 2010: 130).

A study on faculty and librarian collaboration to design library web comics at the City University of New York (CUNY) to enhance Information Literacy resulted in positive outcomes with regards to learning and found to be improving student research writing skills. The online resource has proven to be successful in situation where classroom time are limited (Poggiali & Farrell, 2014:67).

The transformation of academic libraries over time due to technological advancements lead research support to be provided through digital libraries. The outcomes as indicated in this section shows that researchers' perception are becoming more positive towards digital libraries, which is key in the new research practices of researchers which is further discussed in Chapter 4.

3.4 Conclusion

This chapter reported on some of the literature findings that evolved since the 2009 study, with a focus on the perception of the academic librarian supporting research versus the researchers' perception of the academic library / librarian supporting research, in an attempt to answer the main research question of this thesis. The trend in the research on academic libraries reveal the digital age have shifted traditional practices to incorporate contemporary research practices. The Bibliometrics technique previously used in collection development, now also used in the evaluation of research (Corrall, Kennan and Afzal, 2013) is one good example highlighted in this chapter. Research support services that came out as the priority in contemporary university libraries are Research Data Management, Open Access promotion, Social Media for library marketing strategy, library as space is becoming more important, and the focus on Information Literacy Training for PhD students is fundamental, as highlighted in the games evening approach discussed. On the other side of the coin, it is crucial to note that librarian's perception and attitude towards research support services should also be taken into consideration to enhance research support services and to re-connect librarians and researchers in the future. This leads to the next chapter, where the focus shifts to the role of the researcher as a prosumer.

Chapter 4

4 The role of the researcher as prosumer

4.1 Introduction

Research is fundamental to the development and economic growth of a country. In the past, Teaching and Learning was the core pillar of the university, but the growing demand for research production has made the 'teaching pillar' become more and more wobbly. To encourage research activities to flourish, huge funders such as the European Union's Research and Innovation programme: Horizon 2020, Carnegie Corporation in New York, and the National Research Foundation in South Africa, offer universities in particular research funding opportunities. The Horizon 2020 is the European Union's Research and Innovation programme funding projects for seven years (2014-2020), aiming at driving economic growth and increasing jobs in the areas of science, industrial leadership, and dealing with societal issues (Horizon 2020, 2015). Universities in particular, have three pillars namely Teaching and Learning, Research and Community Engagement. Among other criteria, universities are ranked according to their research output rates which gives them a competitive advantage. Therefore research activity, now more than ever before, plays a vital role in the assessment of the quality of an academic institution – and in capacity to obtain vital financial support. In the research cycle, the researcher plays different roles such as being a consumer, producer, and prosumer. In the digital age and network society that researchers live in today, prosumerism is more evident. Prosumerism has changed the research practices of the researcher, where emerging technologies such as Web 2.0 tools are incorporated. Universities and their libraries are moving more towards organisations that have adopted the Mcdonaldization phenomenon (Ritzer, 2011) which was briefly mentioned in Chapter 2, making the university community prosumers (Taylor, 2014; Lunsford, Fishman & Liew, 2013; Figaredo & Álvarez, 2012; Thelle & Nanna, 2011). The Mcdonaldization phenomenon can be described as the customer being actively involved in a service delivery. Examples of Mcdonaldization implemented in universities over time are online registration processes, and the Online Learning Environment which allows lecturers, students and librarians to participate in teaching and learning and research activities. Academic libraries as well have long ago adopted Mcdonaldization through the self-check-in/out service provided to users, and provision of electronic resources. This notion of Mcdonaldization, together with the emerging technologies such as Web 2.0 tools, led to the prosumer concept, which is a subject discussed in Consumer Behaviour to great length. It is therefore ideal to explore the role of the researcher as a prosumer in the digital age. A prosumer is defined as being both a consumer and a producer. In the context of this study, the researcher as prosumer means that the researcher

consumes and produces information and knowledge in the research process. Therefore the purpose of this chapter is to discuss the role of the researcher as a prosumer within the university environment and how the information-seeking behaviour and research practices have changed (or not) over time.

4.2 Background

According to some authors, in the digital society, the role of the contemporary university has changed, incorporating social inclusion into the culture of the institution, without losing its identity. Figaredo and Álvarez, (2012: 249) describes the contemporary university community as a social network. Networks are established by individuals within and outside the university, as is evident in many scientific publications produced by researchers of one university collaborating with researchers from other universities. However the practice of network building has been occurring for many years long before the World Wide Web, as collaboration between researchers took place beyond the boundaries of their parent institutions, forming 'invisible colleges' (Crane, 1972). Observing the broader picture, universities and their libraries built networks with other universities through consortiums and agreements over time, and new agreements continue to grow (Figaredo & Álvarez, 2012: 249). Consortiums are actively existing in academic libraries worldwide in enhancing information provision through the sharing of resources to support research through such agreements. And so these university networks continue to expand internally and externally with actors sharing common interests aligned to the university teaching and research goals. This means that a vast amount of information sharing is taking place, even more so in the digital age. Web 2.0 has contributed to the flow of information being more 'liquid' (Ritzer, 2011: 5), as explained in chapter 2. Figaredo and Álvarez (2012: 249) points out that "the content of these online exchanges in the information society constitutes the social 'glue' that bonds socio-technical innovations applicable to the system".

Lunsford, Fishman and Liew (2013: 470) describes the situation of student academic writing being an institutional standardized conversion, where literacy is measured to determine contribution to the knowledge economy, from examination results into competencies, "intelligence and potential earning power" which is beneficial for the workplace. They further state that "accordingly, institutionalized regimes of assessment translate writing into symbolic capital to be circulated within a global marketplace of human capital" (Lunsford, Fishman and Liew, 2013: 470). This has certainly brought about a change in information production, behaviour, and consumption. Information is now the new product in discussions about economics (Taylor, 2014: 930), where publishers such as Elsevier are making huge profits (Schmitt, 2015). In the 1960s, only a few professionals published

content in print, and after a long acquisition process these publications were mainly housed in libraries making it accessible to their users, which is referred to 'mediated access' to information. However, from the perspective of university researchers, changes in the university system that took place from 1970, and the evolving technology has rapidly changed this process (Taylor, 2014: 930) contributing to a huge increase in research output. The web brought about another change in the way scientific research is disseminated. There is a movement that took place from the traditional gatekeepers which include librarians and publishers, towards self-publishing via blogs or wikis where gatekeepers no longer exist. Due to all these various options in the digital age, brought about the issue of information overload (Taylor, 2014: 930).

A researcher within a university context is defined by Borner (2010) as cited by Karlovčec (2016:3) as "a person who publishes scientific papers, books and journals; produces patents, data sets, hardware and software; or works on research projects". Previously, scientists worked in solitude which meant that their research were conducted individually and very much in isolation, conducting their experiments in labs and communicated their findings in single-authored publications, mainly in the form of books and journals, which was the normal and traditional research practice. One of the factors that brought about change in research practices is the technological evolution, where the shift from researchers working alone moved towards collaborating with many other researchers in their field, locally and internationally. Although Crane (1972) claims that the formation of invisible colleges which could be described as collaboration between many researchers have been occurring in different ways long before the rise of technology. Nevertheless, through social networking sites such as Academia.edu, LinkedIn, ResearchGate and Facebook, researchers practice prosumerism by broadcasting their research profiles on the web, making themselves more visible, so too making it easier to discover researchers in their field as well, linking to the self-publication practice (Taylor, 2014: 930). By subscribing to RSS feeds and electronic journal alert systems, researchers receive updates on their specialised research areas, as soon as new research is published. The Open Access movement and the notion of Open Science are examples of prosumer behaviour in the digital age in the university context, and funders such as Horizon 2020 and NRF encourage these practices to make science more open. There are many methods and techniques measuring the impact of research output such as bibliometrics, scientometrics and altmetrics mainly conducted by librarians to support research at universities. Bibliographic databases such as Scopus and Web of Science assist in conducting research output analysis, and placing researchers and their universities on the research map. Since one of the criteria for ranking universities worldwide is measuring research output, research profiles have become very important for the researcher. By researchers embracing

these tools and technologies to collaborate and interact online for research purposes, impacts on the research culture of the universities. There is claim that the digital society has led to the researcher transforming "the web into a territory of cultural knowledge" (Thelle & Nanna, 2011: 573) in the way research is conducted today. Therefore the researcher plays an important role in higher education institutions contributing to building a knowledge culture.

4.3 Technology impact on the researcher

As previously stated, technology has changed the research behaviour of researchers. Overall technology played a huge role in society for a long time now, ranging from the telephone, microwave, washing machine and bicycle invention. Today, a lot of emphasis has been placed on computer technologies, hardware and software, and especially how it is used in higher education institutions (Johnson et al, 2015), consumed to produce knowledge and goods, but ensure student development and success. Thus the focus of this chapter is on the researcher in the university context, embracing emerging technologies in the consumption and production of knowledge and science, which is the practice of prosumerism in research. Oudshoorn and Pinch (2003: 2) highlighted the importance of the role of the user in the use of technology in general, and further elaborates that the state of the art technology means nothing if the user don't know how to use it, and developers need to engage with the customer when designing new products. So too in the university setting, librarians and faculty collaborate in evaluating electronic resources such as the databases, the faculty holding the subject expertise, and the librarian, who is the information specialist holds the expertise to search and retrieve relevant information from the database, and together the two parties contribute to the developers, known as vendors, to enhance the product, which acts as another example of prosumerism and Mcdonaldization in the university research context. Thelle and Nanna (2011: 573) examined how technologies and software has changed the behaviour of users (Thelle & Nanna, 2011: 573; Hubert, 2011: 45). The design of technology these days have changed user practices without any force, which can be described as persuasive technology (Thelle & Nanna, 2011: 573).

Hubert (2011, 45) suggested in his study on measuring brain activity of digital natives and digital immigrants that the Internet influences the way the human brain operates and develops in decision-making practices. Embracing emerging technologies means that the user need to apply critical thinking abilities to achieve the ultimate results. However, it is argued that the Internet usage does not stimulate the brain in any way with regards to thinking, it instead leads to memory loss (Hubert, 2011: 45). It is more a mechanism of persuasion, as Thelle and Nanna (2011: 576) further states: "when using Europeana or Google Books, the user is persuaded into a certain kind of practice,

where, through a series of mechanisms, the system and the user setting enters into a gradual, mutual process of adaptation and routinisation, that we can call domestication". Thus, relying solely on technology could be seen as both an advantage and disadvantage to the individual or group producing new knowledge or science. The human factor then still play an important role, as researchers embrace these technologies to facilitate research, however, critical thinking, interpretation and analysis of data, and processing it to transform it into information and knowledge is crucial factors of human and intellectual property in the research process.

4.4 Social Networking Sites

It is important to note that Social Networking Sites (SNS) plays a huge role in the way research is conducted these days. It has enabled the researcher to become a prosumer. This section discusses SNS and how it is used in research. However, the concept of social networking is not new. The social construction of technology (SCOT) approach, refers to production of new technologies through a group of people interacting socially (Oudshoorn & Pinch, 2003: 3). There is a connection between the social interaction of users and designers working together to improve or develop products, and was earlier referred to as "technology's interpretive flexibility", resulting in a shift from the perception of "passive consumers of technology" towards a "linear model of technological innovation and diffusion" (Oudshoorn and Pinch, 2003: 3), meaning that consumers in many ways take part in the development and improvement of technologies. As previously mentioned in the example of database evaluation, indicate that consumers of technology are becoming more proactive consumers of technology. Singh and Gill (2015) discuss SNS in the university context as being "the virtual space among people who mutually share information and use it as an effective means of communication". They claim that in universities the use of SNS are ideal among communities that share common interests. This relates to Communities of Practice (CoP) which form part of knowledge management practices (Kleinveldt, Schutte & Stilwell, 2016). SNS can also be referred to as social interactive websites (Singh & Gill, 2015).

Singh and Gill (2015) explored what academics, researchers and students at selected universities of North India actually used SNS for, what SNS were used for research and whether any challenges hindered the use of SNS for research. Their main finding was that "SNSs are the vehicles of communication and should be used for academic and research purposes rather than entertainment and getting engaged in chatting, thereby wasting their precious time" (Singh and Gill, 2015). They further claim that SNS are the "new avatar" for electronic communication and is important that it be embraced by the university community as it enables interaction and sharing of information and

knowledge among all stakeholders, researchers, academics, students and librarians in real-time (Singh and Gill, 2015).

These activities conducted by researchers highlight that research practices are more proactive and voluntary which are the basic characteristics of the prosumer. The researcher is in control of making research output visible. It also leads to self-popularisation, as the researcher incorporates marketing him/herself through research profiles via SNS. This is evident in companies' recruitment processes as the trend these days are to evaluate individual's research profiles online for employment (Singh and Gill, 2015). It is also a criteria in the rating of researchers (NRF, 2015).

Therefore, SNS can be seen as a positive outcome in the learning process, leading to social inclusion in an academic setting, creating freedom of opinion and flexibility in teaching and learning, as well as research. Later in the two case studies, the findings from researchers and librarians will reveal whether their experiences and perceptions of SNS and Web 2.0 tools are in agreement or not with these authors' views and research findings.

4.5 The prosumer

The term 'prosumer' was first used by Toffler in 1980, and also by Marx and Baudrillard, as reported by Ritzer et al (2012). It is also referred to as "interactive audiences" (Thelle and Nanna, 2011: 574). A prosumer is defined as the combination of consuming and producing (Toffler, 1980; Figaredo and Álvarez, 2012: 255; Ritzer et al, 2012; O'Neill, Gallego and Zeller, 2013: 6-7). The Internet together with the Web 2.0 evolution, is said to be the main cause for the rise of the prosumer (Tapscott and Williams, 2007; O'Neill, Gallego and Zeller, 2013), and the term prosumer is often referred to as "a user interacting with web content" (Figaredo and Álvarez, 2012: 255). In the university setting, prosumerism can be described as "community dynamics" meaning that individuals with similar interests work in teams creating "open institutional innovations" and in some cases it also involves crowdsourcing (Figaredo and Álvarez, 2012: 255). In the business world, consumers are now the new partners leading to innovation through collaboration (Hemetsberger, 2003: 4).

So too, in the university setting, each stakeholder; academic, researcher, student, librarian, support staff are partners contributing to the main pillars of the university being teaching and learning, research, and community engagement. Therefore, prosumerism can be said to be a practice that has always been occurring in higher education (Ritzer et al, 2012), evident in the technology trends in higher education discussed in the *NMC Horizon report* in Chapter 2 (Johnson et al, 2015). The concept of prosumer have been adopted in many subjects, making it inter-disciplinary. Some examples of how the prosumerism concept have been integrated into practices are in folksonomies

(Thelle & Nanna, 2011: 576) and electricity energy usage behaviour (Rathnayaka et al, 2012: 236). The practice of prosumerism in the subject of energy consumption and production is further explained by Rathnayaka et al (2012: 236) as follows:

> Smart Grid (SG) achieves bidirectional energy and information flow between the energy user and the utility grid, allowing energy users not only to consume energy, but also to generate the energy and share the excess energy with the utility grid or with other energy consumers. This type of energy user is called the "prosumer".

Thelle and Nanna (2011: 574) quoted the following statement by Lovink (2009) about the prosumer: "*Just have a good web site, then the Web 2.0 crowds will do the rest. Let them work for you, these prosumers!"* This emphasise the very nature of the researcher as a prosumer, as the platforms and tools available through technology allow researchers to disseminate, self-archive and market their own research output as mentioned earlier.

With regards to library services and librarianship practices, the concept of the library user as a prosumer has emerged since the evolution of folksonomies, creating through technology a different virtual environment referred to as 'knowledgescape' (Thelle and Nanna, 2011: 576). Folksonomies can be described as an online practice where users, through social networking sites or Web 2.0 tools, classify and index information on the Internet, a practice known as tagging. In a way, the social tagging is seen to be beneficial to users with regards to their information seeking behaviour as it leads to following the most popular tags on a web page. In contrast, it can also be misleading in the sense of terms that are not understood, or unpopular terms not being linked too. These have resulted in many debates among librarians about the management of knowledge and information, which led to Thelle and Nanna (2011: 576) posing the following question: "what is now the legitimacy of classificatory hierarchies, constructed by cultural professionals, when millions of people now can register and categorize the exploding masses of content that becomes available on the internet"? Professionals have argued about the credibility of folksonomies as they are inconsistent and depends on the users' choice of words, there is no controlled vocabulary as in traditional classification and indexing. Thelle and Nanna (2011: 576) therefore ague that social tagging "represent a loose, horizontal social categorisation in which the semantic elements in principal are unrelated". However, folksonomies have become the common practices of users on the web. Umberto Eco (1996) as cited by Thelle and Nanna (2011: 576), raised the concern that: "as well as you need a printed handbook in order to surf on internet, so we will need new printed manuals in order to cope critically with the worldwide web". However, with new developments in discovery tools and online catalogues, social tagging by library users are welcomed as it gives insight into their construction of search strategies in the retrieval of information.

On the issue of archives and digital search engines, Thelle and Nanna (2011: 576) criticised Google's indexing, ranking system and priority placed on the English language content, linking popularity of records or websites with importance. It was seen as though content in other languages did not carry any weight, and this led to the establishment of the EU-funded European search engine and archive, called *Europeana* (Thelle & Nanna, 2011: 576). Thelle and Nanna (2011: 576) cited De Vabre who stated in his essay "*Google is not the end of history*" that:

> At a time when we are celebrating, so appropriately, the memory of Foucault, Sartre, and so many other thinkers of our modernity, I am almost embarrassed to remind people that the knowledge that is stored in libraries does not deliver itself. In its thickness, its density, its complexity, it screens itself. Digging, exhuming, reconstituting, forming hierarchies are needed. This is the job of the researcher. This is also why the ministry has acted to create, on the internet too, "pathways" in its collections, virtual exhibitions, in order to guide the user within the tremendous richness and diversity of our heritage.

However, O'Neill, Gallego and Zeller (2013: 6-7) argues that not everybody in the digital age is a prosumer. Embracing these new technologies are the choice of the individual, and even though Web 2.0 users have profiles online, they are not necessarily producing new information or knowledge online, meaning that the user could only be consuming online, without any further interaction or communication.

However there is claim that "we were always prosumers" (Ritzer et al, 2012). The technologies of today have just made prosumerism more visible and easier, but as Crane (1972) claimed, the practice of invisible colleges happened long before the Internet. Prosumerism has changed the practices of researchers especially in higher education. As mentioned in Chapter 2, Johnson et al (2015 and 2016) and Adams et al (2017) have been discussing in *The NMC Horizon Report: Higher Education Edition* for the past three years, that the emerging technologies are transforming the university practices, leading to many researchers being influenced by other research techniques. These have also led to changes in methodologies used to conduct research in the contemporary society, as researchers have to re-think how best to reach their target audience, considering the rushed life and being online 24/7 calls for new modes of communication (O'Neill, Gallego & Zeller, 2013: 8-9).

Thus the views of the authors in this section on the researcher as prosumer suggests that although technologies play a part in the prosumer practice among researchers in higher education institutions today, there is claim that prosumerism always existed before the rise of Web 2.0. However, technological advancement have to a great extent made 'invisible colleges' far more visible in the

contemporary university, which is in line with the current evaluation and measuring of research output.

4.5.1 The role of the researcher as prosumer

Figaredo and Álvarez, (2012: 255) describes the concept of prosumer within the university context as being "social open innovation" models which operates as a knowledge management system through the active participation of the actors in the university who create innovation locally and internationally. In order for the practice of a prosumer in higher education, they further state that three vital aspects are necessary, namely: "networks, collaboration and shared assets" (Figaredo and Álvarez, 2012: 255). With the establishment of social networks, introduced a different method of teaching and learning, which relate to blended learning which is facilitated by the emerging technologies embraced in universities (Johnson et al, 2015). The researchers' role as prosumer, by engaging with digital technology, can be described as a new approach to conducting research (Figaredo & Álvarez, 2012: 255).

A writer is described as being a prosumer because consuming other writing is necessary in order to produce new works. So too students can be referred to as prosumers through their interaction via the online learning environments at universities (Lunsford, Fishman & Liew, 2013: 475).

However there is scepticism about researchers being prosumers through SNS. Taylor (2014: 930) also argues that the concept of prosumer with regards to the changing practices of the way research is conducted, resulted in a lower quality of information and knowledge being produced. As mentioned before the traditional gatekeepers of information and knowledge being replaced by Google, which suggests that prosumer behaviour in research could be of lower quality if traditional publishing processes are not followed (Taylor, 2014: 930).

However, researchers today still tend to stick to the traditional dissemination of research output, namely books and journal articles, and that the preferred practice on social media is to communicate about their new publications rather than using social media as a new 'publishing house'. The practice of e-science, which refers to huge collaborative scientific projects using 'large data collections' accessible via 'large scale computing' systems (O'Neill, Gallego and Zeller, 2013: 12), has contributed to the role of the researcher as prosumer locally and internationally. In this context the role of the researcher as a prosumer in the university community is vital in placing the university on the research map. The e-science concept thus relate to the e-research practice, where technologies and peer collaboration online are incorporated in research production. Therefore the need is greater now more than ever for researchers to collaborate internationally in the production of new

knowledge, and SNS thus play an important role in prosumerism. The transformation of the researcher into a prosumer means that "e-science networks not only enable individual researchers or research teams to produce research results by means of large scale computing resources, they also enable the usage or consumption of other collaborators' results and data collections regarding the integration into, for example, joint comparative studies" (O'Neill, Gallego and Zeller, 2013: 12). It is worth noting that institutional repositories play a pivotal role as a 'safer' option to self-archiving, linking to the green route OA model (Raju, Smith & Gibson, 2013) which was briefly discussed in Chapter 2. Although the practice is moving gradually, it shows promise for researchers as prosumers.

4.5.2 The experiences and perceptions of the researcher as prosumer

Following the discussion of what the writers perceive is the role of the researcher as prosumer, it is also important to discuss the experiences and the perceptions of the researcher as the prosumer. In this context, studies of the researchers' perception and experience on the use of emerging technologies, social networking sites, web 2.0 tools, and electronic resources in conducting research is discussed. It is claimed that users are the change agents of technology, and therefore it is crucial to study user behaviour and experiences of using technology, which leads to "configuring the user" concept which is said to be an expansion of semiotics by Science and Technology Studies scholars (Oudshoorn and Pinch, 2003: 4-8). This was further explained by Woolgar (1991) as cited by Oudshoorn and Pinch (2003: 8) who perceived the user as a reader, and stated that "how users 'read' machines is constrained because the design and the production of machines entails a process of configuring the user". However, with the user being a prosumer, development of products and technologies by organisations (such as universities) and companies (the database vendors) rely on the feedback from users, in this case, the user refers to the researcher, the faculty, student, and on the other hand the mediators refers to librarians and information technology support staff, and all stakeholders in the university setting.

It was highlighted that there are many studies discussing the user perceptions of social media in research but there is a gap in the literature reporting on empirical research on researchers' practical experiences of using social media for research (Fenwick, 2016). There are also the ethical issues involved with professionalism and the use of social media, with many institutions putting policies in place regarding this (Fenwick, 2016). Jenkins (2016), advised that in order to successfully use Twitter for research, a two-way interaction is key i.e.: attract users through posting useful content and then start networking with users.

However there is a need for getting the university community involved in enhancing tools for research. Fourie and Fourie (2015: 165) further state:

> considering the popularity of Google and social networking as means for finding information and sharing information in everyday life contexts, and the fact that these and other web search tools will be the resources for the future, it makes sense from a student's point-of-view not to spend too much energy on databases and information services; there is no reason or opportunity to return once out of the academic system.

Therefore information service providers, specifically database service providers need to re-think their marketing strategy towards a new client base, being the undergraduate student (Fourie & Fourie, 2015: 165), as a way of developing humanity into the learning society where life-long information literacies are at the forefront.

A study conducted in Zimbabwe, Africa, revealed that university libraries are the "most-utilised alternative choice" for seeking information for research by agricultural researchers, but not by extension workers due to proximity. Here it was recommended that the use of social media to support research will be beneficial for extension workers (Mugwisi, 2014: 52).

Universities play a crucial role today in the development of teaching and learning, and research through technologies. The following statement published in *The Conversation*: "Technology will make lecturers redundant – but only if they let it" (2016) on 10 February 2016, supports this:

> Digital tools are quickly getting to the point where algorithms will outperform experts, not only in filtering content but also in synthesising it. Teachers should embrace technology by encouraging their students to build knowledge through digital networks both within and outside the academy. That way they will never become redundant. And they'll ensure that their graduates are critical thinkers, not just technological gurus.

As mentioned before, the advancement in ICT has led to the practice of e-research, which gives a university competitive advantage (Thomas, 2010: 38). So too, it is vital that the university community continue to develop their technological skills. E-research is an example of how researchers are practicing prosumerism in universities as it involves embracing both emerging technologies and research methodologies. As mentioned in Chapter 2, the Open Access Movement have "radically improved access to the world's scholarly output" (Raju et al, 2013: 44), which in turn is another example of prosumer practice by researchers publishing in OA journals, especially where universities and there librarians have taken on the role as publishing houses for researchers. However, there is a desperate need for research support in moving towards successful 'prosumer research practices', and to bridge the research knowledge divide (Corbett, 2015). A study investigating South African universities embracing social media through a combination of bibliometric, altmetric and webometric methods found that there is an increase of researchers

making their research output available on ResearchGate, increasing the impact of research output and web impact. It was further pointed out that researchers have realised the importance of social media in research (Onyancha, 2015: 15). To be successful prosumers, it is about finding the right Web 2.0 tool for the specific discipline and user feedback is crucial for future development as recommended by Sewell (2013: 169).

4.6 Conclusion

The chapter discussed the role of the researcher as prosumer in the university setting. It has been found that technology, especially the rise of Web 2.0, plays a vital role in the practices of prosumerism. However there is claim that individuals have always been prosumers. Although there are criticism about the quality of information and knowledge produced on the web, social networking sites have placed researchers and their parent universities on the research landscape, by making their research output more visible on the web and finding experts in their research niche areas quicker and easier to build networks and collaborate to produce new knowledge. The question is, how do academic libraries contribute to and support the role of the researcher as prosumer in knowledge production? The two case studies in this thesis tries to answer this question.

PART 2: What do librarians and researchers want?

Chapter 5

5 Research design and methodology

5.1 Introduction

This chapter describes the research design and methods used by the researcher for collecting the data on the role of academic libraries supporting research, with special reference to Chemistry and Chemical engineering researchers at CPUT and UNIBO. After reviewing the literature on the current state of academic libraries supporting research in Chapter 2, the perceptions of librarians on conducting research in LIS as well as supporting research versus researchers' perception of the library supporting research in Chapter 3, and the role of the researcher as a prosumer in Chapter 4, as well as taking into consideration the recommendations made in the master's thesis for future studies, prepared the author in choosing an appropriate research design and method of collecting data for this PhD thesis. The areas that will be discussed includes the research approach, the data collection methods, the sampling, the instruments and the data analysis technique. The aim of this chapter is to give insight into the method of enquiry used in an attempt to answer the research question and sub-questions of this study. Therefore it is also important to reiterate at this stage the purpose and practical implication presented in Chapter 1, which steered the research design process for collecting the data. The research method conducted in this study is similar to the studies by Grand et al (2016). The purpose of this qualitative case study is to explore the position of communication and science academic libraries supporting chemistry and chemical engineering research at CPUT and UNIBO. The research question is: to what extent new modes of communication and the academic library is used in chemistry and chemical engineering research. What is the gap between what researchers need and want from the library to support research and what research support they are currently receiving, and how faculty librarians perceive their role in supporting research? The practical implication of the study is to provide relevant and potentially useful information for devising solutions to what Chemistry and Chemical Engineering researchers need and want from academic libraries to support their research. The study will give insight into the 21st century research needs and practices and the future of academic libraries in the digital age. The research question leads to the following research sub-questions:

- What is the role and current state of science academic libraries in research?
- What is the role of the researcher as a prosumer in the contemporary university?

- How do the researchers perceive the role of the library in supporting research?
- How do the librarians perceive their own role in supporting research?
- How does research output (publications) inform policy and programmes in universities?
- Where do the library fit into the research cycle in the digital age?

5.1.1 Scope and Limitation

As described in Chapter 1 the scope of this study is focusing on a combination of Science and Technology Studies, Social Sciences, Library and Information Science, and how it contributes to building a research culture within the two higher education institutions. A comparison is made between two very different academic institutions; one being an old well-established university (UNIBO), and a fairly new dynamic university of technology (CPUT). They therefore represent a traditional institution (UNIBO), trying to integrate new approaches to knowledge development and diffusion into an already established system, and a new emerging institution (CPUT), created within the context of the new "knowledge society" approach. In order to make the study feasible within the scope of a PhD thesis, Chemistry and Chemical Engineering researchers at UNIBO and CPUT who are listed on the Scopus bibliographic database were selected as the target audience.

5.2 Research Design

The research design is the mechanism used to determine the type of study with the end output in mind, in an attempt to answer the research question (Mouton, 2001: 49). A research design involves the framework of a research project from planning phase, data collection method, and how the findings are analysed and presented (Leedy & Ormrod, 2013: 74).

Empirical research in the social sciences sector, according to Babbie (2013: 112) means to "explore an interest, test a specific idea, or validate a complex theory". Cahoy (2016), an education librarian at the Pennsylvania State University Libraries, describes empirical research being "based on observed and measured phenomena and derives knowledge from actual experience rather than from theory or belief". She further defines empirical research to be presented in a structured way, having distinct sections which include but not limited to an introduction to the study, a literature review, methodology and discussion. It is therefore important to point out that this PhD thesis is presented in a very similar structure as indicated in the chapter outline section of Chapter 1.

The correlation between the research approaches and the research problem one choose for the study is key. Quantitative and qualitative are two research approaches discussed in research

methodology literature (Leedy & Ormrod, 2013: 98; Creswell & Clark, 2011: 63). However there is a 'quantitative/qualitative divide' observed (Travers, 2001: 6) in the sense that there is a constant debate about which research approach to choose. Travers (2001: 6) further explains that the research approach selected "commits you to a particular way of understanding social science, and studying human beings". Quantitative research entails working with numbers, figures and mainly uses measures such as questionnaires, translating the results in quantitative measurable data. The benefit of quantitative research is methods is that it provides abundant data for research purposes. However, questionnaires can also be used in qualitative research. An example of such a questionnaire, referred to as a self-administered questionnaire could occur when participants in a study decide to answer interview questions (qualitative research) in writing. Qualitative research on the other hand concentrate more on the quality than numerical values, focusing on people's perspective and mainly uses interviews as a measure (Leedy & Ormrod, 2013: 95). Selecting a qualitative approach can be more valuable when the information that the researcher wants to obtain is more complex and not at multiple levels of interpretation. Qualitative research in the social studies of science is essential in order to be clear on the link between science and society, combining appreciation of human behaviour with scientific objectivity (Weinberg, 2002: 13). According to Wilson (1981: 11), for understanding information needs of users, which in this thesis 'users' refer to researchers and PhD students whom librarians support for research, a qualitative approach is ideal in identifying underlying issues occurring on the ground. He further states that in the field of Information Science, there is a need to develop concepts, which a qualitative approach contributes to.

In qualitative research, it is crucial that the researcher selects a research method applicable to the study. Some examples of research methods are action research, case studies, content analyses, observation study and so on (Leedy & Ormrod, 2013: 100). Similar to the research method used by Grand et al (2016: 6), the researcher chose a case study, with a plan to conduct interviews which De Vault (2002: 88) defines as a combination of talk and interaction creating a "shared reality" among individuals within a group. Interviews are a special form of conversation which could be conducted but not limited to a structured, standardised, quantitatively or semi-formal manner (Horvat, 2013: 65; Holstein & Gubrium, 2002: 112). The speediest means of finding out about individual's daily duties are by conducting interviews. However, there is no precise amount of interviews stipulated for a research project as it depends on various factors such as time constraints and the research focus, which do not mean that conducting a small number of interviews will weaken the study (Horvat, 2013: 65; Travers, 2001: 3). A case study deals with the study of individuals to understand

the “real-life social relations” in a particular context (Hird, 2003: 22), which fits in with the current research project. Since the PhD research project is an expansion of the Master’s thesis, which was mainly quantitative, the researcher chose a mixed methods approach for this study, focusing mainly on a qualitative research approach to get a deeper meaning of researchers’ and librarians’ views on research support. The researcher planned to find out the changing mode of communication as well as to what extent the academic library is used in research by Chemistry and Chemical Engineering researchers at CPUT and UNIBO, the gap between what researchers need and want from the library to support research and what research support they are currently receiving, and how faculty librarians perceive their role in supporting research. A literature review on the current position of academic libraries supporting research, the librarians’ perception on supporting research versus the researchers’ perception on the library supporting research, the role of the researcher as a prosumer, together with findings from previous empirical research by the researcher in 2009 formed the foundation of the research. It is therefore important to emphasise here that this PhD research project is an expansion of the Masters in Library and Information Science which focused on the role of the academic library supporting research at a university of technology in South Africa (Kleinveldt, 2009). The study was mainly quantitative, comprising of a survey questionnaire of academics across all six faculties, and the qualitative part entailed a few open ended questions included in the questionnaire and an interview conducted with the research librarian. The previous study which focused on CPUT, was framed on the concepts of knowledge society and academic librarianship, and the research question was “what do researchers need, want and expect from an academic library” (Kleinveldt, 2009; Hart & Kleinveldt, 2011). The book *Researchers’ Use of Academic Libraries and their Services* (2007) formed the basis of the 2009 study. Some key findings which led to the researcher deciding to expand on this study were (Kleinveldt, 2009: IV; Hart & Kleinveldt, 2011):

- At the time, only 52% of CPUT researchers across six faculties strongly agreed that “research is essential to their job and that CPUT needs to build a stronger research culture”.
- Research activity at the time was mainly in pursuing PhD and Masters Degrees by academics.
- An average of 23.4% of work time was spent on research in a year due to heavy workloads.
- The 2009 study revealed that quite a high number of academics (65%) “have not published any articles in accredited journals in the past three years”
- 57% of respondents do not agree that they source information directly from the Internet and so no longer need the library.
- Most respondents, 95 of the 102, make use of the library for research support. However, RISC is not their number one choice for research support. RISC is perhaps underused. It needs to be noted that postgraduate students were excluded from the 2009 study. However, in this thesis PhD students were included in the study. In chapter 7 CPUT PhD

students revealed that RISC is too small and there is a need for bigger venue as the demand for this research space is very high. Accessing e-resources, borrowing print resources and Inter-library loan services were found to be the main library services used by academics in the 2009 study. Quite a high number of respondents, 27 (28%), were undecided whether the Digital Knowledge Repository at CPUT is important to them. However, many elaborated that they were unaware of this service. Later on, comments in chapter 7 indicate that this has changed.

- The traditional current awareness services of libraries, i.e. being kept updated on new research in their field, was found to be at the top of researchers' wish lists for library research support services.
- The ICT infrastructure has been highlighted as critical. The main reason for low rating of the library is that the network / databases are too slow.
- There seems to be fairly strong doubt that librarians have adequate subject knowledge to support research with 27% agreeing that librarians lack subject knowledge. However, there seems to be some confusion with this statement, as later on researchers reveal that they do not expect librarians to possess Chemistry or Chemical Engineering subject knowledge. On the other hand as discussed in Chapter 2, in some higher education institutions, a faculty /subject librarian should possess a bachelor's degree in that faculty together with a LIS qualification such as the postgraduate diploma in Library and Information Science (CILIP, 2016; Prospects, 2017).
- The cross tabulations suggest that there might well be some differences among faculties in terms of responses. This finding is in line with the literature discussed in the PhD research, where the library is highly regarded among social sciences and humanities academics than the natural sciences (Saunders, 2015; Schwartz, 2013; Kleinveldt, 2009).

It is important to point out that the Applied Sciences Faculty in which the Chemistry department exists, was underrepresented in the 2009 study. Since the current focus is on Chemistry and Chemical Engineering disciplines, similarities or vast differences compared to the previous study are highlighted in Chapter 7. Further discussion on these findings above pointed out that "librarians wishing to extend their services beyond information and resources management" might find themselves clashing with the digital world where "easy access to online communities of practice and alerting services, for example, is negating the need for what might be called the 'gateway' services of libraries, especially it seems in the sciences" (Hart & Kleinveldt, 2011: 48).

Since the previous study was more quantitative using a survey questionnaire of academic staff across the six faculties at CPUT, there were a few limitations such as it excluded postgraduate students from the study and it only focused on one institution. Therefore the current research project includes the perceptions and experiences of three groups, the librarians, faculty and PhD students in the Chemistry and Chemical Engineering departments at CPUT and UNIBO. For the purpose of setting the scene for this chapter, the following concluding quote by Webb, GannonLeary and Bent (2007: 130) as cited in the master's thesis (Kleinveldt, 2009: 20), reiterates the purpose of the current PhD thesis:

> While it is vital to listen to researchers and ensure that the library responds to their needs, we must do more than listen and react. Many researchers are unaware of the potential services and resources available to them and will only ask for what they already know about. This ignorance could easily compromise the quality of the research output. How much better might their research have been if they had been better informed? This is an area where librarians can demonstrate their value to the community is as well informed as possible is the responsibility of the library and its staff and we have to find as many ways as we can to achieve this.

What is stated above links directly to the main research question of this PhD thesis which the author attempts to answer from studies which have evolved since the 2009 literature findings (Kleinveldt, 2009) already reported on, and later, Chapters 6 and 7 which reports on the interview responses. The method of collecting the data for the study is discussed below.

5.3 Data Collection Method and instruments

The collection of data has been conducted in two phases. The first consists of a Bibliometric study of Chemistry and Chemical researchers at UNIBO and CPUT by using the Scopus bibliographic database to collect the data based on a set of specific criteria, similar to those used in the study by Singh, Mittal and Ahmad (2007). Some of the criteria used in the bibliometric study by Singh, Mittal and Ahmad (2007: 343) included: "authorship patterns, author productivity, prolific authors and core journals in the subject area", and these were adapted to the bibliometric study conducted for this thesis.

Based on the results of the bibliometric study, a sample of Chemistry and Chemical Engineering researchers was purposely selected, comprising of top, middle and low research performance in an attempt to create an insightful representation of these departments at CPUT and UNIBO. The second phase was to conduct structured interviews with the sample selection of Chemistry and Chemical Engineering researchers, PhD students from third year level in these departments, and Chemistry and Chemical Engineering faculty librarians. The structured interview allowed the researcher to conduct a 'reliable data comparison' (Grand et al, 2016: 6). This way, the study will address views from the researchers' perspective, and the librarians' perspective. The interview protocol for the three groups interviewed are provided in **Appendix D**. Some of the interview questions, particularly in the Likert Scale section, were adopted from the master's thesis for the purposes of comparing previous responses in the CPUT case study to find out whether perceptions of researchers about library resources for research have changed over time. Likert scale statements can be described as a unidimensional scaling method that measure's an individual's attitudes or beliefs in various situations such as the work environment (Trochim, 2006) by using a list of statements that are scored. The scale used was 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'.

The aim of the Likert scale statements is to confirm or contradict previous responses by librarians by delving deeper into librarians' perception of their role in supporting research.

A voice recorder was used during the interview sessions. Some of the participants preferred to respond to the interview questions in writing, which acted as a self-administered questionnaire. Thus there are areas where participants chose not to respond to certain questions, and this has been indicated in the findings.

5.4 Sampling

There are many sampling selection types available. A purposive sampling technique was used to select the target audience for conducting the investigation. The reason for this selection criteria for the sample was to ensure an even and balanced representation of each department. Initially the sample comprised of 30 participants as illustrated in the table below. The process of arriving at the sample size will now be discussed. In order to compare the two groups in Chemistry at UNIBO and CPUT, it was necessary to focus only on Analytical Chemistry for this study as UNIBO has a fairly large and diverse Chemistry Department compared to CPUT which only have an Analytical Chemistry department. Researchers in this thesis refer to academics (with teaching and research responsibilities) and staff members in research positions at the two higher education institutions. At the time of the sample selection process for this study, the population of Analytical Chemistry researchers at UNIBO was 14, with three librarians supporting this group and at CPUT, 26, with two faculty librarians supporting this group. The population of Chemical Engineering researchers at UNIBO was 31, with three librarians supporting this group and at CPUT, 24, with two faculty librarians supporting this group. Figure 5.1 below illustrates the population of Analytical Chemistry and Chemical Engineering faculty members at CPUT and UNIBO. However, it needs to be pointed out that after the initial sample selection exercise, the situation changed which increased the number of participants to a total of 42. This was due to many of the participants initially selected for the study, declining to participate. Thus the researcher had to change the strategy for selecting participants which entailed approaching potential participants at their offices. In research, it is common to experience unexpected outcomes such as participants declining to participate leading to the researcher needing to use a different approach to ensure data is collected within the ethical boundaries (Horvat, 2013: 24). Nevertheless this could be seen as a limitation in research when ethical clearance is required long before the researcher can approach candidates to get confirmation for participation in the research project.

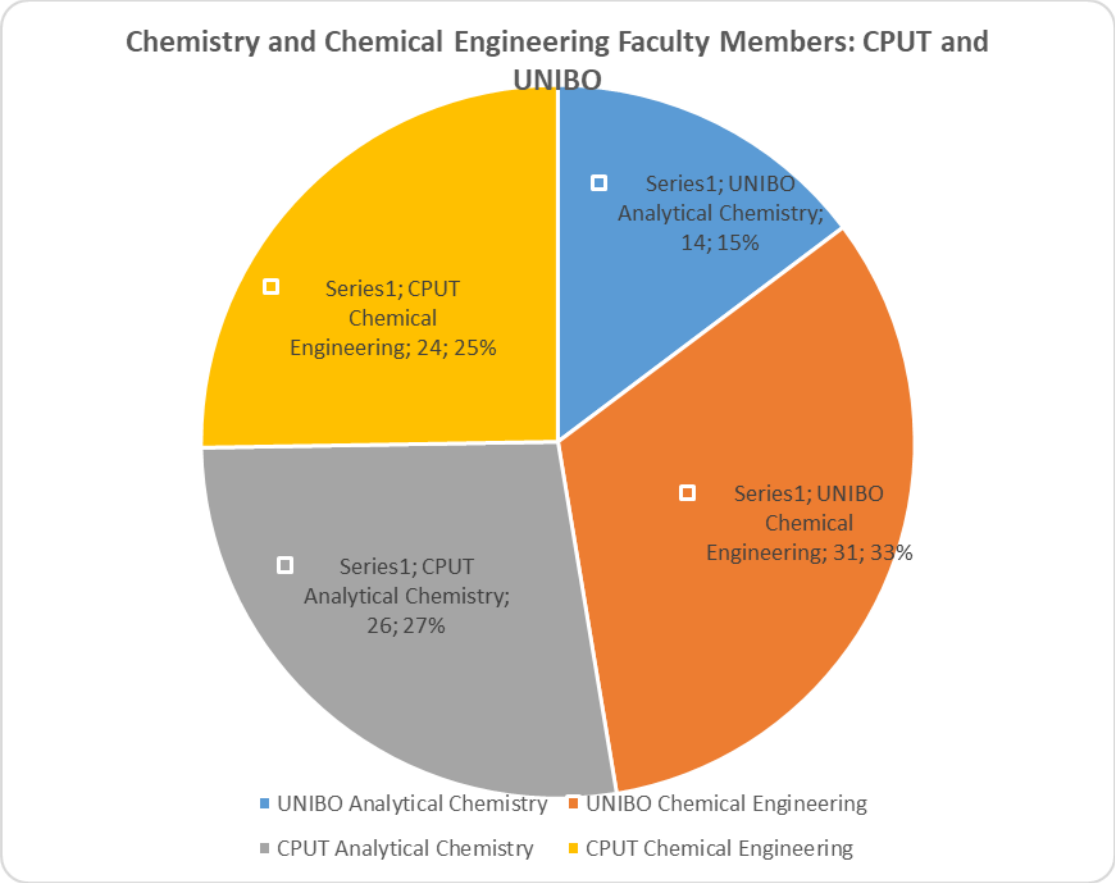

Figure 5.1 Population of Analytical Chemistry and Chemical Engineering academics at CPUT and UNIBO

Specific criteria was set to ensure an even representation of participants through a bibliometric study using the Scopus bibliographic database. The reason for choosing the Scopus database for conducting the bibliometric study was based on the researcher's work experience as a faculty librarian. A comparison between Scopus and the Web of Science bibliographic databases was conducted in 2014 as part of decision making regarding the renewal of database subscriptions. Table 5.1 below was extracted from the report on the comparison of databases. Further investigation showed that CPUT research output were mainly indexed in Scopus compared to Web of Science (Skelly, 2014: 1-2). All librarians gave input on the evaluation of these databases. Scopus was found to be more user-friendly, the usage statistics much higher than Web of Science that was also very expensive. Therefore a decision was made to retain the Scopus database subscription and cancel Web of Science in 2014. Librarians at CPUT currently provide researchers with bibliometric reports which is a requirement in the evaluation of research for rating researchers and for promotion.

Table 5.1 Comparison of bibliometric databases (Skelly, 2014)

Database name	**Vendor**	**Strength**	**Weakness**
ISI / Web of Science / Journal Citation Reports	Thomson Reuters	Data is clean. Includes built-in tools for analysis.	Expensive. Does not include many journals. Tends to favour the natural sciences.
Scopus	Elsevier	Data is clean. Includes built-in tools for analysis. Not as expensive as ISI.	Tends to favour the natural sciences, although it is becoming increasingly multidisciplinary
Google Scholar / Publish or Perish	Google Scholar / Anne-Wil Harzing	Free. Completely insensitive to disciplines. Broadest base.	Data is very messy. Analysis is rudimentary.

Table 5.2 below represents the population of researchers at UNIBO and CPUT, as well as those listed on the Scopus database. The table illustrates the differences between the number or percentage of researchers listed on Scopus versus the number or percentage of researchers who have published in the last five years, 2011-2015. At UNIBO, 100% of researchers in the Analytical Chemistry department are listed on Scopus, and 90% of them published in the last five years. At CPUT, 38% of Analytical Chemistry researchers are listed on Scopus of which 90% have published in the last five years. When comparing the performances of research output, both institutions have the same percentage of researchers who have published in the last five years. This of course does not imply that there is a similarity in quantity with regards to number of publications or the size of the Chemistry department. On the other hand, 97% of Chemical Engineering researchers at UNIBO are listed on the Scopus database of which 97% published in the last five years. At CPUT, 57% of Chemical Engineering researchers are listed on Scopus of which 57% published in the last five years. The discrepancies in percentages between these two higher education institutions in the area of Analytical Chemistry and Chemical Engineering portrays the old, established university such as UNIBO versus a young emerging but dynamic university of technology such as CPUT. Although the CPUT numbers of researchers listed on Scopus are small compared to UNIBO, the percentages of these researchers publishing are much higher, illustrating the development of research output at this young university of technology.

Table 5.2 Number of CPUT and UNIBO academics in Analytical Chemistry and Chemical Engineering listed on Scopus and published in the period 2011-2015

Faculty members listed on Scopus	Population	Total no. of faculty listed in Scopus	Percentage of population	Total no. of faculty members who published in the last 5years	Percentage published in the last 5years
UNIBO Analytical Chemistry	14	14	100%	13	92%
UNIBO Chemical Engineering	31	30	97%	29	97%
CPUT Analytical Chemistry	26	10	38%	9	90%
CPUT Chemical Engineering	24	14	58%	8	57%

The bibliometric study focused on research output for the period 2011-2015, to study research patterns of researchers for selecting the final sample. Further criteria set in the bibliometric study, some adapted from Singh, Mittal and Ahmad (2007) as mentioned earlier, included Journal impact factor, open access publications, the number of times publications were cited, which links to measuring new knowledge and science creation as identified in the literature by Crane (1972); national and international collaborators which links to the changing social research practices of researchers as prosumers discussed in Chapter 4. The breakdown of the 30 participants initially selected as the sample size illustrated in Table 5.3 below, comprises of 10 Analytical Chemistry and 10 Chemical Engineering researchers, 6 PhD students and 4 faculty librarians. PhD student selection was linked to faculty members selected who supervised PhD students. One librarian from each department was initially selected for interviewing based on research support activities. The purposive selection of faculty staff based on the criteria set, resulted in a diverse group of researchers at different research performance levels; top, middle and low, so as to ensure an insightful and widely representation of perspectives on research support.

Table 5.3 Sample size breakdown of 30 participants in Analytical Chemistry and Chemical Engineering at CPUT and UNIBO

Sample size	Total
UNIBO Analytical Chemistry Researchers	5
UNIBO Analytical Chemistry PhD students	2
UNIBO Analytical Chemistry Librarian	1
UNIBO Chemical Engineering Researchers	5
UNIBO Chemical Engineering PhD student	1
UNIBO Chemical Engineering Librarian	1

CPUT Analytical Chemistry Researchers	5
CPUT Analytical Chemistry PhD student	1
CPUT Analytical Chemistry Librarian	1
CPUT Chemical Engineering Researchers	5
CPUT Chemical Engineering PhD students	2
CPUT Chemical Engineering Librarian	1
Total	**30**

The final sample selection based on purposive sampling is indicated in Table 5.4 below. As previously mentioned, the researcher chose these specific participants based on the criteria set for the bibliometric study which included the different positions held in the respective departments, the number of publications in the past five years, the number of Open Access publications, and the highest cited publication, to ensure an insightful representation of the departments. The Chemical Engineering participants selected at CPUT comprised of one Extended Curriculum Programme (ECP) lecturer, two lecturers, a professor who is also the Head of Programme (HOP), and one senior lecturer. At UNIBO the Chemical Engineering participants comprised of two professors, one associate professor, one assistant professor and one fixed-term junior assistant professor. The participants selected in the Analytical Chemistry department at CPUT comprised of two lecturers, a researcher, a research chair and a technician. At UNIBO, Analytical Chemistry participants comprised of two professors, two associate professors and one fixed-term junior assistant professor. The roles of these participants in the department are discussed later in chapters 6 and 7. The researcher followed a process of making contact with participants by email to ask for their participation in the research project. Three follow-up emails were sent to Chemistry and Chemical Engineering faculty before responses were received from participants. Some participants preferred to answer the interview questions in writing, which served as a self-administered questionnaire. However, this led to participants choosing not to answer certain questions, and this is reported in the findings. Interviews were conducted at UNIBO first, and the librarians and PhD students were very enthusiastic to participate. Some faculty members showed reluctance to participate as they were not sure whether their responses would be of significance to the study and some expressed their heavy workloads and time constraints. Nevertheless, only a few of the participants listed in Table 5.4 below agreed to participate after the purpose of the study was explained to them.

Table 5.4 Purposive sample selection based on Bibliometric study of Analytical Chemistry and Chemical Engineering academics at CPUT and UNIBO

Selection	Faculty	Position	No. of publications	No. of open access publications	Highest citation
CPUTChemEng	CPU21	ECP Lecturer	2	1	1
	CPU16	Senior lecturer	2	0	7
	CPU13	HOP Associate professor	15	8	61
	CPU18	Lecturer	1	1	0
	CPU19	Lecturer	1	0	61
CPUTChemist	CPU10	Researcher/ Lecturer: Organic and Physical Chemistry	20	7	44
	CPU9	Lecturer: Analytical Chemistry	4	0	5
	CPU8	Research chair: Physical Chemistry	29	9	9
	CPU7	Lecturer : Analytical Chemistry	3	0	3
	CPU5	Technician	2	1	3
UNIBOChemEng	UNIF24	Professor	100	8	53
	UNIF20	Fixed-term Junior Assistant Professor	16	0	18
	UNIF19	Associate professor	10	3	23
	UNIF17	Assistant professor	8	0	23
	UNIF27	Professor	54	9	40
UNIBOChemist	UNIF10	Professor	63	6	72
	UNIF9	Professor	17	0	37
	UNIF1	Fixed-term Junior Assistant Professor	8	6	22
	UNIF2	Associate Professor	29	6	118
	UNIF3	Associate professor	2	0	24

Due to researchers who declined to participate in the study, the researcher had to approach other candidates, and as a last resort, had to knock on office doors after receiving no email responses and telephone calls were not answered. This led to a slightly skewed sample, as some researchers were not listed on Scopus, which was initially one of the criteria set. Therefore, the actual and final sample for researchers are listed in tables 5.5 below.

Table 5.5 Actual number of participants interviewed

Actual Interviews Conducted	UNIBO	CPUT	Total
PhD Chemical Engineering	2	2	4
PhD Chemistry	3	2	5
Chemical Engineering Faculty	6	5	11
Chemistry Faculty	5	7	12
Librarians	5	5	10
Total	**21**	**21**	**42**

The bibliometrics report in table 5.6 shows that research publications among CPUT Chemistry and Chemical Engineering researchers are on the increase. Later on in Chapter 7 some participants indicated that they are currently pursuing PhD studies. The pressure to increase research output was also revealed.

Table 5.6 Bibliometrics report of researchers

Actual Sample of Researchers	Position	No. of publications	No. of open access publications	Highest citation
CPUCE1	Lecturer	1	1	0
CPUCE2	ECP Lecturer	2	1	1
CPUCE3	HOP Associate professor	15	8	61
CPUCE4	Lecturer	1	0	61
CPUCE5	Lecturer	0	0	0
CPUC1	Part-time lecturer	1	1	0
CPUC2	Lecturer	2	0	11
CPUC3	Technician	0	0	0
CPUC4	Lecturer : Analytical Chemistry	3	0	3
CPUC5	Researcher/ Lecturer: Organic and Physical Chemistry	20	7	44
CPUC6	Part-time lecturer	5	1	9
CPUC7	Lecturer: Analytical Chemistry	4	0	5
UNICE1	Assistant professor	29	0	22
UNICE2	Assistant professor	38	3	19
UNICE3	Assistant professor	8	0	23
UNICE4	Assistant professor	11	0	32
UNICE5	Assistant professor	13	1	38
UNICE6	Fixed-term Junior Assistant Professor	16	0	18
UNIC1	Associate Professor	23	0	21
UNIC2	Professor	63	6	72

UNIC3	Associate Professor	29	6	118
UNIC4	Associate professor	2	0	24
UNIC5	Professor	17	0	37

On the side of the librarians, initially the researcher planned to only interview one librarian supporting researchers in Chemistry and Chemical Engineering departments at UNIBO and CPUT. However, due to the complexity of the two library structures, and for the purposes of comparing the perceptions and experiences of librarians supporting research at these two very different higher education institutions, five librarians from each institution were interviewed. Table 5.7 below illustrates the librarian positions.

Table 5.7 Description of librarians interviewed

Actual Sample of Librarians	**Position**
CPUT	
CPUL1	Branch Librarian: Engineering
CPUL2	Branch Librarian: Applied Sciences
CPUL3	Applied Sciences (Chemistry) Librarian
CPUL4	Engineering (Chemical Engineering) Librarian
CPUL5	Applied Sciences (Chemistry) Librarian
UNIBO	
UNIL1	Chemical Engineering Librarian
UNIL2	Chemistry /Environmental Librarian
UNIL3	Chemistry Librarian
UNIL4	Head of Chemistry Library
UNIL5	Head of Chemical Engineering Library

With regards to Chemistry and Chemical Engineering PhD students that were interviewed, the researcher initially selected students who were currently supervised by researchers that participated in the study. However, some students declined to participate and therefore only three students that were interviewed are supervised by researchers who participated in the study as illustrated in table 5.8 below.

Table 5.8 Description of PhD students interviewed

Actual Sample of PhD students	Supervision	Listed on Scopus
CPUT Chemistry PhD Students		
CPUCS1	CPUC7	yes
CPUCS2	Other	yes
UNIBO Chemistry PhD Students		
UNICS1	Other	yes
UNICS2	UNIC3	yes
UNICS3	Other	yes
CPUT Chemical Engineering PhD Students		
CPUCES1	Other	yes
CPUCES2	Other	yes
UNIBO Chemical Engineering PhD Students		
UNICES1	UNICE3	no
UNICES2	Other	yes

5.5 Analysis and Interpretation of data

Data collected through the bibliometric study was analysed using the EXCEL programme.

The interview responses were analysed using Leedy and Ormrod's (2001) and Silverman's (2011) content analysis process. The data was analysed solely by the researcher in accordance with the research ethics procedure. The researcher decided to personally transcribe interview responses in order to become immersed in the data rigorously which allowed for ideas to surface during the data analysis phase which relates to the approach used by Grand et al (2016: 7), and it also assisted in thinking about recommendations for future studies. The researcher used a coding structure which emerged from the literature review, previous research, and new codes emerging from interview responses. Once the data was coded, the researcher re-read the data and coding to check consistency and validity and reliability of coding process before analysing the coded data.

The research protocol was approved by the CPUT Research Ethics Committee. The research participants read and signed the consent form before the interviews. Some participants were provided with the interview questions on request before the time to make an informed decision in participating, and to assist with language barriers. The main conditions of the signed consent form was for participants to understand the research interview process, allow them to indicate whether

the researcher should provide them with a copy of the transcript for commenting and check for errors before proceeding with analysing and reporting on the data, and also assuring confidentiality and anonymity of participant responses. Participants were also informed that they could withdraw from participating in the project at any given time without any consequences. Transcripts were distributed to participants who had indicated that they required it for reviewing, and were allowed ten working days to respond as indicated in the consent form to allow the researcher to proceed with the analyses and interpretation process. The findings are reported on in chapters 6 and 7, leading to the discussion of the findings in chapter 8. It is hoped that this study will make a contribution to the knowledge base in the area of Science and Technology research and its role in the knowledge societies in the university context.

Chapter 6

6 Perceptions of Librarians supporting research versus researchers' perceptions of librarians supporting in Chemistry and Chemical Engineering Departments: The case of UNIBO

6.1 Introduction

Following Chapter 5 which presented the method of collecting the data for this study, the current chapter reports on the findings of the interviews conducted with participants involved in Chemistry and Chemical Engineering departments at the University of Bologna (UNIBO). The interview responses presented attempts to answer the main research question and sub-questions of the research project demonstrated in Chapters 1 and 5. Research being one of the pillars of a university, the purpose of this study is to investigate the role of academic libraries supporting Chemistry and Chemical Engineering research at UNIBO and CPUT. As previously mentioned, the practical implication of the study is to explore what Chemistry and Chemical Engineering researchers need and want from academic libraries to support their research. The aim of this study is to give insight into the 21st century research needs and practices and the future of academic libraries in the digital age. The responses from participants have been examined against the literature review presented in Chapters 2-4 which looked at the current state of academic libraries in research (Chapter 2), the perception of librarians conducting LIS research versus supporting research as well as what researchers perceive the role of the librarian supporting research to be (Chapter 3), and the role of the researcher as a prosumer (Chapter 4), to identify similarities, gaps or vast differences. Chapter 6 presents the case study of the University of Bologna and begins with describing the background of the institution and the library structure, looking at the vision and mission as well as the research landscape. The findings are organised according to themes that link to the research questions and sub-questions including a brief discussion of each group; librarians, academics/researchers and PhD students in Chemistry and Chemical Engineering departments. It is hoped that this chapter gives insight into the perceptions of the CPUT university community on the actual research activities versus the research trends in the fields of Chemistry and Chemical Engineering and how they are being supported by the library.

6.2 Background

The aim of this section is to give a brief overview of the university, the library, and the two disciplines, namely Chemistry (but specifically Analytical Chemistry) and Chemical Engineering

selected for this study, before reporting on the findings. The University of Bologna was established in 1088 and claimed to be the oldest university in Europe (Università di Bologna, 2016a). The university is made up of five campuses, 11 schools, and 33 departments which includes Chemistry and Chemical Engineering, and 12 research and training centres. With regards to the research landscape, UNIBO currently has an average of 11000 research products, 200 patents, and among other research projects the university is participating in 80 Horizon2020 (also referred to as H2020) funded research projects. The university offers 41 PhD programmes. The 2015/2016 academic report presented a total of 84 724 students who were enrolled for studies at the university with a total number of 5856 UNIBO staff members (Università di Bologna, 2016a).

The academic library is positioned in departments and have a comprehensive electronic collection which includes 48 656 e-journals, 179 058 e-books and 666 databases (Università di Bologna, 2016b). The university has a central library, Bologna University Library, which hosts antique books and some modern collections (which includes the Library and Information Science collection) and then approximately 105 departmental libraries which forms part of the university library system known as Sistema Bibliotecario Di Ateneo (Università di Bologna, 2016b). Among other staff members working in the library, each library has a librarian who manages the operations of the particular library, and a librarian who handles operations on a professional level to support teaching and learning and research. These individuals in particular were selected as the target audience in identifying the views from the academic librarians who are supporting research in Chemistry and Chemical Engineering.

The Chemistry department was reorganised in 1987 and its main target is teaching and multidisciplinary research. Staff members consist of professors, technicians and research fellows. The main research areas are “Analytical Sciences, Computational Chemistry, Electrochemistry, Molecular Spectroscopy, Organic Synthesis, Photochemistry and Supramolecular Chemistry, Physical Organic Chemistry, Polymeric Materials, Structural and Solid State Chemistry” (Dipartimento di Chimica "Giacomo Ciamician" – CHIM, 2016)**.** The focus of this research project was on researchers and PhD students in Analytical Chemistry for the purposes of examining similarities or differences in research and research support between this chapter and Chapter 7 (which is the case of CPUT).

Chemical Engineering forms part of The Department of Civil, Chemical, Environmental and Materials Engineering (DICAM), with the aim to combine diverse research topics in the area of Science and Technology and laboratories in contributing to the society at large. The DICAM department focuses on research areas in Structural, Transport, Hydraulic, Survey and Territory Engineering, Applied

Chemistry and Materials Science, Chemical, Mining, Petroleum and Environmental Engineering. The mission DICAM is "to create and develop advanced research in the areas of civil, chemical, environmental and materials engineering, starting from evaluation, design, construction and service of manmade structures and infrastructures (including industrial production facilities), through the study and characterization of the constituent materials, up to the environmental analysis and impact assessment of the footprint on the territory and the environment" (Department of Civil, Chemical, Environmental and Materials Engineering (DICAM), 2016). The purpose of selecting Chemical Engineering and Analytical Chemistry in particular for this case study, is to compare two different sectors of chemistry-connected disciplines to identify whether there are vast differences or similarities in research practices and needs of researchers and PhD students and how they perceive the academic library in supporting research. It is also important to examine whether the views from librarians supporting research in Analytical Chemistry and Chemical Engineering differ or whether they are in agreement.

The following section will report on the findings from interviews conducted with the librarians in Chemistry and Chemical Engineering departmental libraries at the University of Bologna.

6.3 Findings on the perceptions of librarians supporting research

This section reports on the findings resulting from structured interviews conducted with five librarians in the Chemistry and Chemical Engineering departments. The sample selection comprised of branch librarians and subject / faculty librarians for Chemistry and Chemical Engineering, and one subject /faculty librarian from a satellite campus. Due to the complexity of the library structure, the purposive sampling method was used to ensure a balanced representation of librarians supporting research in the two disciplines. Librarians are coded as follows: UNIL1, UNIL2, UNIL3, UNIL4 and UNIL5. UNIL1 is a Chemical Engineering librarian supporting the department in both teaching and learning and research. UNIL1 only possesses a high-school diploma, worked different jobs not related to libraries before employed as a librarian at UNIBO, and obtained no further qualifications while in the current position. The library where UNIL1 supports chemical engineering, is positioned within the department but research support is provided on an appointment-only basis as the librarian spends two days a week at this location, and three days at the main engineering library. UNIL2 is a Chemistry librarian at a satellite campus outside of Bologna where Analytical Chemistry is also offered among other disciplines where the librarian supports both teaching and learning and research. UNIL2 holds a Masters in Italian Literature and a Diploma in Archiving, worked at the University of Padova as an assistant librarian for 18 months before employed as a librarian at UNIBO, and did the International English Language Testing System (IELTS) test in the current position. At this

particular campus library, the librarian claimed during interview responses that PhD students are their "popular /best long-term users". UNIL3 is a Chemistry librarian at the library which is situated within the Chemistry department where both teaching and learning and research is supported. At the time of appointment as a librarian at UNIBO, UNIL 3 held a Degree in Contemporary History and is currently pursuing the PhD studies in Demographic Sciences at the University of Rome. UNIL4 is the branch librarian managing both the Industrial Chemistry departmental library and the Chemistry departmental library where UNIL3 works, and UNIL5 is the branch librarian who manages both the DICAM departmental library and the departmental library where UNIL1 works. UNIL4 held a postgraduate qualification in Historical Studies at the time of being appointed as a librarian at UNIBO, completed an internship at a special library before UNIBO, and obtained a Masters in Library Management in this current position. UNIL5 held a Degree in Medieval History at the time of employment as a librarian, was previously employed at a scientific museum, and obtained an Advanced Degree in Librarianship and Archiving in the current branch librarian position. The responses have been analysed using Leedy and Ormrod's (2001) and Silverman's (2011) content analysis method as discussed in Chapter 5, and are illustrated by themes in tables and graphs found in **Appendix A** of the thesis. The findings are presented in sections below, organised in themes which are linked to answering the main research question and sub-questions

6.3.1 Librarians' perception of their role in conducting LIS research and supporting research

Librarians were asked to describe their role in supporting Chemistry and Chemical Engineering research. Table 6.1 in the **Appendix A** illustrates the themes identified from responses. The main themes from librarians' responses were "provide documents /materials for research", "collection development", "support research lifecycle – play different role per research phase", Handle queries and Service provision. As much as the main themes tend to be more traditional, it can be seen from responses that librarians play a diverse role, each participating in very different activities (librarian UNIF4 pointing out even being involved in all phases of the research lifecycle) or holding different responsibilities such as teaching data literacy / methodology module for postgraduates and citation metrics support. The teaching of data literacy /methodology which is integrated into the IL training offered to postgraduate students point to a new librarian role, and links to the competency that librarians need to understand research methods to support research (Raju, 2017) as discussed in chapter 2. One librarian (UNIF4) further explains: "*Data literacy is a module in the information literacy course, making researchers aware of research methodology information and sources about collecting, analysing and preserving data. This module is only offered to PhD students and*

researchers. We make reference to research methodology and information sources of data collection methods." "My role differs in each phase of the research life cycle."

The hierarchical structure of the library in terms of decision-making was pointed out (or perhaps confirmed) by librarian UNIL2: "*It is a mixed department" …"The scientific committee verify and make decisions* [about library services]." This is later on highlighted by librarians in the case of CPUT as well. The question is whether this is an advantage or disadvantage is up for further discussion later on. A further comment by librarian UNIL2: *"my role is understated",* is later confirmed in responses by some researchers who only perceive the librarians' role to be providing information in the form of books and journal articles.

Librarians were then asked to describe their research support practices and how it has changed over time. Table 6.2 presents the themes from librarians' responses with emphasis placed on how research support practices have changed. The main themes were: "Main[ly] focus on retrieval of online information: Switch from print to electronic resources: [for?] quick and easy access", "New tools: Online bibliographic databases – Web of Science / Scopus" and new networks being built from existing services in "Inter-Library Loan services: Library Network - NILDE services". One librarian (UNIL4) expressed mixed feelings about supporting research, and elaborated as follows: *"…when I started, I thought it was important to transfer knowledge to the researchers that I support. Now I think that the best way is to plan a support, asking the researchers what are their needs, and, in particular with the PhD student, to spend more time on supporting practical research activities."* The significance of this statement is that it links directly to the main research question of this study, the importance of engaging with researchers to find out whether there are gaps between what researchers need and want in terms of research support, and what is currently being provided by the library and librarian. This is a point discussed in chapters 2 and 3 (Kleinveldt, 2009).

6.3.2 Researchers' perception of the librarians' role in supporting research: from the librarians' point of view

Librarians were asked to describe their experience of supporting faculty and PhD students' research as well as their perception of the faculty's attitude towards librarians supporting their research. Table 6.3 highlights the themes identified from librarians' responses, the main themes being "Information Literacy Training", "Faculty information requests" and "Don't know faculty perception".

Here the majority of librarians mentioned that through Information Literacy training and Information provision there is a positive attitude. However these are very much linked to Teaching and Learning support, which is directly linked to the rich literature on good faculty-librarian collaboration reported

on in previous research (Kleinveldt, 2015; Kleinveldt, Schutte, Stilwell, 2016). It is perhaps necessary to point out the description of Faculty and librarian collaboration, that the expertise of the librarian and expertise of academics complement each other and when the two parties work together, positive results are achieved with regards to student development and success (Kleinveldt, 2015: 14). As much as the literature reveals successful international cases of faculty and librarian collaboration, what needs to be realised is that it is not always easy, and takes a very long time to build good working relationships (Kleinveldt, 2015; Kleinveldt, Schutte, Stilwell, 2016). Librarians' responses below supports what has been highlighted in the literature above:

UNIL1: *"But it is not easy to make them understand that the library is useful. They [PhD students and faculty] only go to the library after they didn't find help anywhere else. Researchers never start at the library as the first point of contact. The PhD students limit themselves by depending on the Internet only for the thesis or research project, so towards the end of their project they are informed by their supervisor they need more literature, now they rush to the library for this, at that late stage. They [PhD students and faculty] don't understand what we can do for them. The faculty don't realise the library's role in supporting them with research."*

UNIL2: *"It is interesting to see how PhD students' progress in their knowledge building, through our assistance or after we train them on Information Literacy. Some faculty are strong library users, others are not and often they are not interested in the library, and we wonder about those who are not. Faculty have a positive attitude, and rely on our support mainly for their teaching."*

UNIL3: *"I gave lessons in close collaboration with some teachers in my department for ten years on the chemical tools for research, how to save time, how to retrieve relevant information in factual database, and so on. I don't really know what is their perception of me… they have different point of view. Faculty members that worked directly with me find my support helpful."*

UNIL4: "*We work with the Comitato Scientifico (faculty board) representative of the library. I update researchers on new publications, and organise courses for PhD students to develop their information seeking skills. Faculty members tend to ask for information and not on how to find the information. I promote our activities clearly as well. Faculty now have a positive opinion, but before they were not so friendly, not recognising our professionalism."*

UNIL5: "*We do the reference services, and we support by purchasing specific research books. I don't know what the faculty's attitude is towards me supporting their research."*

The two librarians who indicated not knowing how researchers perceive their role is directly linked to what was previously mentioned by Ekstrøm**,** Elbaek**,** Erdmann and Grigorov (2016) about the gap existing between what researchers perceive the librarian can offer versus what the librarian actually can offer. As the IFLA (2016: 10) Trend Report 2016 Update points out with special reference to Europe, that the need for the future role of librarians and libraries to be made known to users as well as attention given to closing the librarian skills gap by working on new competencies to support researchers . However, it is later confirmed by researchers' responses that the role of the librarian is basically to provide information in the form of books and journal articles, dealing with subscriptions,

and training students. As previously discussed in Chapter 2, authors claimed that there is no model for supporting research (Fourie & Fourie, 2014; Fourie & Bakker, 2013), which perhaps is the reason for the gap that is widening between what librarians can offer in terms of research support, and what researchers perceive, as Ekstrøm**,** Elbaek**,** Erdmann and Grigorov (2016) claimed**.** Librarians' comments below also pointed to the old habit of researchers and students over time, that the library and librarian is the last resort in seeking information and support for research. Although one librarian earlier reported that specifically in that library, users preferred to consult a librarian instead of using illegal websites. In a previous South African study, a science librarian pointed out that Google is the first point of call for information by students, and that librarians should rather be in the spaces where students prefer to be (Kleinveldt, 2015: 123). Some further comments from librarians were:

UNIL1: *"Since the physical library moved out of the department to another location, many don't visit anymore."*

UNIL3: "*through the Facebook page I (and my colleague) recently communicate on the project "science on the web". There is also a blog where scientists debate scientific issues, OA project, and we participate in the discussion, through requests received by researchers."*

One librarian expressed playing a more proactive role than the traditional reactive role in the following:

UNIL4: "*Each department or research group has a website that shows research projects. I check these websites regularly to see where I can play my research support role, and I send emails to the groups to alert them to information resources."*

As much as this is the direction that librarians are heading according to IFLA 2016 trends, in Bologna the majority of librarians are content with the traditional reactive research support service. Perhaps this is so due to the culture and traditions of UNIBO being the oldest university in Europe, or perhaps the professional qualifications of a librarian plays a major role here. Some contradiction to the earlier comments from the research librarian in the South African study conducted in 2009 is quite thought provoking in the following: "My permanent engagement in research however does not include any formal academic qualifications" (Kleinveldt, 2009: 28), since this particular librarian was very proactive in research support services at CPUT. However in some instances the reactive way is better, not to create a nuisance. Later on in the chapter this assumption is confirmed by researchers not wanting to be bothered, that they prefer to approach a librarian only when the need arises….places the librarian in quite an awkward position, whether to be reactive or proactive. This leads to another inquiry as to what the ideal situation should be, in terms of librarians maintaining

good working relationships with faculty who appreciates the librarian stepping in, and let the rest be is perhaps open for further discussion.

Librarians were asked how their support was benefitting faculty and students' research. Table 6.4 highlights the themes that stood out from librarians' responses whom all mentioned different aspects such as "Ensuring access: Negotiating subscriptions with publishers", "Accuracy /quality of bibliography", "Information Literacy training" and "Create awareness". Only two librarians shared a theme "no feedback on effectiveness of my research support". Their further comments were as follows:

UNIL4: *"With regards to students in Bologna, no one has conducted research on the correlation between graduates and Information Literacy training, no data has been collected on this… However the accuracy of the bibliography is very important in the theses, in particular when published, and here the library or Information Literacy training has played a huge role in improving this."*

UNIL5: *"Our support do benefit our users, but still there is still lots of work to be done to keep student attention and create awareness of library resources."*

For librarians, receiving positive feedback from clients seem to be a rare occurrence, which do not necessarily mean that their support is not valued.

6.3.3 Technology trends in communication and supporting research

Librarians were asked how they felt about their profile and visibility on the web. Table 6.5 represents the themes identified from librarians' responses. Three of the librarians indicated that they had no profile on the web, of which two further stated that their "Contact details available on library website only." Themes that stood out from these three librarians were: "I don't feel like being visible", "Not much visibility", and "I don't like this".

In this context the overconfidence of librarian UNIL1 is open for debate to some extent: *"My users know how to find me when they need help",* especially later on when some researchers point out that they are not aware of the librarian who can support them with research. However, two librarians that are embracing Web 2.0 and social media specifically for supporting research expressed the importance of being visible on the web. The themes that stood out are: "Good interaction via Facebook page", "Different modes of communication: Preferred way by users", "Improve capabilities to answer questions" and "Digital conversations". Librarian UNIL3 explained further: "*I speak for the library not personally…For our community it is important to be updated through the Facebook about new publications, new events. Students often ask for assistance via Facebook."* Although the majority of librarians indicated that they had no web profile, a follow-up question asked librarians to indicate whether they used any social media or Web 2.0 tools for

supporting research. Compared to the responses in the previous question, there is some contradiction. Perhaps the previous question was not fully understood (or could be interpreted as the majority not in favour of being visible on the web but for the purposes of supporting research they are using various platforms), as now the majority of librarians indicated that they use social media or Web 2.0 tools to support research. Librarian UNIL2 further explained: *"The spoken policy in* [our satellite campus] *is not to have a Facebook page for the library, mainly because of maintenance".* One of the librarians who are not using any social media or Web 2.0 tools made the following comment:

UNIL5: *"No I don't use any. I think it is important, but if the library decide to function in this way by having a Facebook page for example, it is necessary to have a librarian competent in dealing with Social Networks. At this stage it is impossible for us to do it in the right way. I prefer only to explain the library website, which has all the information resources and library news or events."*

Table 6.6 illustrates the sites that librarians indicated they had profiles on. Of all the platforms that librarians are using, only "Google+ / Calendar / Drive" is used by two librarians, and librarian UNIL4 further explained: "*I use my Google account to support researchers, planning seminars on Google Calendar and linking PhD students and researchers through Google Drive"*. Other sites that was highlighted which links to the traditional research networking sites are: ResearchGate, Academia.edu, Mendeley and LinkedIn. One librarian mentioned that Web 2.0 was integrated into the Library Catalogue: "Sebina You" resulting in an interactive catalogue, and elaborated as follows:

UNIL3: *"We have a software named "Sebina You". From the Librarians side, we use it as cataloguing software that results – from the users' side – very visual and allows the users to use it as a catalogue interactive. In essence, we are dealing with a typical librarian tool – a catalogue – integrated with the social tools."*

Surprisingly, all librarians thought that social media enhanced their visibility on the web and one librarian added:

UNIL1: *"For libraries I think it could be useful, especially for assisting young users with mobile apps and the library has a catalogue app to access information resources."* However, some mixed feelings are expressed by librarian UNIL5 who added: "*The students like it a lot. It is necessary to dedicate a lot of time for interacting on social media, and at the moment we cannot, we are not able to."*

In terms of how social media enhanced research practices, librarians all responded differently as illustrated in Table 6.7. Here librarians all had different responses, some of the themes being "More user-friendly for young researchers", "librarians forced to adapt eventually", "improve knowledge of

professional practices" and "invisible college". The following comments points out the different opinions that stood out:

UNIL1: *"As I said it is more user-friendly in the young researchers' life. Social media is more entertaining for them and they are willing to embrace social media. Eventually we will be forced to adapt as our users become younger".*

UNIL2: *"I can't say for sure because I don't practice in an official widespread environment… But social media improves network between researchers – and also librarian profession. My knowledge of professional practices are greatly improved when interacting in social media personally, so I would assume the same for researchers".*

UNIL3: *"Previously, before the social media era, researchers were more "concretely" social as they met in the "real" library to discuss with the other researchers. We had a room dedicated to the reading of scientific journals, and researchers used it extensively, I call this a different kind of social media, forming the so called "invisible college" through direct exchange. At that point, the library was at the centre of the researchers' life. Now things are quite different."*

The librarian then continues to express some doubts about the usefulness of social media in research among researchers by saying:

"I'm not so sure on usefulness of social media for their research. I have some doubts. Because previously professors used to have direct exchange with other colleagues in the library's reading room – as the laboratories - where they debated the latest publications (in print version) they were reading. Now we don't know how effective the social media is in these kind of online discussion instead of in the direct confrontation."

UNIL5: *"I don't know at the moment, but in future yes it will enhance".*

Librarians were asked whether they were currently communicating with faculty about research and to give examples of specific aspects they were discussing. Table 6.8 illustrates the themes identified from librarians' responses. The main themes are: "Handle /respond queries" and "Promote information sources: Current awareness". A follow-up question asked librarians how they normally communicated with faculty and students. Table 6.9 highlights the themes in order of priority. The main modes of communication are still traditional, the majority of librarians communicating with researchers preferably via email and face-to-face contact. Although one librarian (UNIL5) pointed out not wanting to fill researchers' mailboxes, therefore emails are limited to overdue loan notifications only, which UNIL5 explains: "*I communicate via email only regarding overdue loans. It is very difficult to communicate via email because faculty mailbox is so full and we don't want to add too much to that."* This perhaps highlights that email is not the ideal mode of reaching out to researchers in a reactive or proactive way. Later in researchers' responses, it is pointed out by a Chemical Engineering researcher that there is a need for a university research blog, very much linking to the research trends, and practice of prosumerism on a different level using Web 2.0 tools

and social media already discussed in Chapter 3. Surprisingly only one librarian indicated using Skype to communicate with faculty about research.

Librarians were asked what their opinion was on being a contact on their faculty and students' social networking sites that they are specifically using for their research. Table 6.10 presents the themes from librarians' responses who all pointed out different aspects such as "Clarify legal position", "Future librarian's role", "Understand protocol of Social Networking Sites (SNS) for research" and "'Ask a librarian' on library website". Three librarians said it is "important" and one librarian said "Communicate via email only". Librarians elaborated further:

UNIL1: "*I have a Twitter account for personal use and follow a few librarians. But I don't know about our users having any of these accounts, we only communicate via email."*

UNIL2: *"But we need to clarify the legal position of social networks, because there is a grey area especially the Copyright Law."*

UNIL4: "*For example, on LinkedIn, I have been contacted by researchers at first contact, then we continue the conversation via email. I think it is better to switch from social media to email for continuing the conversation of research."*

UNIL5: "*We make use of the formal electronic reference "ask a librarian" where queries are received to ASDD and then directed to the relevant library."*

The theme, "future librarian role" very much links to the NMC 2015 Horizon Report, which highlighted one of the short-term trends of technology in higher education being "BYOD or BYOT to the classroom or learning environment" (Johnson et al, 2015: 36) as discussed earlier in Chapter 4 and the IFLA trend report 2016 update (IFLA, 2016) mentioned in Chapter 2. The concept of the role of the researcher as prosumer which was discussed in Chapter 4 was identified in responses by three UNIBO librarians and this has perhaps brought about changes in librarian approach to support tech-savvy users and independent researchers. Librarian UNIL1 mentioned that: *"…professors appreciate that they can retrieve online information on their own and anywhere"* and librarian UNIL3 claimed that: *"Young researchers are native Internet users, so this has changed my approach to supporting them"*. The rise of Web 2.0 and social networking sites contributing to researchers practicing prosumerism, and what is thought-provoking in the particular response by Librarian UNIL2 is that the librarian is wondering about her role in this trend: *"What we as librarians are observing is that researchers are finding information in research networks like ResearchGate. We as librarians are wondering how we fit into this new trend"*. Responses from UNIBO researchers in terms of not needing support from the library or librarian very much highlights what the librarian points out as being a concern in terms of where to fit in.

6.3.4 Librarian-faculty collaboration in research

Librarians were asked about what their thoughts were on researchers working together with them to enhance Library services for research. Table 6.11 highlights the themes identified from librarians' responses. Positive thoughts emerged from librarians' themes with regards to collaboration with researchers to support research in the area of "Collaborate in collection development: Budget planning" and "Information Literacy training", and further stressing the point in the theme that there is a "Need to work together". Librarians made further comments:

UNIL1: *"when the main library decide to introduce a new service, the department will then be approached to hear what they think. For example improving ILL services and discussion takes place higher up in the university through meetings"*

UNIL2: *"As a librarian I would be happy to collaborate to enhance services for research, I'm just not sure how."*

UNIL3: "*We need to work together to identify the best resources and how to deal with the vendors. And we do this every year when we plan the budget, we reflect with the faculty using the usage statistics."*

UNIL4: "*My opinion is that all users and librarians need to work together. Librarians offer services and the users who are prosumers, as they are called today, can give feedback. We work with the faculty committee who decides about resources to acquire."*

UNIL5: "*The students sometimes write to us about recommending a book, which is useful in collection development."*

Faculty-librarian collaboration is emphasised strongly in the literature as mentioned earlier especially in achieving the strategic goals of the university. Librarians were asked what they were currently collaborating on with faculty and students to enhance Library Services specifically for research. Table 6.12 illustrates the themes from librarians' responses. All mentioned that they were collaborating, and the main themes from responses are "Information Literacy training" and "Collection development". Further comments were:

UNIL1: "*Not through my personal intervention"*

UNIL2: *"There is the scientific committee who deals with this"*

UNIL3: "*this year I collaborated in two projects, the "thesis repository" and the "Erasmus Mundus project: chemical innovation and regulation" a course aimed at students coming from different parts of the world. My involvement in this Erasmus project is through training the students participating to the course and explaining to them how to search in the chemistry electronic resources."*

UNIL4: "*We have a specific project for databases or bibliographies, and we arrange training modules for this. We work together to support collection development and citation management tools, and plan training for PhD students. We collaborate with faculty committee to provide these training."*

UNIL5: "*It is difficult. I am part of the governing body which includes students and academics and we meet three times a year to discuss and decide on the library budget, information resources and opening hours. We also discuss new services or processes."*

Librarians were asked whether they discussed any Library issues or shared new ideas or discoveries with the faculty and students, and if so, to give examples. All librarians indicated they did. Table 6.13 highlights the themes from responses, the main one being "Faculty board meetings /governing body". The one theme that stood out was "Familiar with researchers: Informal coffee conversations". All librarians claimed that they are sharing knowledge and ideas with researchers. One comment by librarian UNIL4 that stood out was: "*We are quite familiar with the researchers, so we have informal coffee conversations which are very important, we exchange ideas",* relating to a kind of knowledge café, sharing ideas (which according to the researcher in her capacity as faculty librarian, can range from teaching, information tools, research, budget spending, collections, to ideas for the next assignment for students and so on) between librarian and researchers in a relaxed setting involving coffee. This links to the literature on Information, Network and Knowledge Societies (UNESCO, 2005). Responses by librarians later on confirms interaction with researchers about their research occurs quite frequently.

A question asked librarians how many times in the past year they had contact (in person, by phone or email) with faculty and students in connection with their research. All responded differently to this question with themes such as "countless", "weekly", "daily" and some gave actual figures. All librarians indicated the number of times in the past year that they had contact with faculty and students in connection with their research as follows:

UNIL1: "*Countless. 3-4 times a week".*

UNIL2: "*Weekly. 175 requests for our assistance from researchers via email. But the NILDE requests are much more".*

UNIL3: "*Daily, it depends, when assistance is needed by researchers".*

UNIL4: "50 times"

UNIL5: "*200 reference contact, 20 digital reference services, and daily email queries from professors about specific books or journal articles".*

These statistics provided by librarians suggest that there are quite a bit of interaction taking place regarding research related queries. Later on responses from researchers and students will determine whether there is a correlation.

6.3.5 Librarian collaboration in LIS research and Library Association

Librarians were asked what role the Library Association, Associazione Italiana Biblioteche (AIB) played in their profession to support research. Table 6.14 highlights the themes that stood out from librarians' responses, the main themes being "AIB mailing list", "Information forum /discussion about profession", and "Organise courses for librarians". The theme "Economic crisis- not much activity" somehow suggests there are underlying issues, which is further discussed in Chapter 8. There is a bit of mixed feelings or uncertainty about the role of the library association in the librarian profession to support research. This was pointed out by the UNIL1: "*I don't know exactly what role it should play for research support*" and UNIL3: "*There is a huge debate because a lot of my colleagues don't think that could be an effective advantage in attending the AIB."* Also, some librarians not realising the benefits of belonging to the library association which is a professional body was mentioned. That librarians don't see the benefit of the library association is open for further debate. The economic crisis seems to be restricting librarians participating in the library association activities as pointed out earlier. The following comment by librarian UNIL5 supports this: "*Sometimes I attend courses offered by AIB. But with the economic crisis, not much activity."* This poses a question whether librarians would be participating more in library association activities if there was no economic crisis, or are there other factors influencing librarians' decision not to get involved in a professional body is open for debate. On the other hand, the potential benefit of belonging to a library association is also pointed out by UNIL1: *"There is an opportunity to get useful information to support our profession"* and UNIL2: *"AIB works for librarians….I perceive a new line of work."* Ironically only one out of the five librarians interviewed as illustrated in Figure 6.1 is a member of the AIB library association and also realises the importance of belonging to this professional body. Librarians had the following to say, which to some extent contributes to the researcher suggesting there perhaps being some underlying issues other than the economic crisis that should be investigated further:

UNIL1: *"I don't feel the need to be directly involved. I prefer to see it from the outside, for political reasons."*

UNIL2: *"…ten years ago yes. I'm sorry to say it but in my opinion it does not play an important role to support research practices."*

UNIL5: *"The library [ASDD] has an institutional membership. But I don't have an individual membership. Because AIB have some problem too."*

Another question asked librarians whether they were participating in any research project or library association activities such as conference presentations. Only one librarian UNIL2 indicated being currently involved in a research project who elaborated: *"I am currently involved in a research project in NILDE, and in May next year [2017], I will be presenting on research preference of our users at a conference. We found in our research project that our users (limited to this library only), when they search for information for their research, they prefer to ask the librarian and use the library resources instead of the deep web or illegal libraries. But we think the trend is changing, we need to explore this more."* The research finding that users rather consult a librarian instead of illegal ways is indeed open for debate, as later, responses from PhD students contradicts this finding. However the librarian made it clear that the findings were limited to that particular library only. A study of the university as a whole might with regards to the use of illegal websites might reveal something completely different. For example the recent news on consulting illegal websites like Sci-Hub by researchers in Peru has been reported to be on the increase due to the access issues experienced at the moment after cancellation of Elsevier subscriptions in 2017 (Schiermeier & Mega, 2017). Perhaps this suggests that user information seeking behaviour could be both honourable and not, which links to the literature discussed in Chapter 3 that information seeking behaviour of users depends on circumstances when an information need is realised (Wilson, 1981). A remark by librarian UNIL1: *"Honestly I have no time, even if I have a desire to do this"* and perhaps also a remark by UNIL4: *"not currently. Many years ago I presented at the Library Association conference. AIB has regional sites and I get in touch regularly",* could be linked to overworked librarians which have been highlighted in several responses throughout the interview sessions with librarians. Nevertheless, librarians agree that it is very important to conduct research in order to better support researchers, which is in line with previous research findings conducted at CPUT in 2009, where the research librarian responded that "Librarians doing research is particularly important. I would not expect a research librarian to have anything less than a PhD" and the following theme based on further comments by the research librarian that "Faculty librarians have the same role as the research librarian. It is a whole-library responsibility" (Kleinveldt, 2009: 28). Although librarian UNIL1 previously indicated having no time, acknowledgement is given to other library colleagues who are conducting research: *"Many librarians in UNIBO do this. It can be useful for professional reading to read research articles on our field."* Other comments were as follows:

UNIL2: *"For research librarians it is very important. Research is changing, and the librarian need to change accordingly, by offering new services."*

UNIL3: "*because librarians know the needs of researchers with whom they are often in direct contact. For example, in my university, there isn't a clear policy for Open Access, so researchers don't realize*

the importance of hearing what librarians have to say or advise them on Open Access policy publishing. Researchers don't know our role, and this is a problem. There is no institutional pathway for librarians to get into the departments or faculty and to build good partnerships with the other actors especially in facing copyright issues, citation standards, bibliometric aspects linked to evaluation of research. There needs to be a referee for starting this initiatives."

UNIL4: "*because being involved you can experience the problems in research. Being involved in a research project means learning to work in a group and learning techniques and methodology. Real life experience makes a difference."*

Librarians were asked whether they thought it was important for them to conduct research in order to improve research support services. Table 6.15 illustrates the themes from librarians' responses, the main themes being "Useful and important", "Develop new techniques / Offer New services" and "Know the needs of researchers / Involvement in research". All agreed that it is important.

Another question asked librarians whether they were currently collaborating with researchers (locally and internationally) in their field specifically to support research. Only one librarian was not currently collaborating with anybody in the library field. Table 6.16 indicates the themes from librarians' responses, the main theme being "through NILDE". Two librarians made the following comments:

UNIL4: "*I usually collaborate with other Italian Chemistry librarians and the goal/aim here is to support chemistry researchers. I also subscribe to the mailing list "Chemical Information" - a discussion list moderated by the American Association of Research Libraries for Chemistry Librarians".*

UNIL5: "*Not in general. But in architecture there is a CNBA interest group for architecture libraries that our architectural librarian is involved in. I work with other colleagues at UNIBO on cataloguing antique books and another colleague is part of the collection development policy committee, and Information Literacy committee, within UNIBO".*

This is vital for building a knowledge culture within UNIBO libraries as best practices can be shared and discussion about solution to challenges is worthwhile for developments in the library profession.

6.3.6 Academic library trends in supporting research (OA, OS, RDM)

Librarians were asked what their opinion was on the advantages and disadvantages of Open Access publishing. Table 6.17 points out the themes that stood out, with themes for disadvantages shaded in grey. Only one librarian did not mention any disadvantages. The main advantages from librarians are "Free access to information", "Wider audience", "Reduced budgets" and "Good / Very important". The main disadvantages mentioned by librarians are "Impact factor issues / Low status" and "Author costs are high / who must pay?"

Librarians have different views on the topic of Open Access, which later in the chapter is similar to researchers' views in the Chemistry and Chemical Engineering discipline. Both advantages and disadvantages of publishing in Open Access journals were pointed out, with UNIL2 agreeing with UNIL3 that it is an area that needs more discussion and exploring with all stakeholders involved to find a better solution. Librarians elaborated further in the following comments:

UNIL1: *"I think that the risk is more on the researchers, the people producing the research."* The librarian points out that the library experiences budget cuts and through Open Access publishing is a way of dealing with this challenge. And with a further comment suggests: "*perhaps the authors are at a disadvantage because the publishers have tight conditions."* Here the librarian is perhaps referring to high publishing costs that the author needs to cover to publish in Open Access journals

UNIL2: "*I haven't explored it much"*

UNIL3: *It is a complex problem. The problem is this: OA could be the best way to the publication, but if we are talking of the Green Route. But Horizon2020 and other European directives, create a sub-market, the so-called hybrid OA model, and this is a problem. In fact the Hybrid and the Gold Open Access way to the publication are problematic option for the Authors and the Institutions – because of the high costs of publication they reduced budgets for research. If a researcher choose the Hybrid or Gold OA model, costs doubled, because the author pays the OA access cost, but, at the same time, the library have to subscribe to the same journal. It is a problem worldwide. I am not so sure that the Open Access Hybrid model is sustainable for a long time. We need to find a way to deal with OA publishers, because Green option is free and more open."*

UNIL4: *"Regarding innovations, OA is beneficial for developing countries and also institutions who cannot afford subscription costs." … The fact is that OA journals has not got much status.*

Here the librarian perceive that Open Access journals have low quality, no prestige… which later on in the chapter is pointed out as well by some researchers' responses on their perception of Open Access publishing.

UNIL5: *"It is a very important opportunity for researchers. We explain the possibility of Open Access, the university DL (digital library). We display on the library website OA Chemical Engineering journals. Specific training session on OA publishing are offered to researchers and PhD students by a librarian. The librarian explain the OA publishing options, such as green and gold options."*

A follow-up question asked librarians how Open Access was promoted to Chemistry and Chemical Engineering departments. Table 6.18 highlights the themes identified from librarians' responses, the main themes being "University initiative – website-AlmaDL" which refers to the institutional repository, "Current awareness of Open Content" and "Open Access publishing workshop".

All librarians responded to the next question which asked about their knowledge, perception and experiences of Open Science, that they had no knowledge or experience. The follow-up question

asked librarians what role the library played in promoting Open Science. Three librarians responded that the library didn't play a role in promoting Open Science.

Librarians were then asked what their perception, knowledge and experience of Research Data Management was and what role it played in supporting research, linking to another IFLA hot topic. Table 6.19 presents the themes identified from librarians' responses. Here librarians referred to their knowledge of the institutional repository for the uploading of theses and dissertations. Librarian UNIL2 claimed that the university [is collaborating with] the CNR who deals with RDM, while librarian UNIL 3 claimed that the Central Library Office managed this. One librarian claimed that according to her knowledge no RDM is practiced at the university. Three librarians indicated that they had no knowledge or experience with RDM. Comments from librarians supports this:

UNIL2: "*I'm not sure whether we are doing this in UNIBO libraries. But you can ask CNR, the Italian National Research Council library in Bologna deals with Research Data Management. In this library we only deal with thesis uploading into our repository."*

UNIL3: "*Currently, I only know the University of Bologna repositories, which are managed by the Central Library office. I participate in the uploading of theses and dissertations. In our University there is an office that deals specifically with data and research products."*

UNIL4: "*As I said before, my role is only supporting information. I think this is an area where librarians need to work together. Cooperation is not needed at the level of librarians, but at the level that co-ordinates libraries, which is ASDD: Area of Systems of Departments and Documents. As far as I know, there is no repository for data, only for publications. Some departments manage and store their own data and this is an internal practice."*

A follow-up question asked librarians what their opinion was on the library assisting with managing research data and whether they thought it is a function the library should be managing. Table 6.20 illustrates the themes identified from librarians' responses. The main themes are "Not enough knowledge: no experience", "The library should /could", "In need of RDM training" and "Library to get involved in new areas". One librarian chose not to respond to this question.

These responses are a clear indication where what is presented in the literature, or perhaps pointed out as current best practices by library associations, are completely out of sync with actual practices. That the idea of RDM services are only offered by a few academic libraries in the world, suggests that it cannot at all be a practice that can be generalised at this stage. However, librarian UNIL4 confirmed earlier being aware of the Horizon2020 report, which includes procedures for RDM as well.

6.3.7 Rating of academic library research support services

Librarians were asked whether they were satisfied with the functionality of the Library and to explain why. Table 6.21 illustrates the themes that were identified from librarians' responses. Two librarians said they were satisfied, two were partially satisfied, and one said never. The main themes that stood out from librarian responses were "Staff capacity", "Room for improvement" and "Need more visibility". Librarian satisfaction with regards to library functionality for supporting research is perhaps appallingly low**.** Some further comments from librarians were:

UNIL1: *"Enough is not enough – never. But considering the number of library staff working here versus the number of library users in our library, probably we are doing the best we can do. The more we can do, the better."*

UNIL2: "*I think we could improve on the visibility on the web and social sharing. There is also room for improving technical devices and infrastructure to support students"*

UNIL3: *"Because the library could have more visibility but at this stage it is still difficult for the library build institutional relationships, there is no simple way to collaborate with the faculty. The second problem, we do not have enough personnel, not a good turnover. In 2018 or 2019 we will have a collective library through the unification of the different chemistry libraries in a central location, which could then lead to a good staff complement, and offer a much better service to our users, I hope."*

UNIL4: "*I am satisfied considering the number of staff members because we are very few and try to cover all the needs, but it is difficult. We try to move more towards providing digital services"*

The mixed feelings regarding librarians' satisfaction with the functionality of the library is further discussed in Chapter 8.

A follow up question with a bit of a twist, asked librarians what library resources in their experience are mainly accessed by faculty and students specifically for their research. Table 6.22 presents the themes from librarians' responses, the popular resources being "databases" and "Web of Science / Scopus". The latter links to the new trend in research practices, research evaluation, visibility on the web, for academic promotion purposes, as well as confirming the role of the researcher as prosumer which was discussed in great detail in Chapter 4. Further comments from librarians were:

UNIL1: *"Researchers are always looking for the latest research on their research topic through online resources, mainly journals, because the books become outdated very quickly."*

UNIL3: *"Also databases such as SciFinder, ACS catalogue and Web of Science are used extensively by researchers."*

The borrowing of print books by chemistry and chemical engineering researchers are still very popular, although librarians point out that it is mainly for teaching, it could perhaps be seen as research that is directly linked to their teaching. This is later confirmed by a small percentage of

researchers surprisingly, who claims that their research is linked to their teaching. However a much higher percentage of researchers conduct research that has no relevance to what they teach, which they further state as being unfortunate.

Librarians were asked what research support services they offered in the past year. Table 6.23 highlights the themes from librarians' responses. The main themes are "Information Literacy (IL) training", "Inter-Library Loans (ILL)" and "Reference services". These relate very much to traditional library support services, meaning that it is not confirming what is found in the literature on state of the art research support services, but that these services are still relevant to the traditional activities of UNIBO. Table 6.24 highlights that the main research support services promoted by librarians is a combination of long-term traditional: "Database and Catalogue training" and current practices: "Institutional repository: theses searching" linking to the Open Access movement. Ironically none of the new research support services such as embracing emerging technologies, RDM, which are said to be the hot topics in academic libraries as discussed in Chapter 2 were mentioned by librarians here. However, librarians do seem to be open to providing new services such as RDM in the future provided they got training. This came out among other themes reported on earlier from librarian responses to whether the library should be providing RDM support. Other comments from librarians were:

UNIL2: *"We could be in need of training for Research Data Management. But it is something that we, the library should do. Because we need to support – faculty is overloaded with many duties, and administration."*

UNIL3: *"But I think that the library can help researchers to obtain bibliometric from Scopus or Web of Science. It should be a good thing for the library because the old ways (functions) are phasing out. We must find new areas to involve our users."*

UNIL4: *"The problem is that the focus is now on data, so the academic library must move in this direction to remain relevant."*

It links to the competencies reported on that a librarian supporting research should possess (ASERL, 2000) as mentioned earlier which highlights the importance of training and workshops for librarians to support research, and the IFLA trend report 2016 update even taking it a step further in identifying the need for new competencies (IFLA, 2016).

Librarians were asked to rate the library. All librarians gave the library an above average rating as indicated in Figure 6.2 in terms of research support and therefore did not have to answer the follow-up question which provided a list of possible reasons that librarians could choose and also a space to provide other (reasons not listed) or additional comments if they rated the library low.

The next question focused on possible research support services that acted as a type of 'wish list' that librarians could offer. Table 6.25 indicates a list of possible research support services in order of priority according to librarians' preferences. Librarians had to give a score for each research support service listed on the 'wish list' provided by either choosing: "very important" (which had a score of 1), "useful" (2) or "not important" (3). This meant that scores were calculated in such a way that the lowest number is more important (high ranking) than the higher numbers. The highest score (5) by librarians was given for "Ongoing updates on new information resources and database training" and "Advice on Open Access publishing". The lowest score was for "Advice on research proposal writing" and "Training on social media use for research", which links to previous responses by librarians who indicated that they were not using social media for research support and were not keen on using it. Later in the chapter scores from faculty and students will be highlighted to identify the views from users versus librarians in terms of level of importance of possible research support services.

6.3.8 Competencies for conducting and supporting research

Librarians were asked whether there are any areas that they needed training on that will assist them with supporting research. Table 6.26 represents the themes from librarians' responses. The main themes that stood out were "RDM", "Publishing process: especially OA publishing" and "English Language competencies". The point of needing to improve their English Language proficiency is crucial, to be able to assist the many international students at UNIBO already discussed in chapter 2 (Catana, 2014b: 345), but could also affect their participation in international professional associations' activity. One comment on the language issue from librarian UNIL5 was as follows: *"improving in the English language to better support international students. There is a need for us to speak English more".* Surprisingly only one librarian indicated the need for training on Open Science, when all responded earlier that they had no knowledge or experience on Open Science.

Another question asked librarians what other areas in the research process they thought faculty and students needed assistance with, which librarians or the library can offer in the future. Table 6.27 illustrates the themes from librarians' responses, the main theme being "Training on Reference management tools – Mendeley". Further comments from librarians were:

UNIL1: *"We are receiving more and more queries for instruments or tools that evaluate research, Bibliometrics and Altmetrics, and I am not well prepared for this. This is an area or service that might be useful in the future to offer researchers a Scopus report, and to train the department on the use of reference management tools such as Endnote and Mendeley".*

UNIL3: *"a policy for publication is important, how to deal with the journal publishers."*

UNIL4: *"In the area of internationalization – international collaboration. In the Chemistry curriculum, it is mandatory for students to spend 6 months in a laboratory in a foreign country. The library role is to get in touch with the international library to exchange services to support students during their exchange period."*

UNIL5: *"Most probably the Social media opportunity and providing Information literacy training for undergraduate students, not only for PhD students."*

That the "Training on Reference management tools – Mendeley" was highlighted as the main area that researchers and students need support on by librarians says something about the gap in providing services on 'old' research trends when benchmarked against fairly young higher education institutions like CPUT that have offered training on reference management tools for the past ten years.

6.3.9 Research support in policy building

Librarians were asked in what way their research output or their support contributed to guidelines or procedures in the university. Table 6.28 highlights the themes identified from the librarians' responses, the main theme which two librarians mentioned was "Library Committee deals with this". Librarian UNIL1 further states: "*when the UNIBO library work group deal with new procedures, I adopt it into the existing guidelines. I have not contributed in these work groups, I just adopt".* Perhaps this is because of a top-down organisational structure. The themes which stood out from the other three librarians who indicated their contribution are: "Improve catalogue interface project", "NILDE project – Managing Inter-Library Loans", "Research evaluation: Scopus /Web of Science" and "Internal library guides". Some comments from the librarians are:

UNIL3: "*I participated in two projects. The first is on how to improve the catalogue interface with the aim to evaluate the collections for decision-making and for maintaining and developing of the collections. The second project NILDE – Network for the Interlibrary Document Exchange -, is important for universities as is an essential instrument helpful in managing the Inter-Library Loan supplies."*

UNIL4: "*Through my contribution to the guidelines for researchers during the evaluation section. I mean, the evaluation includes a phase in which researchers have to verify their research/publications on Scopus and Web of Science, etc. They [the researchers] discover many citations with error, so we provide guidance to correct citation errors."*

UNIL5: *"We have collected a lot of information, and we write a lot of guides, but for internal use only."*

Librarians were asked about their opinion on whether research support enhanced teaching and learning in any way and how. The majority of librarians felt strongly that their research support enhanced teaching and learning. Table 6.29 indicates the themes that were identified from

librarians' responses. The main themes identified are "Information literacy (IL) training", "Library play an important role to improve teaching" and "Improve student learning". Some of the comments from librarians on how their research support contributed to teaching and learning are as follows:

UNIL2: *"because our Information Literacy training supports the output of students. IL training increases the students' awareness of writing and searching for reliable information sources…"*

UNIL3: *"This work [IL training] has supported the work of the teachers because it has improved the speed of the students learning."*

UNIL4: "*In chemistry, it is particularly important in laboratory practice when they need methodology papers, this may be a way to enhance teaching and learning."*

UNIL5: *"This library is able to achieve that objective now and more in the future"*

The theme "Independent information seekers: Enhance curiosity" suggests that librarians are contributing to the 'role of the researcher as prosumer' concept through IL training. This is a different angle or approach to how researchers are defined and perhaps have become prosumers through librarians compared to the discussion in Chapter 4. However one librarian UNIL1 was not sure whether research support enhance teaching and learning, points to a lack of librarian-faculty communication after IL training is conducted: *"I don't have direct experience, I don't know since I did not receive this kind of feedback".* The literature highlights how crucial communication is between faculty and librarians to enhance teaching and learning and research. It links to the previous comment by a librarian about engaging with researchers to find out what they need and want, relating to the research question of this study. Librarian acknowledgements are rare. It takes hard work for a librarian to get constant positive feedback from faculty or students, not unless there is a compulsory evaluation system of librarians' services or training in place.

Librarians were then asked how their research support improved student development and success. Table 6.30 highlights the themes identified from responses, the main three being "Information literacy training", "Effective database use" and "Literature searching – most important component: Search strategies". Further comments from librarians were as follows:

UNIL1: *"Success, I don't know how they succeed outside the university. We don't know if they wrote a good thesis. However we hope that our Information Literacy teaching played a role in their success, in the quality of their work. At this stage it is more hope than certainty. Certainly we have trained them on the instruments, the information tools."*

UNIL4: "*What I teach to students is to search for literature which is a research as well. In our Information Literacy training, we highlight searching for literature as most important component, to focus your research goals with search strategies."*

UNIL5: "*In the physical and digital library, the users find many information resources. The students mainly use ScienceDirect, limiting themselves, but when they come to the library for assistance in finding more information, the role of the reference service is vital to make users aware of other databases that they did not know of, such as Compendex."*

A question asked librarians how their research support contributed to community engagement. Table 6.31 provides themes identified from responses with the main theme being "Support society functions organised by graduates". Society functions refer to community or industry events outside of the university that graduates are participating in and they still approach the librarian for guidance on information sources, Copyright advice and so on. Librarians elaborate further:

UNIL1: *"I think that every part of an organisation contribute to the well-being of the community."*

UNIL2: "*So we are starting some initiative to support community engagement… through evaluation of information sources, social awareness is improved… starting with the student and I hope from them it goes out into the society."*

UNIL3: *"We reach out to the community, all community libraries affiliated to NILDE, more than 890 libraries, mostly scientific and academic libraries."*

UNIL4: *"Here in the library we have an interesting experience, because some of our previous students who organise society functions, ask our support. They keep in contact seeking expertise from the library for example on copyright issues, advice on commercial use of scientific results."*

UNIL5: *"So I would say through graduates we contribute to community engagement, when students apply their information literacy skills in the workplace."*

Librarians' comments about community engagement somehow links to the "Horizon2020 work programme 2016-2017 on Science with and for society", which aims to engage more with society through providing access to science research. There is thus a mind shift and a movement towards librarians' research support already reaching beyond the borders of the university which speaks directly to the Horizon 2020 discussion on Responsible Research and Innovation (RRI) being "a process for better aligning research and innovation with the values, needs and expectations of society" (European Commission, 2016: 6).

6.3.10 Likert scale statements

As described in Chapter 5, the aim of the Likert scale statements is to confirm or contradict previous responses by librarians by delving deeper into librarians' perception of their role in supporting research. Figures 6.3 to 6.15 of the **Appendix A** illustrates the librarians' scores per statement. The majority, 60% of librarians agreed with the statement: "I share knowledge about Chemistry or Chemical Engineering research with researchers", which confirms responses earlier where librarians indicated that they shared knowledge and ideas with researchers, and one even pointing that it occurs over coffee in a form of Knowledge Café setting. However it has been observed that this

statement is ambiguous therefore confusing to participants as it refers to librarians possessing the expertise to retrieve knowledge about the latest research in these disciplines that are shared with researchers. It could also mean librarians possessing background knowledge of chemistry or chemical engineering through qualifications. The majority of librarians disagreed with the statement "Now that researchers use the library website, they don't need to visit the physical library", which links back to a previous response where a librarian confirmed that invisible colleges took place in the reading room, and now with the new practices with social networking sites it is not clear whether these type of discussions which took place face-to-face is actually happening online… or it was just a matter of accessing publications quicker and easier. That most librarians agreed with the statement "The University needs to build a stronger research culture", emphasises the role of the librarian being significant more than ever with having to support research to achieve this goal of the university building a stronger research culture. Majority of librarians strongly agreed that "International collaboration builds a stronger knowledge culture in the library", that links to previous responses highlighting NILDE, chemistry librarian mailing lists internationally, also one librarian highlighting to support exchange students better through international library collaboration. However one librarian was undecided, perhaps linked to the idea that some responded earlier not being keen on embracing Web 2.0 or SNS that will increase visibility and international networks. It somehow contradicts the research practices already in place at this university where there are many international collaboration between Chemistry and Chemical Engineering researchers at UNIBO, which is later highlighted in the chapter. Here the majority of librarians agreed that "Research Data Management has become an important practice in supporting research". Even though earlier responses by librarians indicate that they had no experience or knowledge of RDM, and it not being practiced in their library, the need for training was realised. 80% of librarians agreed that "Publishing research in Open Access journals have increased citation counts", linking to previous responses from librarians promoting OA publishing and posting Horizon2020 documents (which addresses OA) on the university website to alert the university community. Also, the background section at the beginning of this chapter makes reference to UNIBO participating in 80 Horizon2020 funded projects, Horizon2020 funding having terms and conditions, one of them being OA publishing. Therefore OA publishing needs to be promoted.

Only two librarians agreed that "Having a research profile on social networking sites have increased the visibility of my work", the low number confirming previous responses on how librarians felt about their visibility on the web. Based on the IFLA trends, Horizon2020 documents, librarians soon

will need to adapt to the changing research environment and activities such as bibliometrics and altmetrics playing a vital role in the evaluation of research.

6.3.11 Additional Comments

Librarians were given the opportunity to make additional comments on the topic of supporting research. The purpose of asking for additional comments was to delve into any aspects that did not emerge during the interview and that could add value to the study. The themes that stood out as illustrated in Table 6.32 are "In need of new techniques to support research" and "Role clarification of librarian is important". Librarian UNIL2 acknowledged in the additional remark that it was time for change: *"We are in need of new ways of doing our work and providing research support services to our users, because our practices are old in my opinion".* Librarian UNIL3 raised quite a number of challenges that librarians are facing, but over and above made a crucial point that "*There is no clear policy, how the library can support research, or how - as librarians – we can be part of departmental or faculty meetings"* which should be noted and discussed further is Chapter 8. A thought-provoking point is made by librarian UNIL4: *"It is important to be conscious about new developments in chemistry research, and increase curiosity. For chemistry librarians in particular, their role is important in innovation",* linking to how librarians' support and skills can contribute to the Horizon2020 Responsible Research and Innovation (RRI) that researchers need to comply with.

6.3.12 Concluding remarks on Librarian responses

The findings by librarians that were reported on in this section has to an extent raised many questions for further debate, and for future research on the role of the academic librarian and the library as a whole, supporting research. Should the library and librarians really exert themselves in the area of research support is questionable considering the staff capacity situation and the heavy workloads raised by librarians. The findings revealed that there are gaps between the literature discussed and what is actually happening on the ground. These observations are further discussed in Chapter 8.

The following section reports on the findings from interviews conducted with the researchers and PhD students in Chemistry and Chemical Engineering departments at the University of Bologna.

6.4 Findings: The perception of Chemistry and Chemical Engineering researchers and PhD students

This section reports on the findings from interviews conducted with Analytical Chemistry and Chemical Engineering researchers and PhD students at UNIBO. The sample comprised of:

- Five Analytical Chemistry researchers coded as follows: UNIC1, UNIC2, UNIC3, UNIC4 and UNIC5. Researchers hold different positions from junior lecturer to full professor to create a balanced representation as described in Chapter 5
- Three Analytical Chemistry PhD students of which one is currently being supervised by a Chemistry researcher also interviewed in this study. Students are coded as UNICS1, UNICS2 and UNICS3, and are currently in their final year of their PhD programme.
- Six Chemical Engineering researchers who are coded as follows: UNICE1, UNICE2, UNICE3, UNICE4, UNICE5 and UNICE6, and hold different positions from junior lecturer to full professor to create a balanced representation.
- Two Chemical Engineering PhD students at UNIBO were interviewed, of which one is currently being supervised by a Chemical Engineering researcher also interviewed in this study as described in Chapter 5. Students are coded as UNICES1 and UNICES2, and are currently in their final year of their PhD programme.

As discussed in Chapter 5, the initial purposive sample selection was based a Bibliometric study to ensure a balanced representation of Chemistry researchers, including well-established independent, to average, passive researchers. However, due to some researchers declining to participate in the study, other researchers in the Analytical Chemistry section was approached. Some researchers chose to answer the interview questions as a self-administered questionnaire, therefore some questions were left unanswered and are indicated in the findings. The following section is arranged in themes in an attempt to answer the research question and sub-questions of the study. Tables and figures illustrating the analysis of the data referred to in this section are found in **Appendix A.**

6.4.1 The role of the researcher as prosumer

Participants were asked to describe their role as a researcher. Table 6.1A which is found in **Appendix A** illustrates the themes identified from Chemistry researchers' responses, who described different roles. The themes that stood out from one researcher were: "very independent", "no interaction with other researchers" and "no support needed", which somehow links to the traditional research practice, of working in isolation as described in Chapter 4. Table 6.1B illustrates the themes identified from Chemistry PhD students' responses, with students indicating their different roles, and stages in their research project. One theme that stood out was "Write research articles". Table

6.1C illustrates the themes identified from Chemical Engineering researchers' responses who also described different roles. The themes that stood out were: "Researchers are also teachers", "Heavy teaching load" and "Supervise PhD and post-doc students". Further comments from researchers were:

UNICE1: "*In Italy researchers are also teachers, since I started in the department in 2005, my role now is to supervise the research of PhD students and post-doc."*

UNICE2: "*My role is actually split into teaching activities and basic, fundamental and applied research, working with industry. Basically half and half. My time is devoted to teaching in the first semester. The second semester is quieter so I concentrate more on research because then all my teaching is done."*

UNICE3: "*I am a researcher, but I can work on research only for about 40% of my time. I am also teaching, supervising students and doing a lot of admin work*."

UNICE4: "*The first thing to say is that I am a part-time worker, which means I have little time for research. My teaching load is as much as a full-time staff member. I am a Research member in industrial safety with a minimum role…"*

UNICE6: "*Well I am a lecturer, actually a non-tenure track assistant professor. Half of my work is devoted to research in the area of process safety in bio- energy production processes ~~and~~. The other half is devoted to students.*"

Table 6.1D illustrates the themes identified from Chemical Engineering PhD students' responses, with students indicating their different roles. Themes that stood out was "Assist Masters students in the lab" and "Independent from researchers in the group". A further comment from one student was:

UNICES1: *I'm kind [of] independent [from] other researchers of our group; however I'm also interdisciplinary and my research [include] my background [and] the interests of the department.*

Participants were then asked to describe their current research practices and how it has changed over time. Table 6.2A presents the themes from the Chemistry researchers' responses with emphasis placed on how research practices have changed over time since they started conducting research. All researchers indicated that changes took place, each pointing out specifically in their niche areas, but also to how access to information has changed. The themes that were quite striking were: "Currently heavy teaching load: Don't care about publishing anymore", "Data handling is main part of my research practice", "Focus on writing grant proposals" and "Previously conducted a lot of research: Published many papers in the past". Some comments from researchers is perhaps worth pointing out to emphasise the impact of change, and the pressure of conducting research:

UNIC2: *"The changes are that since I started conducting research, I now manage a research group of 20 people. I apply and obtain grants at national level. For international grants, it is a problem to raise money. So I spend lots of time writing for grants. In the research revolution everything changes in equipment and techniques used."*

UNIC3: *"The most important point, and changes that happened, is to find and use information through computers, software. The main part of my research practice involves data handling."*

UNIC4: *"Initially, researcher at the National Council of Research (1981-1992) dealing with forage analysis: crazy for "pure" research, day, night, weekends, holidays, paper publication, congresses, international projects; 1992-1995: professor at the University of Reggio Calabria, food chemistry, days travelling back and forth, teaching duties, etc.; 1996-present, University of Bologna, much teaching duty, like to do research, but don't care anymore about publishing (I've already published some 150 papers)."*

Here the reality of the situation comes to light with regards to what is actually happening on the ground. The heavy workload issue is a point that comes out very strongly in the findings from the librarians and researchers in both cases, UNIBO and CPUT. It suggests an area of concern perhaps considering the high expectations that the literature presents, the pressure to conduct more research at universities to remain competitive that there is a gap, but are the heavy workloads taken into consideration? Are higher education institutions really able to keep up, considering staff capacity (both academic and support staff which includes the library staff capacity) versus student enrolment figures? The handling of data as a main research practice revealed by one Chemistry researcher confirms in a way the research trend, RDM.

Table 6.2B presents the themes from the Chemistry PhD students' responses with one of the themes highlighting "no change" occurred in research practices. Further comments from students were:

UNICS1: "*Half of my time is spent doing experiments in the lab, quarter is spent on data treatment analysis, writing manuscripts, preparing for conference presentations and teaching. At the beginning I did more research and lab work, now, towards the end, I am doing more writing*"

UNICS2: "*My first step was basically to conduct a literature review, and on the practical side of things, I was learning what is happening in the Chemistry department by working in the lab. I then started having an idea about my research project, and then started following the different steps in my research on the production of materials. It involved familiarising myself with the analytical techniques for characterising the material. I then participated in an exchange student programme in Edinburgh to broaden my knowledge of my field.*"

Table 6.2C presents the themes from the Chemical Engineering researchers' responses with emphasis placed on how research practices have changed over time since they started conducting research. All researchers indicated changes that took place, some pointing out aspects specifically related to their niche areas, but also indicated how access to information has changed. The themes that were quite striking was:" Technological developments useful", "My research practices

changed", "Changes beneficial to our research" and "Accessing library resources electronically now". Some comments from researchers that are perhaps worth pointing out to emphasise the impact of change, and the pressure of conducting research are:

UNICE1: "*I was a PhD student from 2000-2004, and 2005 I joined the faculty here. What changed here was that the depth of the research decreased. Methodology changed, before every research project started deep investigation of the state of the art, with literature review. Now we are forced to produce more papers. Previously we worked alone on research. Now we are a large group working on a research project than before. Now I manage the work rather than doing it myself. More people involved in a research project these days. Previously I was always doing theoretical work, 8 years ago we had no lab to do experimental work. IT developed, in the past we developed a programme internally in the department but we had to stop because technology changed alot, we can't programme modern software, we know longer have the knowledge to programme anymore*."

UNICE2: "*My main topic is analysis of solubility of gases of polymer and transportation of polymer materials, focusing on appropriate models… My research practices have changed a lot. I changed positions as well. So I do less experimental activity on my own, I'm co-ordinating more now. The modelling activity I am still heavily involved in. Most experimental machines we use are self-built, so some technological advances were clearly useful. It is detrimental as chemical engineers to characterise, and there are competitors. Material scientists deal with synthesising while we the chemical engineers deal with characterisation. Many apparatus are now commercially available than in the past, and this is one of the changes*."

UNICE3: "*Well my research practice starts from an idea which comes from anything, for example watching television and getting an idea from something that has nothing to do with chemical engineering, sometimes from work in my lab, which leads to thinking about how the idea can be taken further. I then start by reading up on the topic of the original idea. If it is feasible, I try to build a project. I started my research (PhD studies) in 1992, 24 years ago. My research practices have changed since then, mainly due to changes in technology of course. We used to work on paper, drawing graphs, and doing calculations. Now we do everything electronically, and it helps a lot, especially accessing the library resources. Even when one is looking for a document and your library does not have it, we can still get it through Inter-Library Loans, sometimes one receives the pdf almost immediately, and these changes are beneficial to our research.*"

UNICE4: "*My research activity is in industrial safety with specific focus on chemical plants / petro chemicals. My attention is on the risk of major accidents by toxic clouds or big explosions. I have worked on the development of procedures / methodologies to estimate these risks, also focused on the transportation of hazardous chemicals by rail, road, and sea. Now my focus changed a bit, to the environment. I started research in 1998, so it was still the beginning of the Internet. The use of print resources decreased, and Internet usage has increased tremendously. Of course the Internet introduced many possibilities for accessing information for research*."

UNICE5: "*My main subject is on concrete with recycle aggregate, the possibility of reusing waste through recycling is now very important. This is what has changed in my research area*."

UNICE6: "*There was a big change. Because I previously used to work in the lab, doing experimental research (focused on chemical reaction hazards. Since I moved to Bologna, my research is more computational and modelling in the field of process safety*."

Table 6.2D presents the themes from the Chemical Engineering students' responses. Here students had different experiences as illustrated in the themes "Research practice remained the same since I started" and "Research practice changed through gaining experience in scientific language". Further comments from students were:

UNICES1: "*At the moment I work in the lab doing experiments and do literature searches for my research project. My research practice is almost always the same since I started."*

UNICES2: "*I work on sustainable waste-based mortars for restoration of built environment which are inspired from ancient formulations. It has changed basically as I've got more experience and expertise in scientific language."*

Participants were asked how they felt about their research profile and visibility on the web. Table 6.3A represents the themes identified from Chemistry researchers' responses. The main themes were: "Availability of my research on the web is important" and "UNIBO website profile". Other themes that were thought provoking are: "Quality of my research is important", "Don't like social media" and "I don't care about visibility: My ego is satisfied". Some comments from researchers were as follows:

UNIC1: "*I think the only important visibility relies on the availability on the web of the products of my research (published papers) and on their quality."*
UNIC2: *"I only use the UNIBO website profile, I have an official web profile. I feel ok about it. I don't like Facebook and these things, probably I am too old."*

UNIC4: "*At present, I guess that from the conventional benchmarks my profile as a researcher is practically nil. I don't care about visibility, in any form. However, those who need to solve a problem call me, so my ego is satisfied"*

UNIC5: "*I am rather visible also because of my business activity on spinoffs."*

Table 6.3B represents the themes identified from Chemistry PhD students' responses. The main theme that came out of student responses was "I feel ok". Further comments from students were:

UNICS2: "*I have a web page where my CV and information about my research project is visible. My profile is open. I am happy to collaborate internationally and locally. It is a smart way of connecting people.*"

UNICS3: "*The research topic is not new but it can be applied for different applications. I just show my research profile on Research gate website*."

Table 6.3C represents the themes identified from Chemical Engineering researchers' responses. The main themes were: "My UNIBO profile low impact: not updated" and "It is quite good: people can access me via Google". Other themes that were thought provoking are: "Researcher's responsibility

to update research profiles to increase visibility", "Research group webpage improved visibility of lab activities" and "Good viewing/download statistics and citations report". Some comments from researchers were as follows:

UNICE1: "*It's quite good because you can search for me via Google and access especially my UNIBO profile which is good for students to access. It is up to us to update our research profiles though. If we don't, people won't see all our research publications*."

UNICE2: "*The UNIBO profile don't have a big impact worldwide at least. It is useful for teaching, but my research is not visible on UNIBO, it is not updated. The research group also have a webpage and is accessible to everybody, it has improved though in terms of illustration of labs and activities. I am not sure how accessible it is worldwide. Perhaps to Italian companies it is useful*."

UNICE3: *"I feel good and bad at the same time in a way that I am not so good at updating my website. So basically I need to update my website on what I am doing, but I need time. Sometimes I update it once a year, and by then, the information is already old… we are required to do this and it's beneficial, but I am not so consistent in these things."*

UNICE4: "*My visibility is limited. But my research group has a big visibility on the web. I think visibility corresponds to reality- a leading position in the field of industry safety in Italy and Europe and probably worldwide – this group – it is recognised…"*

UNICE6: "*I am happy of our website and in particular of personal page. I find very nice the statistics section, where you can check who was looking at your profile on a world map*."

Table 6.3D represents the themes identified from Chemical Engineering PhD students' responses. Themes that stood out from student responses were "Departmental website is not so visible" and "I feel good". Further comments from students were:

UNICES1: "*We have a departmental website but it is not so visible. Students get my contact details on this website, that's all. So I don't know."*

UNICES2: "*I feel good and it helps me to [collect] points of the achievements which are the mid-term and long-term plans for future."*

Table 6.4A indicates the "sites" that Chemistry researchers indicated they had profiles on. It is striking that only one researcher is using Social Networking Sites as indicated by the theme "LinkedIn, Facebook, ResearchGate, and LOOP". Three researchers indicated "I don't have any". One researcher suggested probably to choose at some point in the future "Probably I will go with LinkedIn". What was also thought provoking in the themes that stood out are: "No need for web 2.0 for scientific research", "Indirectly through colleagues: Research group Facebook page" and "I don't know what Web 2.0 means". The following comments from researchers perhaps says something

about not needing to follow the research trend, or the 'modern prosumer' behaviour, if it could be described this way:

UNIC1: *"I use only e-mail (since 1984) to exchange comments, manuscripts, tables of data and results with collaborators. I see no need of web 2.0 applications for a (serious) scientific research."*

UNIC3: "*No not at the moment, probably I will go with LinkedIn, but it is difficult to manage these profiles. I have a University of Bologna website profile."*

UNIC4: "*Don't use socials, don't know what Web 2.0 means. Only use chemical data bases (SciFinder, ScienceDirect, European Chemicals Agency, etc.)."*

UNIC5: "*Yes, I have my own profile on UniBO website and on my spinoffs. I also use LinkedIn, Facebook, Research Gate, and Loop."*

Surprisingly all Chemistry PhD students indicated "No / not for my research" as illustrated in Table 6.4B. However, in the previous response, one student (UNICS3) claimed having a research profile on ResearchGate. Further comments from students were:

UNICS1: "*Only what is on Scopus and Web of Science, and I feature on the website of my supervisor. So no I am not using social media because my research is very specialised. I do not need it at this stage in my career. Social media is not the proper way to find specialised information as it is not being used in an active way. I only bump into ResearchGate through accessing papers I need. I email the author directly if I need to read a specific paper*."

UNICS2: *"Personally I have not used this for research because I do not have publications at the moment. I use social media but not for my research activities. My idea is to have a closed group on Facebook and not a personal research profile. We have a departmental webpage on the university website where the research group is present, it is not well updated. I think that these profiles are more for researchers than for a PhD student because we are only concentrating on one project at the moment."*

It is perhaps striking that three Chemical Engineering researchers classify "UNIBO webpage" as part of Social Networking Sites used for research as highlighted in Table 6.4C. Another three researchers indicated "I am not active". The main tools that researchers indicated were "ResearchGate" and "LinkedIn". The following comments from researchers perhaps says something about not needing to follow the research trend, or the 'modern prosumer' behaviour, if it could be described this way:

UNICE1: "*ResearchGate. On LinkedIn as well but I am not active. I mainly use the UNIBO webpage*."

UNICE2: "*I had a ResearchGate account but I cancelled it because I received too many emails and requests. I was not getting much out of it, I was not satisfied, and that is why I closed it. I received too many silly questions. Clearly I am not able to use it properly. That is probably my main concern. I have a LinkedIn account but I am not active. But I think it is powerful, but more towards industry."*

UNICE3: "*I have a LinkedIn account, which I think is more useful for job seekers and I do not use it at all. I have an Academia.edu account but it is behind schedule because I have not updated my profile. Social media is good for networking only, good communication tool. I used a Facebook page for the*

summer school I was running and it was good for communication. But not as a research tool. I don't think Twitter / Facebook is good for research, or as a research tool."

UNICE4: "*No. I am registered on ResearchGate but not using it. It is not necessary in my opinion. I use the UNIBO profile."*

UNICE5: "*No, only UNIBO profile on the web."*

UNICE6: "*ResearchGate, very helpful. I started using it to maybe increase my citation counts but at this stage I don't have an answer whether it does. I receive requests for my papers from other researchers on ResearchGate and I am hoping that it leads to my papers being cited*"

Table 6.4D indicates the "sites" that Chemical Engineering PhD students indicated they had profiles on. Surprisingly only one student indicated "LinkedIn" but also said "not for my research". It is perhaps thought provoking that the other student indicated "No, I don't know them", again evidence of the pitfalls of participants choosing to treat the interview as a self-administered questionnaire which limits a researcher from clarifying questions. Further comments from students were:

UNICES1: "*I don't use any for research. I have a LinkedIn account."*

UNICES2: "*not actually; I don't know them."*

A question asked participants whether they thought that social media enhanced their visibility on the web, and surprisingly, there were mixed feelings. Two Chemistry researchers responded: "Probably/ it depends", another two: "Certainly yes" and one responded: "No opinion". Table 6.5A illustrates the themes that came out from responses, the main one being: "No relevance for scientific / established researchers". Two themes that are thought provoking are: "Concerned with reliability of information on Facebook for research" and "I already have my visibility without social media". Further comments from researchers are as follows:

UNIC1: "*Probably, but, as mentioned above, I think this issue is of no relevance for scientific researchers. In contrast, it is likely of some help for actors and market operators."*

UNIC2: *"It depends… I don't think it enhances my visibility as a researcher, I already have my visibility without social media, I'm an established researcher."*

UNIC3: "Certainly yes, I can only imagine that it does, since at this point I am not using social media. But just to say that I don't know how useful or reliable Facebook is in research, whether one can trust the information/facts posted there".

Table 6.5B highlighted the themes identified from Chemistry PhD students' opinion on the use of social media to enhance their visibility on the web and surprisingly all students responded "Yes I think so". However, two indicated "But At a later stage". One student elaborated further:

UNICS2: *"Yes I think it is something that can go more directly to the people. Most people are using Facebook instead of ResearchGate. In the future, yes it will be useful to spread my ideas for possible collaboration."*

Two Chemical Engineering researchers responded: "Yes", another two: "no", one said "It could work for job applications" and one responded: "Maybe". Table 6.5C illustrates the themes that came out from responses. Two themes that are thought provoking are: "It could work for job applications" and "Repetition of information". Further comments from researchers are as follows:

UNICE1: "*especially ResearchGate. I see people request papers from me and I answer questions to help. It especially helps PhD students. The main tool is my university webpage."*

UNICE3: "*It could for work if you use social media for job applications. I don't do it*."

UNICE4: "*I think there is a redundancy, repetition of information through social media. In my opinion, there should only be an official research profile on the university website. Social Media don't add value, there is no time for social media, it is not necessary.*"

UNICE6: "*Yes I think and hope so, that is why I decided to have this profile. I hope it is worth it."*

Table 6.5D highlighted the themes identified from Chemical Engineering PhD students' responses being "Not much: I don't use it at the moment" and "It can help".

Participants were asked how social media enhanced research practices. Table 6.6A illustrates the main theme identified from Chemistry researchers' responses being "Social media do not enhance my research practices". The following comment from one researcher perhaps suggests that the publishers are trying to encourage researchers to use social media:

UNIC3: "*Since I am an editor of a journal, I find that the publishers are very interested in using social media and think it is important. They [publishers] think there are good benefits for favouring relationships between scientists and publications."*

Two Chemistry PhD students indicated "Not at the moment" as Table 6.6B illustrated. Themes that came from the other student's response was "Important for external network building" and "Link between research and job opportunities". Further comments from students were:

UNICS2: "*If you improve your visibility not just internally, you have more options online for outside networks such as companies are important. LinkedIn is a maybe a good link between research and work /job possibilities."*

UNICS3: "*Not very important, it is just a network to briefly introduce about researcher's profile and research topic."*

Table 6.6C illustrates the different themes that came out of Chemical Engineering researchers' responses. Two themes that stood out were "ResearchGate idea could be interesting" and "Find useful information or ideas via SNS". The following comment from researchers are:

UNICE1: "*No, only to share publications*."

UNICE2: "*I have no idea. Seriously I am not so active on social media. I am not into social media. With regards to ResearchGate, the idea could be interesting, smart*."

UNICE3: "*Sometimes I find information through social media, Facebook groups of researchers, that is useful to look at for ideas*."

UNICE6: "*Not yet on this platform. Maybe I am not on that level yet. At this stage it has not lead to collaboration through making contact via ResearchGate*."

Themes that came from Chemical Engineering PhD students' responses as indicated in Table 6.6D were "I don't think they do" and "Through Collaborating or getting in contact with researchers in the same area". Further comments from students were:

UNICES1: "*I don't think they do because as I said I don't use it."*

UNICES2: "*just I can say in case of being in contact with other scientific groups that work on the same stuff."*

A question asked participants what their opinion was on the faculty librarian being a contact on their Social Networking Sites that they are specifically using for research. Figure 6.1A represents the themes identified by Chemistry researchers' responses. Two researchers indicated that it is not important, another two said they don't use SNS, and one indicated that it is working well, collaboration on the Library Facebook page. Further comments from researchers were:

UNIC4: "*Telling you the truth, social networking gives me hives..."*

UNIC5: "*My library has a Facebook page which I use, I post on this page, and they share my posts. And I share their posts."*

Table 6.7B represents the themes identified by Chemistry PhD students' responses. Two students indicated "Not applicable". It is perhaps surprising that one student indicated "It would be very smart" and "Librarian knows what is the latest research in our field". The student elaborated further:

UNICS2: "*It would be very smart if the librarian is present in the Facebook page of the research group. It will be very useful for information provision. The librarian knows better than us what the recent publications on our research area is."*

Table 6.7C represents the themes identified by Chemical Engineering researchers' responses. Two themes that stood out were: "Librarian not directly involved in my research" and "There is no need for another communication tool". However one researcher highlighted the positive side of this kind of interaction taking place through "It is positive: Librarians can endorse my skills". Further comments from researchers were:

UNICE1: "*I would find it strange since our librarians are not involved directly in our research so it will be uncommon."*

UNICE2: *"I don't have a specific thought on that, I don't see clearly now with regards to my research. The librarian is more of a guide, not directly involved in my research."*

UNICE3: *"I don't feel the need for another tool. We have a more personal way to communicate. But perhaps for other librarians and academics it could be useful."*

UNICE4: "*In my opinion it is not necessary."*

UNICE5: "*Not applicable. I don't use social media."*

UNICE6: "*I think it is positive. They can endorse some of my skills."*

Table 6.7D represents the themes identified from Chemical Engineering PhD students' responses. One student indicated "I think it would be a good thing". It is perhaps surprising that the other student indicated "No comment".

6.4.2 Researchers' perception of the role of the librarian supporting research

Participants were asked to describe their experience of the library supporting research as well as their perception of the faculty librarian's role in supporting their research. Table 6.8A highlights the themes identified from Chemistry researchers' responses. The main theme regarding their experience of the library supporting research was "use the electronic library resources". With regards to the librarian's role in supporting research, two researchers indicated "Rarely ask librarians' support for publications", another said "Librarian play a small role" and surprisingly only two researchers indicated "Librarian play an important role in supporting research". Some further comments from researchers were:

UNIC1: *"Only rarely I have to ask the librarians' support to get publications that I cannot download by myself in the web."*

UNIC2: "*We only use the electronic library resources. Only for old papers, we visit the physical library. We don't meet with faculty librarians anymore."*

UNIC3: *"In the start of my research activity, I dedicated a good part of my life in the physical library previously before the Internet. Now I access most of the information online. I still like to go to the physical library to browse books, because now I read articles online in my office. The librarian play a very important role in supporting research in information provision."*

UNIC4: *"They are helpful and kind."*

UNIC5: "*It's long while I have moved from traditional literature search on paper to digital searches. [Librarian play] Little role."*

Table 6.8B highlights the themes identified from Chemistry PhD students' responses. The main themes were "Providing access to full text articles" and "Positive perception: Very Happy with

librarian's support". However one student indicated "Only use electronic resources" and "Librarian play no role". Another theme that stood out was "But the book is vital for in-depth background knowledge: science behind the work". Further comments from students were:

UNICS1: "*Actually, so far the only interaction with librarians was through a paper I really needed. Very limited interaction. But my perception of the librarian's role is positive. I am very happy with the librarian's assistance.*"

UNICS2: "*The library is fundamental. Personally I think a PhD student need to have information from papers. I am always interested in the latest updates in my research field. But sometimes it is important to take a step back, and consult the book. Sometimes articles cannot give you the in-depth background knowledge, the science behind the work, therefore we need to consult books… and e-books are really beneficial. The librarian is useful, knows the collection. I believe that the librarian has the knowledge on information resources and tools, a figure [person] is very useful, saves us a lot of time. Direct contact is a good idea."*

UNICS3: "*I do not go to the library. I only use e-library or the Web of [Science], Scopus that I can access to download research articles. So the librarian has no role in supporting my research*"

Table 6.8C highlights the themes identified from Chemical Engineering researchers' responses. The main themes regarding their experience of the library supporting research was "I always use electronic resources for my research" and "I mainly use library printed books for teaching". With regards to the librarian's role in supporting research, researchers indicated "Library /librarian play fundamental role" and "We are lost without our librarian". Some further comments from researchers were:

UNICE1: "*I don't communicate that often with the librarian, only for requesting books*."

UNICE2: "*Clearly it has a fundamental role, resources are definitely needed. My experience of our physical departmental library is small, but plenty of books mainly for teaching and for research there are many electronic resources. The librarian is gorgeous, very helpful and incredibly effective. The big deal is if she is not here, we are lost. The NILDE system is super useful too, especially old papers that are not accessible here in Bologna, the librarian provide us with access through Inter-Library Loans services in a short period of time, it is very positive*."

UNICE3: "*The library we have here is very good, because of the infrastructures and the librarian. If the librarian is not able to assist, we could have all the best infrastructure of the world, but it would not help us. Without the expertise of the librarian, who saves us a lot of time we are stuck. The role of the librarian is very important and our librarian is very good, excellent actually*."

UNICE4: "*The library in my opinion is the librarian! I receive a lot of support from the librarian during my Masters, PhD and research activities*."

UNICE5: "*The library and librarian play a big role. I use NILDE as well which is very useful*."

UNICE6: "*Well I have very good experience, very positive, I get quick and precise responses from the librarian when I need help*."

Table 6.8D highlights the themes identified from Chemical Engineering PhD students' responses. Themes from the one student were "NILDE is very useful" and "Librarian play a positive role in my research". However one student indicated "I don't use physical libraries". Further comments from one student was:

UNICES1: "*My library offers a service, which is called NILDE, it is very useful because I can access information that our university do not have access to via this service. I ask the librarian to assist with research tools. I perceive the librarian's role as positive in supporting my research*."

Participants were asked what they perceive the librarian's role to be in supporting their research. Table 6.9A highlight the themes from Chemistry researchers' responses. The main themes are "Co-ordinate information resources" and perhaps appalling "Librarian role is not to support research". Over and above this, the following themes were thought provoking: "Librarians should be more actively involved in training in online learning environments" and "Librarians should be more actively involved in training in online learning environments", which raises more questions and further debate. Further comments from researchers were:

UNIC2: "*The librarian role is not to support research but to facilitate free access, to save money, to co-ordinate information resources*"

UNIC4: *"Again, if we are talking about experiments, a librarian has nothing to do, except helping the researcher in getting "difficult" literature (most of it can be easily downloaded from internet). The role is therefore marginal."*

UNIC5: "*Librarian can become more and more active on teaching digital tools and help spreading knowledge on research activities. For instance, they should manage department web sites."*

Table 6.9B highlight the themes from Chemistry PhD students' responses, the main one being "Information provision". Further comments from students were:

UNICS2: "*The librarian is useful, I understand that she cannot be an expert on all the different research areas. But probably her role is positive from a management point of view, for information and collections."*

UNICS3: "*because I never go to the library when I do my research here*."

Table 6.9C highlight the themes from Chemical Engineering researchers' responses. The main themes are "Important role" and perhaps surprising "The main role of the librarian is to train me how to retrieve information for my research". Over and above this, the following themes were thought provoking: "We need more librarians to support research beyond information provision",

"For young researchers and PhD students, the librarian role is crucial" and "Librarian knows better how to do some practical things". Further comments from researchers were:

UNICE1: "*The main role would be to show me how to retrieve information I need for research. How to reach that collection of standards for example. I don't see any other role to be honest.*"

UNICE2: "*It's good, she play an important role. But it depends on the resources. There needs to be more librarians to play a bigger role in supporting research beyond information provision, in an ideal world. Perhaps this is already happening at rich universities, I don't know.*"

UNICE3: "*Very important role*."

UNICE4: "*She has a big role. Now I am an old researcher, but for a young researcher and PhD students it is very important."*

UNICE5: "*Providing information, but also giving new ideas."*

UNICE6: "*The librarian plays an important role especially being interface for other libraries outside the university. They know better how to do some stuff in the practical things."*

Table 6.9D highlight the themes from Chemical Engineering PhD students' responses. One theme that stood out was "But too much work for librarian to support each PhD student". Further comments from students were:

UNICES1: "*It is beneficial. But I think for one librarian it will be too much work because we are many PhD students to expect her to support each research project*."

UNICES2: "*maybe sending very selective newsletters*."

6.4.3 Faculty-librarian Collaboration and communication

Participants were asked whether they were currently communicating with their faculty librarian about their research and to give examples of specific aspects they were discussing. Table 6.10A illustrates the themes identified from Chemistry researchers' responses. Three researchers indicated not communicating with their faculty librarian, one indicated not communicating on research, but on the book acquisitions and being the library referee, meaning library matters are communicated on. Only one researcher indicated communicating on literature searches. Researchers elaborated further:

UNIC1: *"I would not get any benefit from this practice."*

UNIC3: "*Of course not specifically about my research, but about acquiring books or finding articles. We have a special working relationship, because I am the scientific referee of the library in the Environmental Sciences department so I get in touch with the librarian frequently. So my position is a bit different from my other colleagues I would say."*

UNIC4: "*Communicating*" *seems to me a big word: when I need some information or need to find some literature I ask them, and they always help me quickly and usually with a positive outcome."*

UNIC5: "*I am almost 100% using digital searches and PDFs for literatures."*

Table 6.10B illustrates the themes identified from Chemistry PhD students' responses. Surprisingly all students indicated that they are not communicating with their faculty librarian about their research. The themes that were striking are "Not useful beyond information provision" and "May not know my topic".

Table 6.10C illustrates the themes identified from Chemical Engineering researchers' responses. One researcher indicated not communicating with their faculty librarian, two indicated not communicating on their research, and two responded that they were communicating with their faculty librarian. The main themes were "Only about information resources I need" and "Search strategies for information retrieval on my research". Researchers elaborated further:

UNICE4: "*I don't think she understands my research but I am in contact with her continuously. I think the library must also support my students because they can learn much, the librarian knows the collection very well. Research activity and support in my opinion is something which is too new for the librarian. But she knows the collection*."

UNICE5: "*Yes, currently communicating about the subject of my research, regarding what I want to know about the topic*."

UNICE6: "*Not really, but for teaching yes, I use many books and articles so we communicate about that for my teaching. Probably they know what my research is about based on my queries for information sources."*

Table 6.10D illustrates the themes identified from Chemical Engineering PhD students' responses. Surprisingly one student indicated not communicating with their faculty librarian about their research, the other student said "seldom". The themes that were striking are "Only when needed, when not sure of something" and "I only access online articles". Further comments from students were:

UNICES1: "*Not really, only when needed. When I have doubts then I do contact my librarian."*

UNICES2: "*I need very new articles which are available online."*

A question asked participants whether their faculty librarian was involved in assisting their research. Here surprisingly, the majority of Chemistry researchers indicated that their faculty librarian is involved in assisting with their research as illustrated in Table 6.11A. However, previously many indicated not communicating with their faculty librarian on their research. Further comments from researchers were:

UNIC2: "*We have no relations with people, only the uncommon requests"*

UNIC3: "*through information provision and suggestions for book selections. The librarian also assist me with using digital platforms and databases."*

UNIC5: *"They assist me with sharing posts in social media."*

Here surprisingly all Chemistry PhD students indicated "no", that their faculty librarian was involved in assisting their research.

Table 6.11C highlights that the majority of Chemical Engineering researchers indicated that their faculty librarian is involved in assisting with their research. However, previously many indicated not communicating with their faculty librarian on their research. One researcher indicated "no" and another, "not directly". Further comments from researchers were:

UNICE2: "*Not directly. I am asking, she provides me with the information. She knows the topics in the books, databases etc. she can advise."*

UNICE3: "*Yes, by providing me ways of how to find information or documents. So I search the databases on my own and download the papers. The ones that I can't access through our electronic resources, I request via NILDE. But sometimes I don't get information on a specific research topic, then I go to the librarian for assistance."*

UNICE4: "*Yes, if I don't know where to retrieve something, I ask her and she helps me."*

UNICE5: "*She assists yes. I ask for help and the librarian usually find a solution for me."*

UNICE6: *"Providing information yes, when I need books to be purchased. But not directly in my research. They assist me through training my postgraduate students on who to used library resources."*

Here surprisingly all Chemical Engineering PhD students also indicated that their faculty librarian was not involved in assisting their research. Students elaborated further:

UNICES1: "*No, the librarian is only involved in providing me with information."*

UNICES2: "*I've never met them."*

Participants were asked how they normally communicated with their faculty librarian. Table 6.12A illustrates the themes identified in order of preference. The preferred mode of communicating with the faculty librarian according to the majority of Chemistry researchers are through "Face-to-face preferred" and "Email". Surprisingly only one researcher is communicating with the faculty librarian via social media. The preferred mode of communicating with the faculty librarian according to two of the Chemistry PhD students are via "email" as illustrated in Table 6.12B. It is perhaps thought provoking that one student said "never". The preferred mode of communicating with the faculty librarian according to the majority of Chemical Engineering researchers are through "Face-to-face preferred" and "Email" as highlighted in Table 6.12C. It is perhaps surprising that no other

communication tool (eg: the Online Learning Environment or Social Media) is mentioned here, it is still very traditional. Researchers elaborated further:

UNICE1: *"I just go downstairs and ask her."*

UNICE2: "*depends on the requirement*."

UNICE3: "*or I just walk across to the library*."

UNICE6: "*Email first, or I call them because it is nicer, or face-to-face when I have more time, it is good to have that direct contact."*

The preferred mode of communicating with the faculty librarian according to one of the Chemical Engineering PhD students are via "email" and "Face-to-face" as illustrated in Table 6.12D. It is perhaps thought provoking that one student said "no comment".

Participants were asked what their thoughts were on librarians and researchers working together to enhance Library services for research. Table 6.13A illustrates the themes identified from Chemistry researchers' responses. Here, all researchers had different views. The one theme that was striking is "Never seen a librarian working together with a chemistry researcher: forgive my ignorance". Researchers elaborated further:

UNIC1: "*Librarians already know which services researchers ask them*."

UNIC2: "*If the librarian is an expert in administration to help us with the bureaucracy, and to contact and negotiate with publishers, it will be good."*

UNIC4: "*Never seen a librarian working together with a chemist researcher nor co-authoring a research paper. Even review articles are written by research leaders in that field. If nowadays is different, forgive my ignorance."*

UNIC5: "*Sharing titles and resources should optimize costs."*

Table 6.13B illustrates the themes identified from Chemistry PhD students' responses, the main one being "Could be helpful". However, one student indicated "Not necessary: wide field". A theme that stood out was "Approach for finding information".

Table 6.13C illustrates the themes identified from Chemical Engineering researchers' responses. Here, all researchers responded "It is a good idea". Themes that were striking are "To find out what researchers need is crucial" and "Librarian is active: stimulates us with new possibilities". Researchers elaborated further:

UNICE1: "*It is a good idea. Some of my colleagues are already doing that through meetings maybe once or twice a year where suggestions come from us to the librarians*."

UNICE2: "*At a certain point, the services and role of librarian are changing, so it is very useful to propose new services or promote electronic resources, making it more visible are important for researchers. To find out what is needed by researchers, it is crucial. Current awareness is important*."

UNICE4: "*It is very important. I am satisfied with the collaboration which is actually present here for me. I also see that collaboration has updated with time. Our librarian is very active, stimulates us with new possibilities which are great*."

Table 6.13D illustrates the themes identified from Chemical Engineering PhD students' responses. Here students' views are completely the opposite in the themes "Students need to talk more to the librarian about what they need". However, one student indicated "Not necessary: wide field" and "A PhD student should be independent". Further comments from students were:

UNICES1: "*It would be good because the students must talk more to the librarian and say what the problems are and how to improve."*

UNICES2: "*seriously? Meaningless; a PhD student should be independent I think."*

On the point of current collaboration with the faculty library to enhance library services for research, sadly only one Chemistry researcher indicated collaborating with the librarian for book acquisitions as the researcher is the library referee for the Chemistry department. Further comments were:

UNIC1: "*I need no particular service from the library."*

UNIC2: "*since I am the scientific referee. For instance, we collaborate on the selection of books, textbooks."*

UNIC4: "*It is not my duty. As far as I know, a colleague is responsible of the library*."

Similarly, all Chemistry PhD students indicated that they are not currently collaborating with the faculty library to enhance library services for research. Further comments were:

UNICS1: "*because I am ok with services."*

UNICS3: "*We almost only use the information from the articles that we download from the journals."*

Only one Chemical Engineering researcher indicated collaborating with the librarian only when identifying and recommending book titles to be purchased. Further comments were:

UNICE1: *"No, but other colleagues are doing this."*

UNICE3: "*No, we were never asked to do this. It could be something we can talk about in the future."*

UNICE5: "*If I see an interesting book, I will recommend to the librarian to purchase*."

UNICE6: *"If they ask me something I will contribute, but not collaborating at the moment."*

All Chemical Engineering PhD students also indicated that they are not collaborating with the faculty library to enhance library services for research. Further comments were:

UNICES1: "*No, no reason."*

UNICES2: "*no; never needed that."*

Participants were then asked whether they discussed any library issues or ideas or new discoveries with the faculty librarian and to give an example. Here the majority of Chemistry researchers indicated that they did not. Only one researcher (UNIC3) said yes and added: "*Informally yes. Sometimes I propose books on the history of science."* Two of the researchers who indicated "no" added the following:

UNIC4: "*No reason. May be I am not enough involved in this kind of talks."*

UNIC5: "*I basically search what I need through digital tools."*

All Chemistry PhD students indicated that they are not, with one (UNICS2) adding *"I have not have the chance."*

Here the majority of Chemical Engineering researchers indicated that they did not discuss any library issues or ideas or new discoveries with the faculty librarian. Only one researcher (UNICE5) said yes and added: "*Books for students and for research."* One of the researchers who indicated "no" added the following:

UNICE3: "*No. I have not thought of it."*

Both Chemical Engineering PhD students indicated that they are not discussing any library issues or ideas or new discoveries with the faculty librarian.

Participants were asked how many times in the past year they had contact with their faculty librarian in connection with their research. Figure 6.2A highlights that one Chemistry researcher had contact with the faculty librarian 50 times in the past year in connection with his /her research. Figure 6.2B highlights that one Chemistry PhD student had contact with the faculty librarian three times in the past year. Figure 6.2C highlights that surprisingly one Chemical Engineering researcher had contact with the faculty librarian 100 times in the past year in connection with his /her research. Figure 6.2D

highlights that one Chemical Engineering PhD student had contact with the faculty librarian twice only in the past year.

6.4.4 Chemistry and Chemical Engineering researchers and PhD students' perception of research trends

Participants were asked whether they published in Open Access journals and their opinion on the advantages and disadvantages of Open Access publishing. Table 6.14A points out the themes that stood out, with themes for disadvantages shaded in grey. In response to whether Chemistry researchers are publishing in Open Access Journals, two researchers indicated "no /not yet", one said "yes", another "not regularly" and one researcher said "It depends on impact factor and cost of OA publishing". Surprisingly only one researcher indicated an advantage of OA publishing in the theme "Advantage is that scientific research is freely accessible to the entire community". It is perhaps striking that the disadvantages far outweighs the one advantage of OA publishing mentioned, the main themes for the disadvantages being: "OA: Small impact", "I have to pay Publication fees: problem", "OA don't have good reputation: not recognised by scientific community" and "Public funding force us to publish OA". One theme that stood out is "We are pushed to look for highest impact factor journals to publish in". Further comments from researchers are:

UNIC1: "*Their impact on the academic community is generally small. Often they also require a fee for publication*".

UNIC2: "*It depends on the impact factor and the cost of publishing in an Open Access journal. If an Open Access journal has a low impact factor, then we are not interested. Open Access journals does not have a good reputation and not recognised by the scientific community. We publish only in prestigious journal. When applying for promotion, the h-index, impact factor is taken into consideration. I still prefer the old way. Some public funds, we are forced to publish OA, but not our problem at the moment."*

UNIC3: "*Yes I have published a few in OA journals, but the problem with Open Access publishing is I have to pay. The advantage is that knowledge on scientific results become part of the entire community. That of course is the main point, many researchers use public funds*."

UNIC5: "*Not regularly yet. We are so much pushed by looking to highest IFs. In general, Open Access journals still are relatively low IF journals compared to proprietary journals"*

Table 6.14B points out that the advantages expressed by Chemistry PhD students were "It is the way to go", "Very helpful to spread knowledge outside: industry benefit" and "Free access to information". The disadvantages pointed out were "Low impact factor of OA journals not good for my reputation" and "Author has to pay". One theme that was thought provoking is "Many options to

access full text: ILL, email a friend from another university, email author, or illegal website LIBGEN". Further comments from students were:

UNICS1: "*I published a couple of papers in Open Access journals. I think in the future it is the way to go. I think we should be free to decide where we want to publish. What matters is the reputation of journal. We have a number of workarounds when we as students do not have access to a particularly paper, for example through Inter-Library loans, but another common way is I email a friend who is studying at another university to share the paper with me, or I email the author directly to send me the paper, the last option is LIBGEN, the illegal platform for sharing papers. So either way, I manage to access the full text through one of these options. It is not good for my reputation to publish in an Open Access journal if it has a low impact factor."*

UNICS2: "*To me it is something very helpful to spread the knowledge outside. It is also very useful for industry who have R&D section can access OA journals, especially for small companies who can't subscribe to databases. The disadvantage is that the author has to pay who maybe don't have the funds."*

In response to whether Chemical Engineering researchers are publishing in Open Access Journals, Table 6.14C points out that three researchers indicated "A few yes", one said "yes", and two researcher said "no". Surprisingly only one researcher indicated only advantages of OA publishing while the rest of the researchers indicated more disadvantages than advantages. The main themes for the disadvantages were: "Author has to pay" and "Low quality: low impact factor". Themes that stood out are "People interested in my research are academics who can afford subscribing to journals", "Researchers in Chemical Engineering still stick to closed access publishing" and "No difference between closed access and OA, everything free through UNIBO". Further comments from researchers are:

UNICE1: "*Very few. Maybe I am wrong, but I don't like it very much, because I have to pay to publish OA. I don't think the review process is strict in OA publications because we are paying. It is like low quality work can be published because the author pays. We need to publish in high impact factor journals and most OA journals are not. The basic principle is good, but all the core journals are still closed access, and researchers in this field still remain publishing in these closed journals."*

UNICE2: "*No, but we are forced to do so because we are participating in the H2020 project and in that framework we will need to publish in OA journals. The disadvantages are that the impact factor is lower, and we as the author need to pay. I really don't see the advantages... most people interested in my research are academics and can afford to pay or do subscribe to the journals. But there might be other fields where Open Access is very important".*

UNICE3: "*Not much because I don't have money to pay for publishing in Open Access journals. The other reason is that it has a lot of crap, I receive so many emails asking me to publish my work in a journal that has no high quality or impact. I publish my work in reputable, high quality journals, if I had the money, I could publish in the same journal Open Access (hybrid journal), since this option is now available. With a grant I will be able to do that, but at the moment I can't afford it."*

UNICE4: "*This OA… My publications are governed by my chief who decides where to publish and I am very happy to obey him. In any case I think all universities have access to publications even if it is not*

OA. We publish in high impact journals because we are evaluated by the university on or research, and we need to maximise. In my opinion there is no difference between OA and closed access because UNIBO allows me to access an enormous amount of papers. For me, everything is free because UNIBO pays for me."

UNICE5: "*The disadvantage is that the author has to pay a lot of money. But if one is doing funded research then publishing Open Access journals are very useful."*

UNICE6: "*I think at the beginning the journals might not look appealing, when it is a new journal with no historical background. But OA makes my work available for anybody to access freely. Especially industry can access my research."*

Table 6.14D points out the themes that stood out, and surprisingly Chemical Engineering PhD students only highlighted advantages. The advantages that stood out were "Only tool we have for research" and "Save time". One theme that was thought provoking is "More responsibility on researchers to publish". Further comments from students were:

UNICES1: "*It is very useful. I think as a PhD student it is the only tool we have for research. We access for free."*

UNICES2: *"the advantage is that much time is going to be saved + more responsibility for researchers to publish."*

With regards to whether Open Access publishing play a role in building a knowledge culture in the Chemistry field, Table 6.15A highlights the themes identified from Chemistry researchers' responses, the main themes being "In the future maybe" and "Economic benefit: high subscription fees". Another theme that stood out was "information overload". Further comments from researchers were:

UNIC3: *"Of course it play a role in the economy. Open Access journals and books is beneficial when one looks at the high costs of subscriptions. On the other hand, we face information overload, which could prevent one from going in the right direction, I don't know. There is an explosion of journals."*

UNIC5: "*Because of the increasing costs for subscriptions to proprietary journals, I guess they will be the future. They shall also create more competition and contribute reducing costs of subscriptions."*

Table 6.15B highlights the themes identified from Chemistry PhD students' responses regarding the role of Open Content, indicating different, opposite views being "There is no difference: access all information without paying" versus "Play a vital role in my research". Further comments from students were:

UNICS1: "*In my daily practice, there is no difference. It is not easy to distinguish, since I access all my information without having to pay for access."*

UNICS2: "*I have downloaded so many Open Access papers. I recently downloaded a book chapter that was so important to my research. Open Access content plays a positive role in my research project."*

Table 6.15C highlights the themes identified from Chemical Engineering researchers' responses, the main themes being "A big role", "OA could be useful" and surprisingly "No difference between closed access and OA, everything free through UNIBO". Other themes that stood out are "Solution to university dealing with high subscription fees: still slow process: OA will eventually be beneficial for the whole university" and "Research community need to recognise the importance of OA". Further comments from researchers were:

UNICE1: "*Almost nothing at the moment. I also have to say that most interesting papers are in conventional journals. The university pays for these, so for me, there is no difference between closed or open access because everything is free for me. For me, everything is Open Access because I am at a university. But this administration of access to journals is not my problem…"*

UNICE2: *"It could be useful. But my research is specialised, so only of interest to the target audience, specific group of scientists, and not for the general public, related to universities who have subscriptions. Maybe I am missing the point…but my research related to academics. I am planning in the future to write reviews that will be more relevant for public and in that sense, OA will be useful*."

UNICE3: "*I think that Open Access could help. The problem is that [research] community has to recognise the importance of this. Like I said, the new grants require one to publish Open Access. So if you have the money, then it is good. Looking at the university paying high subscription fees for access to journals, this will be less and less required if we (the researchers) publish more in Open Access, and I know that it is still a slow process, but at the end of the day it will be beneficial for the whole university."*

UNICE6: "*it helps industry and community especially in process–safety to have access to research without having to purchase it.*"

Table 6.15D highlights the themes identified from Chemical Engineering PhD students' responses being "Very important" and "Firstly journals".

Participants were asked about their knowledge, perception and experiences of Open Science. The majority of Chemistry researchers indicated that they had no knowledge or experience. However one theme that stood out as illustrated in Table 6.16A was: "My students are heading in this direction". Further comments by researchers were:

UNIC2: "*I don't like it. People will see too early what we are working on. I prefer to publish first. It takes time to conduct the research and people can steal your work, so no I don't like this."*

UNIC3: "*My students are going in this direction. Also looking at the European projects moving in the Open Science, is important and beneficial I suppose. But I don't have personal experience at the moment."*

Table 6.16B illustrates the themes that came out of Chemistry PhD students' responses. The themes that are perhaps thought provoking are: "It is difficult: Don't think it is worth practicing this",

"Positive from a scientific viewpoint" and "Not good if research has commercial value". Further comments from students were:

UNICS1: "*I was not aware of it, don't have knowledge on this. It will be difficult, because research is very scattered, and it takes a huge amount of time to polish up and present them in a way that other people can understand. At this stage I don't think it is worth it to practice this*."

UNICS2: "*From a scientific point of view it is positive, you can get feedback from other researchers. In my case I have not participated in Open Science because I am involved with industry and working with confidential information. If it has commercial value then it is not a good idea to make it openly available.*"

Perhaps surprising, only two Chemical Engineering researchers indicated that they had no knowledge or experience. Table 6.16C illustrates the themes that came out of responses. It is thought provoking that the main themes are: "Better to publish" and "Peer-review publication is sufficient". Further comments by researchers were:

UNICE1: "*If you want to do something that you want to restrict, then register a patent. If not, it should be completely open…Science should be open to everybody.*"

UNICE2: "*I have no experience of this. Only through mainstream publications and conferences. But I have discussions with scientists in my internal research group. I am not confident on the web and putting my work out there before publishing. I am sceptical about this, people can steal my work. One needs to write in a specific format to put it out there. So it is better to write a publication."*

UNICE3: "*It depends, in my field all materials and equipment is expensive, it is an expensive research. If you have industrial money, then you can't do it. If it is patented, you can't practice Open Science. If you get a public grant, probably it will be fine."*

UNICE4: "*I don't think it is necessary to have this interaction while you are doing research, one should do this on your own. In my opinion when you publish a paper, so the comments you get in the review is sufficient on how you can improve."*

UNICE5: "*In my experience, one receive reviews fast which is very useful for publishing purposes in Open Access."*

UNICE6: "*I don't have any experience at the moment. My impression is that theoretically it sounds good, but practically I am not sure if this is good. I might be wrong. It could be good to get help from others, but then putting one's work in a format which makes sense, one cannot just put the work out there, it takes time to create a document so that people can have a discussion about*."

Both Chemical Engineering PhD students indicated that they had no experience or knowledge of Open Science as illustrated in Table 6.16D.

The follow-up question asked participants what role Open Science played in their field. One Chemistry researcher indicated that Open Science played "no role", two indicated "not relevant", another said "Still new so can't say right now", and one researcher indicated "don't know". Two researchers elaborated that:

UNIC1: “*as far as "open science" is meant as scientific divulgation*.”

UNIC3: “*We have just started so I can’t say right now*.”

Table 6.17B illustrates that two Chemistry PhD students indicated “Not practiced in department at the moment”. The other themes that are thought provoking are “Useful in applied science: crowdfunding is a form of Open Science” and “Not explored it: working with confidential information”. One student elaborated:

UNICS2: “*It could be useful in general or applied science for example crowdfunding, it is a form of Open science- the idea is open”*

Two Chemical Engineering researchers indicated that Open Science played “no role”, two indicated “Not much”, another said “Big role”, and one researcher indicated “I have no idea”. Researchers elaborated that:

UNICE1: “*Not very much because of patented processes and developed with companies so we can’t share anything in chemical engineering so we can’t share anything.*”

UNICE2: “*I am sticking to mainstream publishing and conference participation.”*

UNICE3: “*Not much so far. It could be more in the future but not now.”*

UNICE6: “*I have no idea, unfortunately I don’t know. But probably after this interview I will check this area.”*

Table 6.17D illustrates that one Chemical Engineering PhD student indicated “Could be useful”. The other student had no comment.

One of the questions focusing on the research trends discussed in Chapter 2, asked participants what their perception, knowledge and experience of Research Data Management was and what role it played in their research. Table 6.18A presents the themes identified from Chemistry researchers’ responses, the main ones being “play no role” and “no experience”. However the one theme that is thought provoking is “If you know what you are doing then you don’t have to manage anything”. Further comments from researchers are:

UNIC2: “Not for our case. There is nobody who control data before published.”

UNIC4: “My perception of anything dealing with "Management" is bad. I like to "do" thing, knowing what I'm doing, not to "manage" things, possibly done by others, which I know nothing of. As you probably understand, my opinion on RDM is baloney. If you know what you are doing, you don't need to manage anything: just do it neatly and answer the problem questions as faster and better you can, and that's it.”

Table 6.18B presents the themes identified from Chemistry PhD students' responses, who all had different views. Themes that stood out were "For reuse or verifying", "Extremely rare for researchers to want to access my dataset", "My data is stored on a cloud: possibility to share", "When collaborating with companies we cannot share data" and "Data needs to be accurate". One student elaborated:

UNICS2: "*Personally I store my data on a cloud. There is the possibility to share my data with the research group. With some activities we cannot share the data, especially when collaborating with companies. I think that Research Data Management is important to re-look at or check the data. One needs to be very careful when publishing data, it needs to be accurate. But RDM could be positive. For instance, if I access a good dataset that is five years old on my research, I could ask myself that what I am trying to do, is it really something new if there is a good dataset out there already?"*

Table 6.18C presents the themes identified from Chemical Engineering researchers' responses, the main ones being "Upload data as supplementary is important", "Data reuse: new research" "Data reuse: new research" and "No experience yet, but in future yes". However the themes that are thought provoking are "Having data means having power" and "Producing data is expensive: one needs to pay for access to data". Further comments from researchers are:

UNICE1: *"I agree with this practice. The dataset needs to be complete and one needs to update supplementary, such as data for reuse and creating new research, also for verification. It is a good idea to share raw data. Because another researcher can use my raw data and interpret it differently*."

UNICE2: "*I don't have any experience. The H2020 project we have just started, so we are not required at this stage to manage data. It could be useful."*

UNICE3: *"It is important. However Research Data Management needs some standardisation. Formats of data need to be consistent… and sometimes it is difficult when students use different formats which makes it difficult to read.*"

UNICE4: "*Having data means having power. Producing data requires resources, and it is expensive. It is obvious that a person has to pay for having access to data. I myself don't produce data, I work on data that is accessible in databases. If this data is not available, I work on fictitious but realistic data*."

UNICE6: "*No I have not been asked to do this yet but I am happy to do this. It is good for verification and for re-use. Sometimes I would like access to other researchers' data as well. I think it is very important to upload supplementary information with publications. Reproducibility is part of research.*"

Table 6.18D presents the themes identified from Chemical Engineering PhD students' responses. One student had no comment. Themes that stood out from the other student were "I didn't know it existed" and "Could be useful". One student elaborated:

UNICES1: "*I don't do it yet. I am at the beginning of my research. I didn't know that it existed. But I think it could be useful."*

Participants were asked what their opinion is on the library assisting with managing their research data, and whether they thought is should be a function of the library. Table 6.19A indicate the themes identified from Chemistry researchers' responses, the main one being: "Library could assist in online bibliographic searching". Further comments from researchers were:

UNIC1: *"I cannot figure out how a librarian could assist me in managing my experimental spectra or the results of my calculations. I probably missed the real sense of this question. The library could make a bibliographic research, based on keywords, to be further refined by a researcher."*

UNIC2: "*it is too technical, the library has no background to do this. The library does not know about my research"*.

UNIC3: "*I don't know because I have no experience of this. Most probably they [the library] have the competencies. But I also don't know whether scientists would want the library to handle their data, the library will need more personnel to do this. "*

UNIC4: "*They [library] do not assist me in data management. I do not think that data management should be a librarian duty, but I may be wrong."*

UNIC5: "*Digital searches in my field have reduced much the role of librarians in everyday activity. I believe they can be indeed useful in teaching digital search engines and organize digital sources."*

Table 6.19B indicate the themes identified from Chemistry PhD students' responses. Two students indicated "I don't think the library should" and one student said "It would be very good". Further comments from students were:

UNICS1: "*I don't think the library should! It is difficult data, sometimes it is even difficult for the person who collected the data, so it will be very difficult for someone else to handle that dataset, so it will add to the difficulties."*

UNICS2: "*It would be very good to upload the thesis and data in the institutional repository for PhD students especially because to start a project, one needs to see what other projects were completed in the department and access to datasets. Yes of course I think it should be a library function."*

UNICS3: *"Published articles from the department may already be managed.*"

Chemical Engineering researchers had mixed feelings which is evident in the themes: "Not sure about the library handling data: complex" and "Maybe it could be useful" as indicated in Table 6.19C. Further comments from researchers were:

UNICE1: *"Absolutely yes. Here the service is already available, through the uploading of theses and could upload supplementary material although this does not happen that much with my students. But I'm not so sure about the library taking on this function of data because it is too complex."*

UNICE2: "*Firstly I don't have direct experience. I'm not quite sure, I think it will be useful to some extent. However it will be hard to manage different kind of data… from different research fields… But me having no experience on this, it is hard to judge at this point."*

UNICE3: "*It could be a library function I think, but I think we will need far more library staff for this than we have. There should be an expert on Research Data Management. We need a professional for this because this needs to be done in a professional way*"

UNICE4: "*In my opinion it is not necessary*."

UNICE5: *"It is interesting. I'm not sure whether the library should, but perhaps this is a great opportunity."*

UNICE6: "*I don't know as I don't have experience, I don't know how much work it entails. I don't know if it is necessary or whether the researcher should be doing it themselves."*

Table 6.19D indicate the themes identified from Chemical Engineering PhD students' responses. One student indicated "I think it would be a good thing" and one student said "Not in my field". Further comments from students were:

UNICES1: "*I think it would be a good thing to store my data and so that other students could access my data in the future."*

UNICES2: "*not in my field; we rely more on labs."*

Participants were asked what percentage of their working year they estimate that they spend on research. Figure 6.3A represents the percentages indicated by Chemistry researchers. One research responded that there was not an actual percentage to estimate. Figure 6.3C represents the percentages indicated by Chemical Engineering researchers. The highest percentage spent in a year on research by one researcher was 60%, the lowest being 20%.

6.4.5 Faculty research informing policy or procedures

Participants were asked in what way their research output contributed to guidelines or procedures in the university. Table 6.20A highlights the themes identified from the Chemistry researchers' responses. Two researchers indicated "no contributions". A theme that stood out was "Works the other way: guidelines are set and researchers need to follow them". The following comments are thought provoking:

UNIC3: *"I think it is important from a scientific point of view to contribute by increasing the knowledge acquired by scientists. As you know, academics are rated on research output based on guidelines. For example we have to publish more in journals with high impact factor, these are measures set worldwide so we have to follow it. I think it works in the opposite direction, guidelines are set and researchers need to follow it in their research practices."*

UNIC5: "*My spinoffs are taken as an example for entrepreneurial activity in an academic contest."*

Table 6.20B highlights the themes identified from the Chemistry PhD students' responses. Here students had different opinions, such as "Not at the moment", "Only a small contribution" and "I don't know". The themes that are perhaps thought provoking are: "My research independent", "Pioneer in creating collaboration during my exchange programme" and "I just publish". Further comments from students were:

UNICS1: "*Not at this stage. I think it [procedures] is still very independent from my research."*

UNICS2: "*I am only making a small contribution. From my project and the exchange period, I was the pioneer for creating the collaboration between the two universities. My most important contribution was making collaborations real, which led to real-joint publications and open channels.*"

All Chemical Engineering researchers indicated different themes as indicated in Table 6.20C. A theme that stood out was "My research made a huge contribution to industry and Italian Law". The following comments are thought provoking:

UNICE1: "*No, I think it's quite uncommon in my research on industrial safety*."

UNICE2: "*From an experimental point of view, all apparatus are self-made. Previously I was building apparatus that was useful for the research group and establishing procedures for the lab. Modelling activity [?] recently we have employed a basic theory, proved to be very effective for transport in polymer, clearly a procedure that can be useful for anybody in the world. Everybody can make use of this, a software can be developed from this. It is just a simple idea, but nobody has thought about it."*

UNICE4: "*My procedures are technical. The results of my research and the research group have not affected procedures in the university. But for industry my research has made a huge contribution especially in Italian Law."*

UNICE6: "*Since I just started 3 years ago, my research has not made such contribution yet."*

Table 6.20D highlights the themes identified from the Chemical Engineering PhD students' responses. Here students had different opinions, such as "Not yet, hopefully in the future" and "Use a simple approach to solving a research problem". Further comments from students were:

UNICES1: "*Not yet, hopefully it will in the future*."

UNICES2: "*I do have a simpler look to the problems as I am coming from another field; then I do make the problems simple for myself. This is a step forward to relate readers from other fields + my orientation to application*"

Participants were asked about their opinion on whether research enhanced teaching and learning in any way and how. The majority of Chemistry researchers felt strongly that their research output enhanced teaching and learning. Table 6.21A indicates the themes that were identified from Chemistry researchers' responses, the main ones being: "Stay updated in the field to teach new

concepts" and "A good teacher conducts research". Some further comments from researchers placed emphasis:

UNIC1: "Of course, but only on a long-time scale and with reference to important discoveries."

UNIC4: "Absolutely, yes. My research experience helps my teaching 100%. Supervised about 80 experimental thesis (former 5-year laurea, 3-year- and magistrale laurea, doctorate, specialization in analytical chemistry). I use examples from my practical experience to help students understand how what they learn can be put in practice and how analytical chemistry can be a powerful tool of success in their career as chemists."

UNIC5: "*It is fundamental to keep updated and give student updated teaching of scientific topics."*

All Chemical Engineering researchers felt strongly that their research output enhanced teaching and learning with the response "yes for sure". Table 6.21C indicates the themes that were identified from researchers' responses, the main ones being: "Easily give examples in teaching" and "Research is fundamental for teaching and vice versa". One theme that was thought provoking is "My research different from what I teach". Some further comments from researchers placed emphasis:

UNICE1: "*When you research on industrial safety and you have to teach, you can easily give examples to students in one's teaching, especially when you explain methodologies, it is easier to explain.*"

UNICE2: "*Research is fundamental for teaching and vice versa. It gives you ideas of what are the needs, to keep up to date, and bring to the students practical examples. Although not all my research activity is directly linked to my teaching."*

UNICE3: "*I teach two masters final level modules which are research intensive and connected to research on bio-separations. Since I also do research in bio separations, is quite a young field, it is research connected. So many discussions are taking place at conferences on this. So I show what I see or discovered, either through my research or what I learned at conferences, to my students. From what I see from conferences, from literature, I update my lessons and teaching material*."

UNICE4: "*I teach Masters level which is more advanced. There is the possibility to not only introduce fundamentals but also to explain deeper. There is a connection between teaching and research activity.*"

UNICE5: "*through sharing new ideas.*"

UNICE6: "*Well what I teach is different from what I do research on. So I would say that it has any connection in my case. But in general yes research would improve teaching yes. I would love to teach my research field, but I am teaching more basic things at undergraduate levels, more fundamental things and it is not easy to include my research.*

Participants were then asked how their research output improved student development and success. Table 6.22A highlights the themes identified from Chemistry researchers' responses, the main one being "Graduates get good positions based on research conducted in my lab". Only one

researcher indicated that “it did not”. Another theme that stood out was “My Scientific methods is critical in data”. Further comments from researchers were:

UNIC1: “*I wonder if we are confusing advanced research and fundamental education*.”

UNIC3: “*In the teaching and thesis activity is very important, my research does improve student development and success, especially in scientific methods – critical in data.*”

UNIC4: “*First of all, all my good-excellent students, that is those who have studied my subjects or have done their experimental thesis in my laboratories, never faced a problem finding job, some even had the opportunity to choose among several offers, which is remarkable in days of general whining about lack of jobs for young people. Secondly, and particularly those who have done their experimental thesis in my laboratory, occupy positions of responsibility in private laboratories. I am regularly asked for young analytical chemists by companies. Finally, with two students of mine, have founded a university spin off in 2002, which has increased some 60-fold (sixty) its value in about 12 year activity. Overall, three former students of mine have lived (and one still is living) on the spin off activity during about 13 years.”*

UNIC5: “*Thesis (BS, MS and PhD) projects have supported their CVs for seeking highly-specialized positions”.*

Table 6.22C highlights the themes identified from Chemical Engineering researchers’ responses, the main ones being “By teaching students to apply the fundamentals to improve their research” and “Students doing research in my lab is good for their development and success”. Another theme that stood out was “Students get good positions all over the world through my research networks”. Further comments from researchers were:

UNICE1: “*If I am able to teach them how to apply fundamentals they are able to go further than me and improve their research in the future. My research helps them.*”

UNICE2: “*Specifically the students who are doing Masters and PhD, just by doing their research activity here in my lab is good for their development and success. It was clearly a plus for students.*”

UNICE3: “*I have students who do their final thesis in my lab. Material from the best thesis can give rise to a scientific publication. With regards to my past students, they have very good positions around the world. I have many contacts with colleagues all over the world and there is a mutual student exchange with them, so I would say that students can really benefit through my support and my contacts. My former students are really doing well*.”

UNICE4: “*I am the tutor for student internships in industry so through my strong connections with industry and public authorities influences student development. There are norms that must be followed by industry and I have strict connections with these*.”

UNICE5: “*My research helps students to become engineers and know how to use these materials*.”

UNICE6: “*When I advise students on research projects which relates to my research. I think that they come out with several skills through my guidance.”*

Participants were asked how their research output contributed to community engagement. Table 6.23A provides themes identified from Chemistry researchers' responses. It is perhaps surprising that two researchers indicated "No / No opinion", one responded "Sometimes" and two researchers said "I hope so". Further comments from researchers were:

UNIC2: "*Sometimes we do applied science / methodology that are appealing to the community that can appreciate our findings. For example NASA*."

UNIC3: "*In my academic research relating to applied activities such as renewable energy, I hope that it contributes to the community and the environment*."

Table 6.23C provides themes identified from Chemical Engineering researchers' responses. Three researchers indicated "Yes definitely", one responded "Maybe" and two researchers said "Not much". One theme that stood out was "My ultimate research goal is protect community". Further comments from researchers were:

UNICE1: "*We are involved in teaching programmes for firefighters and the protection agency etc., so we provide guidelines."*

UNICE2: "*My research is more basic, but it can also be applied, but not so much."*

UNICE3: "*Because of the field, it is very specific, not seen as community research, it is mainly industry related."*

UNICE4: "*The community and the environment can be affected negatively and experience damages by major accidents. The ultimate aim of my research is to protect the community."*

UNICE6: "*my research, in process safety is based on the matter of community engagement*."

6.4.6 Competencies for conducting research

Participants were asked whether there were any areas in the research process that they needed assistance with, and whether they would like the library or faculty librarian to assist. Table 6.24A highlights the themes identified from Chemistry researchers' responses. Two researchers indicated that they needed no further research assistance from the library or the librarian. The three researchers indicated different needs, the two themes that were striking is "Open Access publishing guidance" and "Librarians in other departments for information provision on financial /business science". Some further comments were:

UNIC2: "*The library must help us more with accessing resources not available in UNIBO faster, almost in real-time, and from any library around the world for free."*

UNIC3: "*I would like the librarian to provide training on Mendeley, and Open Access options. All these new electronic platforms I would need training on."*

UNIC5: "*Librarians working in other Department might help. For instance on searching literature on topics such as financial and business science*. *They may suggest me best resources for a given literature search."*

Table 6.24B highlights the themes identified from Chemistry PhD students' responses. The themes that stood out was "IL training for PhD students", "Discovering databases through my supervisor" and "Public dissemination". One student indicated "Now No need". UNICS2 commented "*It would be good for the librarian who has the expertise to train PhD students on information resources and referencing. Because I have never received any training from the library, I was discovering the databases through my supervisor referring me to the platforms to search."*

Table 6.24C highlights the themes identified from Chemical Engineering researchers' responses. Two researchers indicated that "I can't expect the library/librarian to assist in other stages of my research". Four researchers indicated different needs, the two themes that were striking is "Librarian could assist academics in teaching with technology" and "Proofreading perhaps". Some further comments were:

UNICE1: *"I can only imagine assisting with referencing, Mendeley. But my research is too technical and so I can't expect the library or the librarian to assist in other stages of my research."*

UNICE2: *"Manpower for librarians are limited so there are no way that the librarians can do more… I am aware that they are running workshops for 1st year PhD students and young researchers. Of course it will be ideal to receive assistance from the librarian in all phases of my research process, but I cannot expect one librarian to do this for all of us researchers who are all working on different research niche areas."*

UNICE3: "*Nothing I can think of, besides the librarian teaching my students Information Literacy*."

UNICE5: "*Improve the way to do lessons, and if possible the library could assist with this, perhaps guiding us on teaching with technology*."

UNICE6: "*Maybe proofreading if they could, I'm not sure whether librarians are meant to do this."*

Table 6.24D highlights the themes identified from Chemical Engineering PhD students' responses. Themes that are perhaps thought provoking were "Access to Chemistry information resources" and "Researchers should be independent of librarians". Students commented further:

UNICES1: "*The Chemistry area, because there is an overlap with chemical engineering. So access to more information on chemistry information resources will be useful from our campus library, and not just chemical engineering information resources."*

UNICES2: "*I repeat. I think researchers should be independent of librarians -they should be librarian enough!*"

Participants were asked whether they were engaged in a research project at the moment. Here all Chemistry researchers indicated that they were currently busy with a research project, with one even adding that he/she is currently busy with several. All Chemical Engineering researchers also indicated that they were currently busy with a research project.

Participants were asked whether they were collaborating with other researchers locally and internationally in their field, and if so, how they got in contact with them. Table 6.25A illustrates the themes identified from Chemistry researchers' responses. The main themes were "Meetings/ Conferences", "Email", "Through the literature" and "Collaborative research publications". Table 6.25B illustrates that all Chemistry PhD students are involved in collaborative activities in the Chemistry field. The main contact was "Through my supervisor". Table 6.25C illustrates the themes identified from Chemical Engineering researchers' responses. The main themes were "Conferences" and "Through colleagues". Some further comments by researchers were:

UNICE2: "*Locally in the department, CNR (National Research Council). Internationally – I spent time in the States, conferences, and visiting professors to Bologna presenting at seminars in our department*."

UNICE3: "*Locally by telephone and personal meetings and email as well. I also identify authors from publications and approach them by email, and sometimes meet at conferences*."

UNICE4: "*My colleagues who worked or studies with me, they are all working in industry, so I know them through personal contact."*

UNICE6: "*Locally through my supervisor. Internationally because I knew them because of my former positions or I met them at conferences."*

Both Chemical Engineering PhD students are involved in collaborative activities in the Chemical Engineering field. The main mode of contact as illustrated in Table 6.25D was "Through my supervisor" and "Conference". Students elaborated further:

UNICES1: "*Yes, PhD students from the environmental department and medical school. I got in contact with these collaborators through my supervisor."*

UNICES2: "*with some research institutes. One of them I knew before starting my PhD; the other one linked in a conference in Ravenna."*

With regards to who provided participants with information on their research, Table 6.26A highlights the themes identified from Chemistry researchers' responses. The main themes were "By myself: accessing scientific publications" and "Scientists working on the project: collaborators". It is perhaps appalling that only one researcher indicated "Sometimes I ask the librarian". Table 6.26B highlights

the themes identified from Chemistry PhD students' responses. The main themes were "By myself through journals" and "Co-workers / PhD peers". UNICS2 commented that: "*At the beginning I relied on my supervisor. But in general the student has to create his/her own steps. So I have to find out by myself information about my research area. I also consult colleagues and other students for information. From the librarian, assistance with access to information resources."* Table 6.26C highlights the themes identified from Chemical Engineering researchers' responses. The main theme was "Do it myself". Surprisingly three researchers indicated "Ask librarian for information resources". Some further comments by researchers are worth noting:

UNICE1: *"I first do it myself by searching for literature, then ask colleagues and consult the librarian for articles."*

UNICE2: "*By myself, and the librarian when I need books."*

UNICE3: *"Researchers and colleagues. And librarians only for the background information but not on the real research."*

UNICE5: *"We have meetings to discuss the state of art and see how we can contribute – researchers and industry discuss and unpack aspects for research. We start from a problem and then look for a solution.*"

Table 6.26D highlights the themes identified from Chemical Engineering PhD students' responses. The main themes from one of the students were "My professor", "PhD students" and "Librarian". The other student had no comment, surprisingly.

6.4.7 Rating library research support services

Participants were asked how they use the library to benefit their own research. Table 6.27A illustrates the themes that were identified from Chemistry researchers' responses, the main ones being "Electronic resources only" and "If I had more time, I would enjoy browsing journal issues /books". Further comments from researchers were:

UNIC3: "*Well if I had more time, I enjoy to browse the journal issues. Unfortunately now I have to use keywords to retrieve articles which in a sense is an advantage to get to the specific information faster. However, the disadvantage is that I miss out on other articles published in a specific journal issue because of this. I lose the serendipity of browsing a journal, miss out on the editorials where one can get ideas, when I search using keywords to retrieve journal articles. It is faster but limiting. Of course each discipline has a different opinion and experience of this."*

UNIC4: "*More than physically to read books and papers (but sometimes I still do it), I use the library as a support to retrieve documents."*

Table 6.27B illustrates the themes that were identified from Chemistry PhD students' responses, the main one being "Virtual library is very important". Further comments from students were:

UNICS1: *"I don't go often to the physical library, but the virtual library is super important. It is fundamental. Having access to scientific research through the library databases is very important."*

UNICS2: "*I use the library to understand the basic principles. It is compulsory to use the library books. I was confronted with a unique technique during my exchange, so I had to consult the library books."*

UNICS3: "*Only use e-library (!)"*

Table 6.27C illustrates the themes that were identified from Chemical Engineering researchers' responses, the main ones being "Electronic resources", "books" and "Rely heavily on the library". Further comments from researchers were:

UNICE2: *"To support what I am writing. The use of the library is more intense whenever I do something new, then I need to have a fundamental understanding from book, then afterwards retrieving articles from the electronic resources as well."*

UNICE3: "*I use lots of scientific papers, often old papers for research, so I rely heavily on the library."*

UNICE6: "*Well I use the library very often for electronic resources and when I have more time, I visit the physical library to browse the print collection."*

Table 6.27D illustrates the themes that were identified from Chemical Engineering PhD students' responses, the main one being "Electronic resources".

A follow-up question regarding library resources used by participants particularly for their research revealed that the main themes from Chemistry researchers' responses as illustrated in Table 6.28A were: "Scientific journals", "Chemistry databases" and "Books". Surprisingly one researcher mentioned "librarian" as a library resource being used particularly for research. One researcher elaborated further:

UNIC5: *"Mostly on-line, specialized journals on Analytical Chemistry, Nano/Biotech Sciences, and top general journals such as Nature and Science."*

Table 6.28B highlight the themes identified from Chemistry PhD students' responses. The main theme from students' responses is: "Electronic resources". Further comments from students were:

UNICS2: "*Books including e-books, databases like ScienceDirect, ACS, and RSC is absolutely important for me that I use on a daily basis."*

UNICS3: *"Using the research articles from the journals that are able to be accessed by the account of the university."*

Table 6.28C highlight the themes identified from Chemical Engineering researchers' responses. The main themes from researchers' response were: "Electronic resources", and "Books". Other themes that stood out were "Standards" and "Scopus". One researcher elaborated further:

UNICE3: *"But I would like to attend referencing training though."*

Table 6.28D highlight the themes identified from Chemical Engineering PhD students' responses. Here students highlighted different library resources.

Participants were asked what resources they were accessing from the library website specifically for their research. Table 6.29A illustrates the themes identified from Chemistry researchers' responses, the main ones being "Free downloads/ Databases/ e-journals/ e-books" and "Scopus". The one theme that stood out was "Bibliometric queries". Table 6.29B illustrates the themes identified from Chemistry PhD students' responses, the main one being "Articles mainly". Table 6.29C illustrates the themes identified from Chemical Engineering researchers' responses, the main ones being "Standards", "Engineering Village" and "Scopus". The one theme that stood out was "Dictionaries". Table 6.29D illustrates the themes identified from Chemical Engineering PhD students' responses. Two themes that stood out were "Attend database and referencing training" and perhaps appalling "Search engines".

Participants were asked whether they were satisfied with the functionality of the library and if not, how the library could be improved to support research. Surprisingly, or perhaps ironic that all Chemistry researchers responded "yes", that they are satisfied with the functionality of the library. Further comments were:

UNIC2: "*we are able to access information online*"

UNIC5: "*Our library is one of the top libraries of my university. However, it is very costly."*

Two Chemistry PhD students indicated that they were satisfied with the library. One student (UNICS3) said "yes and no", and commented "*We just concern about how many journals we can access from the e-library of the university".* Surprisingly all Chemical Engineering researchers indicated "yes". UNICE2 elaborated further that *"as long as the librarian we have is available, she makes things much easier."* One Chemical Engineering PhD student (UNICES1) said "yes" and UNICES2 said "No comment".

Participants were asked to select from a list provided, library resources specifically used for their research in the past year. Researchers could choose more than one. Table 6.30A indicates that the most used library service for research in the past year by Chemistry researchers is "Used library's e-resources (e-books, online journals, databases etc.)". Table 6.30B indicates that the most used library service for research in the past year by Chemistry PhD students is "Used library's e-resources (e-books, online journals, databases etc.)" and "Borrowed library's print resources". Table 6.30C

indicates that the most used library services for research in the past year Chemical Engineering researchers were “Used library’s e-resources (e-books, online journals, databases etc.)” and “Borrowed library’s print resources”. It is surprising perhaps, that nobody attended a training workshop on e-resources or databases in the past year. Table 6.30D indicates that the most used library service for research in the past year by Chemical Engineering PhD students is “Used library’s e-resources (e-books, online journals, databases etc.)”.

Participants were asked to rate the library in supporting research by scoring between 1 for non-existent to 10 for indispensable. Figure 6.4A indicates that three Chemistry researchers rated the library services for research being “good”, one researcher selected “indispensable”, and one rate the library service low. Since only one academic rated the library lower than 5, a follow-up question gave a list of possible reasons for low rating as follows:

1. Collection in my area is not adequate
2. Network /databases too slow
3. The library website is not user-friendly
4. I do not know how to search for information on the library website
5. Other (please specify)

Surprisingly, none of the options were chosen, instead UNIC1 specified: “*All what I need is direct access to chemical and physical journals*”. Figure 6.4B indicates that one Chemistry PhD student rated the library services for research being “good”, another student selected “indispensable”, and the other student rated the library service “weak”. Since only one Chemistry PhD student rated the library lower than 5, an additional question asking to select reasons was posed. Sadly one of the pitfalls of the interview handled as a self-administered questionnaire, UNICS3 chose option 5 but did not specify the reason for the weak rating of the library. Figure 6.4C indicates that two Chemical Engineering researchers rated the library services for research being “good”, and four researchers selected “indispensable”. Since no researchers rated the library services for research low, the follow-up question which asked researchers to indicate their reason for the low rating, was not applicable. Figure 6.4D indicates that both Chemical Engineering PhD students rated the library services for research being “good”.

A follow-up question asked participants to give a score for each research support service listed on the ‘wish list’ provided by either choosing: “very important” (which had a score of 1), “useful” (2) or “not important” (3). This meant that scores were calculated in such a way that the lowest number is more important (high ranking) than the higher numbers. Table 6.31A indicates that Chemistry

researchers still placed the traditional “Ongoing updates on new information resources” and “Database training” at the top of their priority list. Research services placed at the bottom of the priority list by Chemistry researchers are “Advice on my research topic” and “Training on social media use for research”. Table 6.31B indicates that Chemistry PhD students placed “Advice on research proposal writing” and “Database training” at the top of their priority list. One student added “Other: “Access to the highest possible number of bibliographic resources” (UNICS1) at the top of the list as well. Research services placed at the bottom of the priority list by Chemistry PhD students are “Advice on my research topic” and “Training on mobile apps for research”. Table 6.31C indicates that Chemical Engineering researchers still placed the traditional “Ongoing updates on new information resources”, “Advice on bibliographic referencing” and “Database training” at the top of their priority list. It is perhaps thought provoking that “Advice on Open Access publishing” was also placed high on the priority list, considering earlier responses from researchers indicated that the disadvantages far outweighed the advantages of OA publishing. Research services placed at the bottom of the priority list by Chemical Engineering researchers are “Training on mobile apps for research” and “Training on social media use for research”. Table 6.31D indicates that Chemical Engineering PhD students placed “Providing a reading list on faculty and students’ research topic and providing advice on their literature review” and “Ongoing updates on new information resources” at the top of their priority list. Research services placed at the bottom of the priority list by Chemical Engineering PhD students are “Advice on my research topic” and surprisingly “Advice on Open Access publishing”.

6.4.8 Likert Scale Statements

The aim of the Likert statements was to confirm previous responses to research support services by the library, or whether there were contradiction. The Figures 6.5A and 6.5B in the Appendix A highlights the scores ranging from ‘strongly agree to strongly disagree’ indicated by the four groups. The statements that stood out are mentioned below.

With regards to the statement “Librarians do not have the subject knowledge to help my research”, two Chemistry researchers strongly agreed and one agreed that librarians did not have the subject knowledge to support researchers. Surprisingly one Chemistry PhD student strongly agreed and two were undecided that librarians did not have the subject knowledge to support researchers. The majority of Chemical Engineering researchers disagreed that librarians did not have the subject knowledge to support researchers. One Chemical Engineering PhD student strongly agreed and one student was undecided that librarians did not have the subject knowledge to support researchers.

It is perhaps surprising that Chemistry researchers and PhD students had different views that due to the Internet researchers no longer need the library. Here, one of the Chemistry researchers who completed the interview as a self-administered questionnaire, did not answer. It is perhaps surprising, or odd, since there was an undecided" option. The majority of Chemical Engineering researchers disagreed, which confirms earlier reference to the physical library space still highly regarded. Chemical Engineering PhD students also had different views.

The majority of Chemistry and Chemical Engineering researchers and PhD students strongly agreed with the statement that research is essential to their job. These responses are in line with the mission of the departments with regards to the direction of research. However one Chemical Engineering PhD student was undecided.

It is perhaps odd that only one Chemistry researcher strongly agreed, two agreed, one disagreed and another undecided about international collaboration building a stronger knowledge culture in their field. On the other hand two Chemistry PhD students strongly agreed, and one agreed. Surprisingly one Chemical Engineering researcher and PhD student was undecided.

A statement which points to one of the IFLA hot topics in academic libraries supporting research, that Research Data Management is becoming an important practice in conducting research, probed the researchers' point of view on this. Surprisingly only one Chemistry researcher strongly agreed and two Chemistry PhD students were undecided. Four Chemical Engineering researchers were undecided about Research Data Management is becoming an important practice in conducting research. On the other hand one Chemical Engineering PhD student disagreed and one was undecided.

Surprisingly two Chemistry researchers were undecided and two disagreed with the statement that publishing in Open Access journals increased citation counts. Two Chemistry PhD students were also undecided. The majority of Chemical Engineering researchers were undecided about the statement that publishing in Open Access journals increase citation counts. Only one researcher and one Chemical Engineering PhD student agreed.

The last statement attempted to affirm researchers' previous opinions on social networking sites and their visibility on the web. Here responses confirms with previous responses by Chemistry researchers where all had different opinions on being visible on the web or embracing SNS in their research. Two Chemistry PhD students agreed and one was undecided that having a research profile

on SNS increased their visibility of their research. Surprisingly the majority of Chemical Engineering researchers and PhD students were undecided.

6.4.9 Additional comments by Chemistry and Chemical Engineering researchers and PhD Students

Participants were given an opportunity at the end of the interview to add any additional comments. Table 6.32A illustrates the themes identified from Chemistry researchers' responses. Two researchers had no additional comments. Various themes were identified from the three researchers' comments, with emphasis still being placed on the physical library. Further comments from researchers were:

UNIC2: "*About 20 years ago, the physical library was very important, but not now anymore. Only for specific books yes. It is difficult for me to ask a librarian to help me with information on my research, because the librarian is not a qualified chemist, in fact the librarian have no qualification, just there to do admin work. I cannot ask a librarian to do a patent search for me, or search the originality of research, they won't know what to do! I prefer to go to a research office, the library is too general."*

UNIC3: "*It is still a difficult moment with regard to the accessibility of knowledge is now through electronic systems… I am still very much attached to print book and the physical library because physical contact remains very important to me. I still encourage my students to go to the library, because it is the best environment for accessing scientific knowledge, and also a place to think and grasp ideas. I am a conservative, and believe contact with the librarian and the physical library is key in research. One scientist said at the end of his conference presentation that spending one day in the library can save you six months in the lab."*

UNIC4: "*Some questions seem to over-emphasize the role of librarians in my field, but perhaps it's my fault, please forgive me. I have lost some of the enthusiasm of the early research years. I am not updated with recent developments in research tools (data management? socials? open sources?). In any case, your interview was very interesting and forced me to face issues new to me."*

Table 6.32B illustrates the themes identified from Chemistry PhD students' responses. Only one student commented as follows:

UNICS2: "*Regarding the activity from the library online, it is enough. Of course training will be very useful. The positive aspect of the library is providing vast amount of information resources on various topics, not only on my research topic, but also having access to information on personal interests."*

Table 6.32C illustrates the themes identified from Chemical Engineering researchers' responses. Two researchers had no additional comments. Various themes were identified from researchers' comments, with emphasis still being placed heavily on the communication that needs to improve. Further comments from researchers were:

UNICE1: "*Evaluation for promotion at this university should not only be on my research, but also on teaching and other the extra activities should be taken into consideration for promotion purposes, for example the guideline we provide to firefighters or the protection agency, our consultancy services should also carry weight and the teaching part for promotion in the faculty…"*

UNICE2: "*I would just like to stress the promotion of library services more. There is a need for close contact with postgraduate students and researchers. Increase communication, share information, be in contact more closely with the university community about who is doing what, to see which department is doing similar activities so we could form collaboration or share best practices. There is no well organised platform in UNIBO for researchers, perhaps a blog at the Intranet level will be useful specifically for research.*"

UNICE3: "*Well as I said before, the library and librarians' role is very important. We should not disregard the importance of the librarian because of electronic resources. Behind the electronic resources there is a person, and that is important. Our librarian is very special, without her, this could be disruptive*."

UNICE4: "*No, I am really satisfied with the library services."*

UNICE5: "*Perhaps if the library can help in the beginning stages of research, through workshops and training."*

UNICE6: "*It would be useful to have regular training for postgraduate students or young researchers on searching for reliable information sources and tools for referencing. Facilitating ILL logistics, easier exchange of books amongst external libraries. We would really love support with these bibliometric reports that we researchers need for evaluation."*

Table 6.32D illustrates the themes identified from Chemical Engineering PhD students' responses. Only one student commented as follows:

UNICES1: "*This interview made me think about different aspects of the library and how I can collaborate with the librarian. It opened my mind."*

6.4.10 Reflection on researchers and PhD students' responses

Responses revealed mixed feelings regarding the need for library support in research. However, all researchers and PhD students agree that research is essential to their job, and visibility of their work is fundamental.

6.5 Concluding remarks

The chapter reported on interview responses from librarians supporting research in Chemistry and Chemical Engineering departments, as well responses by Chemistry and Chemical Engineering researchers and PhD students. Some similarities and some vast differences between librarians versus researchers and PhD student responses with regards to the trends were revealed. These significant findings will be discussed in more detail in Chapter 8.

Chapter 7:

7 Perceptions of Librarians supporting research versus researchers' perceptions of librarians supporting in Chemistry and Chemical Engineering Departments: The case of CPUT

7.1 Introduction

Chapter 7 presents the findings and discussion on interviews conducted with librarians, faculty and PhD students in Chemistry and Chemical Engineering departments at the Cape Peninsula University of Technology. This chapter follows from Chapter 5 where the method of collecting and analysing the data was discussed. It is also important to note that some comparison with previous research results by Kleinveldt (2009) are made in this chapter for highlighting any significant changes that may have occurred in research activity and research support since then, as the current PhD research project is an expansion of the Masters research project. Research is fundamental for the development and growth of a country, and for building and sustaining a knowledge society. According to the UNESCO document *Towards a Knowledge Society* (2005: 60), a 'knowledge society' is defined as "one that creates, shares and uses knowledge for the prosperity and well-being of its people". The knowledge society follows from the information society which focused heavily on information technologies and contributed very much to social exclusion, the widening of the gap to access technology and information. Since a knowledge society is a learning society, the researcher places higher education institutions in this context as these are learning organisations as previously pointed out in Chapter 1 (Travers, 2001; Servos, 1993).

Since the previous study was more quantitative using a survey questionnaire of academic staff across the six faculties at CPUT, there were a few limitations such as it excluded postgraduate students from the study and it only focused on one institution. Therefore the current research project includes the perceptions and experiences of three groups, the librarians, faculty and PhD students in the Chemistry and Chemical Engineering departments at CPUT.

Chapter 7 presents the Cape Peninsula University of Technology case study and begins with describing briefly the background of the institution and the library structure, looking at the vision and mission as well as the research landscape. The findings are organised similarly to Chapter 6 according to themes that link to the research questions and sub-questions including a brief discussion of each group; librarians, academics/researchers and PhD students in Chemistry and Chemical Engineering departments. It is hoped that this chapter gives insight into the perceptions of

the CPUT university community on the actual research activities versus the research trends in the fields of Chemistry and Chemical Engineering and how they are being supported by the library.

7.2 Background

The aim of this section is to give a brief background on the Cape Peninsula University of Technology, the library and the two disciplines namely Chemistry and Chemical Engineering on which the study focuses. The Cape Technikon and Peninsula Technikon amalgamated in 2005 and formed the Cape Peninsula University of Technology. However, these two former institutions have a history as well, dating back to the 1900s. The former Cape Technikon started in 1920 as a technical college, and the former Peninsula Technikon also started as a technical college in 1962 (CPUT, 2017a). CPUT is a geographically dispersed institution which consists of six faculties across ten campuses. The vision of the institution is "To be at the heart of technology education and innovation in Africa" (CPUT, 2017b) and the mission for research is: "We will enhance and develop the quality and effectiveness of our research and knowledge production" (CPUT, 2017b).

Based on the historical background of the two former Technikons, where the core function was to teach, the pressure has been placed on academic staff to conduct research in order for the institution to feature on the research landscape. It links directly to the previous study conducted by Kleinveldt (2009) where it was recommended that there is a need for further inquiry to study patterns in research activities and support of research, which motivated the author to pursue this area further.

So too the academic library play an important role in supporting the three pillars of the institution, namely: Teaching and Learning, Research and Community Engagement (CPUT, 2017b). Previously the core function of this academic library was to support teaching and learning. Although at present the core function of the academic library supporting teaching and learning remains, especially with regards to Information Literacy Certificate programme rolled out since 2013, the focus is shifting more towards research support due to the trends discussed in Chapter 2. The visibility of research profiles and output are on the rise, and this is due to the support from the library in more proactive ways of promoting the Digital Knowledge (DK), which is the institutional repository (IR), and according to the latest January 2017 webometrics report, DK is ranked 12th in South Africa, 22nd in Africa and 970th in the world (Ranking Web of Repositories, 2017). Compared to the previous study in 2009 when DK was still unknown to many researchers at CPUT, there has been a huge improvement since then, compliments to the hard working librarians promoting this to the faculty and encouraging researchers to upload their work into the repository. Later it is highlighted in the

findings by librarians how researchers see the benefit of making their work visible for promotion purposes. In addition to this, the library is also offering Bibliometrics /Altmetrics services, and promoting ORCID IDs to the faculty. CPUT Libraries are going the extra mile in supporting research in many ways, the Advanced Information Literacy Programme and the recent Research Data Management support evidence of this. The library has also been involved in Community Engagement activities over the past years. CPUT Libraries had a fulltime staff complement of 101 in the year 2015 (CPUT Libraries Annual Report, 2015). There are altogether ten campus libraries of which four are part of this study.

The Chemistry department forms part of the Faculty of Applied Sciences, and the vision for the faculty is "to be the faculty of choice in science and technology, nationally and in Africa" (CPUT Faculties, 2017a) which is aligned to the vision of CPUT. The promotion of research activities and building research networks forms a pivotal component of the strategic goals of the Faculty of Applied Sciences are (CPUT Faculties, 2017a).

The Chemistry department is focused on research niche areas in environmental chemistry and toxicology, radiochemistry and ion exchange separations. The mission of the chemistry department "strives through quality education, scholarship and research, to produce graduates who are life-long learners, equipped with relevant up-to-date technical skills and vocational training ensuring that they are employable and able to respond to societal and technological needs" (CPUT Departments and contacts, 2017a).

The Chemical Engineering department forms part of the Faculty of Engineering, and their aim is "to integrate its education and research programmes into a cohesive system, providing students with modern technology platforms for relevant and industry-responsive education, with a high degree of work-integrated learning" (CPUT Faculties, 2017b). One of the goals of the Chemical Engineering department is to focus on "applied research with technological and commercial value" (CPUT Chemical Engineering, 2017a).

The research niche areas in the Chemical Engineering department are "Environmental Engineering and Bioproducts Technology", "Hydrometallurgy, Biotechnology and Mineral Processing", and "Oil and Gas Technology" (CPUT Chemical Engineering, 2017b).

Considering the mission and strategic goals of the departments and the library, research has been highlighted as a key performance area, both on the side of the departments who conduct research versus the library who supports research. Therefore the interviews conducted with these units will

reveal the current state of affairs in Chemistry and Chemical Engineering fields with regards to their perception of the library supporting research. On the side of the library, the perceived role of supporting research is crucial for the future direction of research support services at CPUT. The following sections will report on the findings from librarians, researchers and PhD students.

7.3 Findings on the perceptions of librarians supporting research

This section reports on the interview responses from librarians at CPUT who are supporting Chemistry and Chemical Engineering, as well as some other departments within Applied Sciences and Engineering faculties offered at the satellite campus. Purposive sampling was used to select librarians, in order to create a balanced representation, and also for the purpose of comparing the case of CPUT with UNIBO. Therefore the five librarians interviewed are coded CPUL1-CPUL5, and hold the following positions at CPUT Libraries:

- CPUL1 – Branch librarian at a satellite campus where a branch of Engineering is located
- CPUL2 – Branch librarian at a satellite campus where a component of Applied Sciences is located
- CPUL3 – An Applied Sciences faculty librarian supporting Chemistry at one of the two main campuses in Applied Sciences
- CPUL4 – An Engineering faculty librarian supporting Chemical Engineering at the main campus
- CPUL5 – An Applied Sciences faculty librarian supporting Chemistry at the main campus

It is important to point out that to hold a faculty librarian or branch librarian position at CPUT Libraries, one of the minimum requirements in the selection and recruiting process is that a candidate applying for such a position must hold a Library and Information Science qualification, and additional qualifications such as a Master's degree are advantageous. CPUL1, CPUL3, and CPUL5 are currently pursuing a Master's degree in librarianship as pointed out in responses later on. CPUL4 obtained a Masters in Library and Information Science while employed in the current position of engineering faculty librarian. The findings, that were analysed using the content analysis method by Leedy and Ormrod's (2001) and Silverman's (2011) as discussed in Chapter 5, are presented in tables and graphs found in **Appendix B**. The report on the findings below have been organised according to the same thematic structure used in the case of UNIBO in Chapter 6, in an attempt to answer the main research questions and sub-questions of this study.

7.3.1 Librarians' perception of their role in conducting LIS research and supporting research

Librarians were asked to describe their role in supporting Chemistry and Chemical Engineering research. Table 7.1 in **Appendix B** indicates the themes which came out of CPUT librarians' responses. The main themes identified are: "Ensuring researcher visibility through ORCID IDs

/Scopus promotion", "Bibliometrics /altmetrics reports: Evaluating research output: lecturer promotion process assistance", "Institutional repository – upload theses assistance", "Handling queries", "Information literacy training" and librarians playing a "Big role" in supporting research. Other themes that came out which varied from the collective themes above are: "Publishing assistance: Open Access guidance", "Grant proposal assistance", "Engaging with all stakeholders", "Librarians in a learning process – new practices", "Reactive-to-proactive Information provision" and "Young university- developing researchers". The following comment by CPUL2 gives insight into supporting research at a young university of technology such as CPUT:

"In terms of research practices, it is still in its infancy phase, being a young university, the department is in a developing stage for researchers. In terms of my role in supporting research, it is reactive, as it is based on the lecturers approaching me with their research queries and I respond accordingly by finding the necessary information. Librarians are in a learning curve, new practices. But we do understand the importance of these new practices, engaging with all stakeholders, this is the way forward for librarians. As a branch librarian, my challenge is how to position staff in the branch library to our core business in the changes and new developments taking place, as we also need to support teaching and learning."

The role of the faculty /branch librarian is completely transformed, and very modern. It is clear that at CPUT, librarians have rapidly taken on the future role for supporting research, which is in line with the IFLA hot topics, ASERL competencies, the technology research trends about BYOT /BYOD discussed in Chapter 2, and taking into account the National Research Foundation (2017) requirements for funding research and how to support researchers with this. However, the traditional role and responsibilities of a faculty librarian still exists. Collection development, faculty liaison, information literacy training which takes up about 80% of librarians' work time as they need to teach all first year students and all levels up to PhD level as requested by the faculty due to the IL policy in place since 2009, information provision, and sitting on faculty board and departmental meetings where library matters are discussed, are just to mention a few of the faculty librarians' core function. Sadly librarians have been overworked as later it is pointed out in several responses, as the heavy workload just gets heavier as new research demands increase, with the same small amount of librarians needing to support not only research, but teaching and learning as well as community engagement. The question is, how much more can librarians still take on without any additional assistance? This is open for further discussion.

A comment by CPUL3 regarding the ORCID ID and Scopus promotion was: *"it is a NRF* [National Research Foundation] *requirement".* This was one of the proactive services offered to faculty based on NRF rating and evaluation of researchers in SA. Librarians now are going beyond the traditional

library services to support research, but by identifying funder requirements are able to offer this service.

With regards to research support practices and how it has changed over time, Table 7.2 presents the themes from librarians' responses with emphasis placed on how research support practices or services have changed. The main themes that stood out are: "Evaluating research output", "Ensure Research visibility on the web- ORCID, Scopus, PoP, ResearchGate", "Drastic change in how we support research", "Individual training increased : in researchers' space/office", "Institutional repository – upload theses assistance", and "Importance of librarians supporting research realised". Some of the comments from librarians are:

CPUL1: "*Things have become more interactive since I started supporting research, and we do a lot of promotion of services."*

CPUL2: *"Our recent research support services are Bibliometric and Altmetric services provided to researchers at CPUT. The library is proactively engaging in research practices, by studying researchers' profiles, making sure they have ORCID ID, assist with their research visibility on the web, Scopus, PoP (Publish or Perish) and ResearchGate etc. We are also strategically working on a pilot study with the research committee in the department, looking at research topics …together with our [international] collaborators at [a university] in the United States, to see how we can support researchers."*

CPUL3: *"I'm glad that you ask this question, because I had a meeting with two researchers this morning who are busy applying for ad hominem promotion. One of the requirements are that researchers be registered or should be listed on Scopus/ORCID/ institutional repository, but I discovered that they were not listed, and so I assisted the researchers with these. Only one researcher had a publication listed on Scopus, and several on Publish or Perish. They were so excited when I introduced them to the institutional repository and ORCID because now their work is being cited compared to before, their work was not being cited. Researchers now realise the importance of librarians supporting their research, they are now more visible. Since I started this position, lots have changed."*

CPUL4: "*I help them in grant applications and support them with publishing in Open Access journals because in our trends, they have to publish in OA journals. I assist researchers with uploading their publications in the institutional repository – the university need to see the Return on Investment. The Open Access policy is already in place, the objective is to increase visibility of research output, h-index, increased citations. Once researchers registered on ORCID, we check their records to ensure their visibility on the institutional repository. There is a drastic change in how we support research, because previously we did not act on trends, now the visibility of the library and the librarian is there. Even the faculty are now chasing after us because of our services."*

CPUL5: *"My research support practices has changed completely since I started. I need to keep up to date with the new developments, also based on top trends in 2016 for academic libraries…"*

The majority of librarians indicated that their role and support in research has changed drastically. The theme "Importance of librarians supporting research realised" is thought-provoking, but

perhaps a breakthrough for librarians, that faculty is recognising what the librarians are able to offer in terms of research support.

7.3.2 Researchers' perception of the librarians' role in supporting research: from the librarians' point of view

The main themes as highlighted in Table 7.3 on librarians' perception of the faculty and PhD students toward research support being "How librarians promote themselves and services makes the difference", "Faculty recognise librarians' support: Faculty have positive attitude", "Faculty open to librarian supporting research" is perhaps a step in the right direction for CPUT through the marketing and good working relationship between the librarians and faculty on the increase, which leads to more student engagement as well as is evident in the outcomes of the IL training highlighted in librarian responses.

The importance of the theme "Clarify librarian role- research partner" is perhaps the most crucial to begin with, increasing acceptance from the university community regarding research support from librarians. This is in line with what was previously mentioned in chapter 6 about organisations and librarians and closing the gap. The following quote supports this:

CPUL2: "*I think the faculty is very open to include us in their research activities. I think the barrier is that the researchers are not always sure of our role. It is important to clarify, we are not research assistants, but research partners. We have a specific role to play within that research, we are not the subject specialist, we are not qualified chemists, we are information specialists. But researchers are open to us advising and guiding them in research in terms of what we can offer them specific to the research process and how we can add value within our specific specialist field so that there is no role confusion."*

A theme that stood out from one librarian "Students are lazy- [that is] my perception", is perhaps thought-provoking, and could lead to further discussion on information-seeking behaviour of students. Another theme "Librarians speak their 'research language'" is perhaps a sign of the future role of the librarian in research (ASERL, 2000). It also links to a blogpost that points out the shift from librarians telling researchers what the library has to offer towards why the library actually exists particularly for supporting research (Stavick, 2017).

Librarians were asked how their support was benefitting faculty and students' research. Table 7.4 highlights the themes that stood out from librarians' responses, the main ones being "Pivotal role – save them time", "Provide guidance / support" and "Information Literacy training: Students' work improved- referencing / search strategies". Librarians elaborated further:

CPUL1: "*The knowledge that they can come to us and request information or assistance. Sometimes they don't have the time to search so they come to me for help. So I guide them as well."*

CPUL2: "*There is a lot of appreciation. We provide information support. We play a pivotal role in saving them time in finding information, whether it is on literature, finding research partners to link up with etc."*

CPUL3: *"I received feedback from the lectures that postgraduate students' bibliographic referencing and search strategies are improving."*

CPUL5: "*H-index, and number of citations, through getting researchers' profiles updated is very important for rating researchers and for promotion purposes. The benefits of my support is reflected in the research reported on."*

That these main themes above came out from librarians with regards to how their support benefit faculty and students' research is thought provoking in the current digital age, the research trends, prosumerism already discussed to great lengths in this thesis.

7.3.3 Technology trends in communication and supporting research

Librarians were asked how they felt about their profile and visibility on the web. Table 7.5 highlights the themes that stood out, the main ones being: "Physical visibility more effective at this small campus", "Value of librarians supporting research needs to be realised" and "It is actually nice: feel great". One of the comments that stood out is:

CPUL3: "*Since I started this position, I realised that many things have changed, and discovered that I can do A,B,C, by marketing myself. Now people recognise me with my profile on the web, and take my work seriously, because before the faculty didn't recognise librarians' profession, we were just seen as issuing books. Now they can see that we librarians have far more to offer them in supporting their research."*

Librarians have a positive mind-set regarding their profile and visibility on the web. However, the theme "Physical visibility more effective at this small campus" was mentioned by both branch librarians based at the smaller satellite campuses. This seems to be working well at small campuses, both librarians who indicated this are based at small campuses. On the other hand, online visibility works better for librarians at the much bigger branches where huge numbers of users are supported, and embracing technology is complimenting support services.

Librarians had the opportunity to list the Web 2.0 tools or Social Networking Sites (SNS) that they were specifically using to support research. Surprisingly only one librarian (CPUL1) was not using any, and mentioned that: "*I don't think there is a need for it here, we are a more specialised campus / departmental library."* It confirms what the same librarian mentioned earlier that at the particular small campus, physical visibility was much more meaningful. Table 7.6 illustrates the list, with the main sites (in order of majority votes) being "Mendeley", "ResearchGate", "Facebook", "LinkedIn", "Academia.edu", "Google+ / Calendar / Drive", and "WhatsApp". Other sites mentioned that stood

out was "LOOP[6]", which the librarian CPUL5 claimed is similar to ResearchGate. It is perhaps surprising that only one librarian (CPUL5) mentioned using Libguides[7].

Librarians were asked whether they thought that social media enhanced their visibility on the web, and the majority agreed. One librarian (CPUL1) answered that it depends, and elaborated further: "*It depends on what kind of social media you are using. We have a library Facebook page but not for research support purposes, it is more for general. I don't think that the academics here on this campus are active on sites like LinkedIn or ResearchGate".* The significant role that social media is playing in supporting research is highlighted. It links to the role of the researcher as prosumer, where in chapter 3 it was emphasised that this practice of prosumerism is due to Web 2.0. The comments below supports this:

CPUL4: "*my visibility increased drastically because of social media. Everybody can see what I am doing. Communication has increased this way, we follow each other. In the institutional repository I am promoting researcher profiles."*

CPUL5: "*People can contact me easily, there are so many options."*

Librarians highlighted that social media enhanced research practices of faculty through: "Collaboration", "Accessibility of information", "Improves visibility of researchers" and "Increased consultation: handling online queries through ResearchGate" as illustrated in Table 7.7. This has increased the flexibility of handling queries which very much links to the future role of the librarian.

One librarian said it improves services, and another librarian said that it is a good way of building networks with experts. However one librarian (CPUL1) was not sure how social media is used for research purposes and commented that: "*I think people use social media, but I'm not sure for research purposes. But Mendeley is a good tool for researchers, so yes".* Comments from other librarians are as follows:

CPUL2: "*I am not an active user of these accounts which is a bit sad... because I am not conducting research or publishing at the moment. However I do receive followers, and definitely see the advantage for research practices, definitely improves the researchers' visibility…"*

[6] The mission of LOOP is to "enhance academic reputation and impact for researchers within their communities as well as to the public" (LOOP, 2017).

[7] Libguides is a Content Management System (CMS) used by many university libraries worldwide (Springshare, 2017), customised by subject and disciplines at CPUT to support the university community with information and research resources available in the library (physical and virtual) in a specific course. The Libguides act as a "one-stop shop" in a particular field for the user, and also a marketing strategy for library resources.

CPUL3: "*Researchers in the institution consult me more since I registered on ResearchGate/ LinkedIn."*

CPUL4: "*It improved the services very well. For example articles that we do not have access to, by requesting through ResearchGate, one receive access."*

CPUL5: *"in developing groups to form networks. For example Mendeley, one form groups. I have been collaborating with experts on Libguides."*

All librarians indicated that they are currently communicating with faculty about research. Table 7.8 illustrates the themes identified from librarians' responses. The main themes are: "Literature searches", "Current awareness" and "Setting up alerts – research updates". An example of research related conversations between researchers and a librarian was revealed in the following comment:

CPUL5: *"currently about bibliometrics and altmetrics, we created a database of researchers. Evaluating researcher profiles for example checking whether they have an ORCID ID and so on, so where I identify gaps, then we have a conversation about fixing this. It is mandatory for promotion purposes that researchers' profiles are up to date and linked, ORCID is a solution to linking all publications of an author. Through my training provided to one researcher with this, she was able to share with the rest of the department the importance of their research profiles and visibility of research output. This led to other researchers requesting training on this."*

However, one theme that is thought-provoking and comes out later on in responses as well is "Staff capacity challenges" which is open for further discussion later. Once again as mentioned earlier, the heavy workload is highlighted, and librarians are really being stretched beyond their limits. How to deal with this issue is perhaps beyond the control of the library, but at a university level to assess overall staff capacity versus duties and responsibilities. The following quote supports this:

CPUL2: "*Working in three faculties does not make it easy I must confess, we have our manpower challenges because we are not just engaging in research support, we would like to do more, however."*

The main theme that came out from librarians with regards to how their support benefit faculty and students' research was "Pivotal role – save them time", is thought provoking in the current digital age, considering the research trends, prosumerism concept practiced by researchers already discussed to great lengths in this thesis. Table 7.9 highlights that as much as the main mode of communication between researchers and librarians is still very much traditional via email and face to face, it is quite important to note that following closely after these traditional modes of communication are "Blackboard" and "WhatsApp", which is much more modern and in line with the contemporary 'tech-savvy' user which Johnson et al (2015, 2016, 2017) pointed out being part of higher education technology trends. One of CPUT's strategies is to enhance blended learning through all subjects by having a Blackboard presence (CPUT, 2017). This is to some extent supporting the prosumer concept in research as librarians are getting into the space of researchers and

students. In a previous study, one of the successes discussed was embedding the librarian in the Blackboard pages of academics to support blended learning was highlighted as it improved faculty-librarian collaboration as well as student interaction (Kleinveldt, 2015; Kleinveldt, Schutte & Stilwell, 2016). The variety of options available to researchers at CPUT in terms of library resources is evident in themes that stood out from librarians' responses in terms of promotion and support for research. As previously mentioned the successful marketing of DK is evident in the latest webometrics report, showing an improvement in ranking of CPUT's institutional repository (Ranking Web of Repositories, 2017).

With regards to librarians' opinion on being a contact on researchers' social networking sites, all were very positive about embracing emerging technologies that could improve communication with researchers. The main themes indicated in Table 7.10 were: "I don't have a problem", "Broadens my knowledge" and "It is fine/ a good thing". Three themes that were thought provoking were: "Quicker way of contacting me", "As long as it is work/research-related" and "I should be visible to support wherever". As mentioned above, it links to the role of the researcher as prosumer to some extent where librarians are getting on board, by interacting and providing support within the spaces of the researchers and students. This perhaps is the new direction in bridging the communication gap.

7.3.4 Librarian-faculty collaboration in research

Table 7.11 highlights the themes identified from librarians' responses to their thoughts on researchers working together with them to enhance library services for research. The themes that stood out are: "Good idea", "Library core business – support university", "Good to collaborate-work together" and "Important to know my clients". Some further comments from librarians were:

CPUL1: "*The library needs to be embedded in research of the faculty and departments."*

CPUL2: "*Our [the library] core business is to support our faculty and the institution. When they see us as an authoritative partner with regards to support… that is important."*

CPUL3: "*We are here to support the university community, if we work alone, we will not know what our users really need. So it is always good to work together, because then we will know what to improve on, or what to get rid of."*

CPUL4: "*Sometimes we don't know their needs, I think they are the ones we should listen to… we should not just assume what they need. For example with the book exhibitions, we are buying books just to spend the budget. Lecturers say that the level of content at these exhibitions are not what they need, that is why they don't attend exhibitions. We should listen to what they need."*

CPUL5: "*We should constantly work together, that is how we can bring change for the university and the society. I cannot work in isolation, I need to know my clients that is key. I need to know what my clients are doing, their subject areas, that is my view."*

Three librarians indicated as illustrated in Table 7.12 that they are currently collaborating on "Library matters /Resources", "IL-team teaching" and "Run research workshops with postgraduates" with faculty to enhance library services for research. Once again the issue of overworked librarians in the themes "Not currently: Work overload", "Previous collaboration was very successful" highlighted by one librarian. As much as librarians are positive about collaborating with faculty, but sadly it is not possible for all. Librarians elaborated further:

CPUL1: "*collaboration takes place during departmental meetings where I update on library matters."*

CPUL2: "*We are in the process of doing that. With all these projects that we are involved in, there is liaison with faculty, and up to now we haven't receive any resistance to us rolling out new services for example the thesis submission processes which change from time to time."*

CPUL3: "*Not currently, things are hectic, work overload, limited time, student and staff protests also had an impact. But the last project we ran with Fundani where we collaborated with a team (librarians and faculty) to integrate tablet technology into our Information Literacy training was very successful, it also led to an international conference presentation and international publication."*

CPUL4: "*we liaise with departments on a daily basis about resources that can help them…"*

CPUL5: *"In Information Literacy yes, we [lecturer and I] work together by team-teaching. We run research workshops with postgraduates."*

All librarians indicated that they were discussing Library issues or share new ideas or discoveries with the faculty and students. Table 7.13 highlights the main theme being "Departmental meetings". Some further comments from librarians are as follows:

CPUL3: "*Ideas yes. For example, advising on databases."*

CPUL5*: "we had an opportunity where chemistry free titles were shared with faculty and students. And promote Scopus, maximising their impact."*

Librarians are now more than ever before sharing library matters with faculty through departmental meetings and faculty board meetings. A few years ago it was very difficult to get a "library slot" in these meetings, but the importance of having the faculty librarians involved in these meetings was motivated at a much higher level being the Dean's Forum and up to Senate. Only after consensus was reached things started improving slightly. It is worth noting that the inclusion of faculty librarians in notifications of departmental and faculty board meetings is still an area for improvement, as many times librarians are informed on the last minute and sometimes not at all. Therefore a lot of effort is made on the side of the librarian to constantly remind and ask departments for their meeting schedules beforehand to avoid compiling library reports in a rush that are so vital to present at these platforms.

The number of times that librarians had contact in person or via email with faculty specifically on their research varied from depending on the size of the campus, ranging from actual numbers at the smaller campuses to "too many to measure" at the bigger campuses. Librarian CPUL4 elaborated further: "*Even on my way home when I am taking my bag, they rush to ask for my assistance."* This very much links to the culture of the institution, the pressure is felt by researchers to conduct more research, and seek the help of a librarian as the importance of supporting them with research is realised, as previously mentioned, presenting at departmental and faculty board meetings has made a huge difference. Also for students, IL training has made an impact.

7.3.5 Librarian collaboration in LIS research and Library Association

Librarians were asked what role the Library Association, Library and Information Association of South Africa (LIASA) played in their profession to support research. Table 7.14 highlights the themes that stood out from librarians' responses, with the main themes being "An active role in librarian profession: HELIG (Higher Education Libraries Interest Group)", "Create awareness" and "Webinars/Workshops". Surprisingly, two librarians said "At the moment I can't say". Although the majority of librarians have a positive attitude towards LIASA and its role in supporting the profession, some underlying issues surfaced as well. As depicted in the following theme: "I need to be informed about LIASA: I have no interest" is perhaps thought provoking. There is somewhat unhappiness expressed around the current situation, that perhaps is not against the library association per se, but leading more to organisational aspects influencing librarians' decision to become (or not to) a member of the professional body is perhaps raising a concern. This comes out very strongly from the librarian's direct quote: CPUL3: "*I don't know whether you know my feelings about LIASA. I need to be informed more about LIASA. I have no interest, sorry",* that is saying something perhaps, but open for further discussion. On the other side, the comments below confirms the overall positive role that LIASA play in the profession especially regarding the research trends and how the library association provides support:

CPUL2: "*LIASA has an interest group, HELIG (Higher Education Libraries Interest Group), I think up to now a lot of emphasis has been placed on Information Literacy. As much as Information Literacy is very important focus in higher education, there is the realisation that Research is core, and librarians supporting research is also a key function. The Library Association has rolled out many workshops on OA, ORCID and so on to create awareness, so yes I would say that the association has played a role in the librarian profession. But we are not necessarily there yet as a University of technology library, although the awareness is there. Webinars, the Research Academy a few years ago, even in library schools research support is now included in the curriculum, and many discussions are taking place within the library association to support librarians in dealing with research support."*

CPUL4: "*I see announcements, webinars advertised, lots of support and assistance offered".*

CPUL5: *"They support more than just for research. We are engaged in many activities through the library association. The sharing of best practices plays a huge role in our profession. LIASA recently had an Information Literacy workshop, where we shared expertise, and also discussed the way forward"*

When asked about belonging to the professional body, surprisingly only two out of the five librarians interviewed indicated that they are currently a member of the library association, LIASA. Additional themes that stood out from responses on membership are "Very important", "Expensive", "Institutional membership" as illustrated in Figure 7.1. However the theme "No longer: Restrictions at work" is perhaps confirming there being underlying organisational aspects. The question is, why there is this feeling, and what has led to restrictions at work? The themes "Do see the benefits of LIASA" and "feel guilty about not being a member at present" again shows the difference in opinion and experiences among librarians. This perhaps says something about the mind-set of librarians, they tend to be both optimistic and pessimistic about the library association membership and participation seems to be to a large extent determined by organisational dynamics at this library. Librarians elaborated further, which to some extent confirms this argument:

CPUL2: *"I will always be [a member] while I am a librarian."*

CPUL3: *"it's so expensive, I am expected to pay membership every year. I feel that there should be an institutional membership, meaning that as a librarian at this institution, one should automatically become a member through institutional membership. So to me, individual membership doesn't make sense."*

CPUL4: *"I am no longer a member, I am still considering renewing in the future. It was the problem of attending workshops and conferences. There are suddenly restrictions at work to attend, there is a long process now if you want to attend workshops, and sometimes you are told that you can't go. So I thought no, because I will be joining for nothing. But I do see the benefits of LIASA because it is a professional body."*

CPUL5: *"I feel guilty about not being a member at present."*

Another question asked librarians whether they were participating in any research project or library association activities such as conference presentations. Three librarians are currently involved in research projects. CPUL3 and CPUL5 are currently conducting research for their Master's degree. One of the librarians who is not currently involved in a research project, would like to do so in the future. One theme was "International collaborative project leading to a publication", and CPUL2 elaborated further:

I have been very much involved in projects. I am the representative on the education faculty board. I am the spokesperson for research on campus, marketing services and liaising with researchers. So yes I am actively involved whenever the request comes out. In agriculture, we are looking at a software, DigitalGreen, which we can customise for our department at CPUT to use for agricultural

information, it is a collaborative project between me and the agricultural librarian at Virginia Tech in the States, and the outcomes will lead to a publication.

There is clear indication of librarian participation in research projects. That two of the librarians are pursuing a Master's degree in Library and Information Science confirms the changing, and future role of academic librarians. Also, in order to better support researchers, it is becoming more crucial for librarians to conduct research as it was already pointed out in the 2009 research findings (Kleinveldt, 2009). The literature discussed in Chapter 2 highlight the need for practicing librarians to conduct LIS research for enhancing existing library services supporting research. Following this, librarians were asked whether they thought it was important for them to conduct research in order to improve research support services. All librarians agreed that it was of the utmost importance. Table 7.15 illustrates the themes from librarians' responses, the main themes being "Understand research process", "Stay up to date" and "Find time to do research". Additional comments from librarians were:

CPUL2: "*even though we struggle to find time. In order to understand research process, we need to engage with research. If we see an opportunity to partner with researchers, it will be beneficial for that department, for the library and the institution as a whole. I am a research partner in the faculty by providing information and it makes a difference."*

CPUL3: "*What I have discovered, and I shared this with another colleague… The more you do research and read about research, the more you understand what is happening. The more you learn and get familiar with what other researchers are doing."*

CPUL4: "*Since we are information specialists. I don't see why we are not publishing, it's just laziness. Or maybe we are busy with other things, like the Information Literacy training is clouding our minds, because of Heavy workloads we are losing or [missing] out on important things that we should be focusing on…"*

CPUL5: *"To keep up with the new developments and new tools. If you are not, we won't have the strength to improve or implement new services to our researchers. If we don't keep up to date, there will be a huge gap."*

Perhaps there is a connection between being a LIASA member and research, which motivates librarians to participate in collaborative projects as it is the gateway to building networks with library experts worldwide. The theme "International collaborative project leading to a publication" mentioned earlier links to the IFLA strategy to build stronger library associations that will in turn increase international collaboration which is key (IFLA, 2017). Library associations are the gateway for building networks with library professionals worldwide. The importance of librarians conducting research has been realised by all librarian and is in line with the future role of librarians pointed out previously in Chapters 2 and 3.

The majority of librarians indicated that they were currently collaborating with library researchers (locally and internationally) in their field specifically to support research. Two librarians are not collaborating with researchers in the library field. As indicated in Table 7.16, the themes from the three librarians who are collaborating are "collaborating with colleagues internally" and "through social media: share best practices". The sharing of best practices between librarians via social media once again points out that librarians are open to embracing emerging technologies, linking to the literature which describes the importance at higher education institutions (Johnson et al, 2017).

7.3.6 Academic library trends in supporting research (OA, OS, RDM)

Librarians' opinion on Open Access were very positive, all indicating that the advantages far outweighs the disadvantages. However, the stigma attached to Open Access and the challenges faced with hybrid journals were pointed out. Table 7.17 points out the themes that stood out, with themes for disadvantages shaded in grey. The main themes for advantages were "Increase researcher visibility", "Free access to information", "Higher citations, higher ratings, and High impact journals part of OA movement", "Good for the researcher" and "Definitely more advantages than disadvantages". The main theme for disadvantages of Open Access according to librarians are: "Author fees – expensive". Another disadvantage pointed out by one librarian is "OA publishing stigma: Researchers concerned about reputability of OA journals and work being stolen" and from another librarian "Hybrid journals –author and library pay high costs". Further comments are:

CPUL2: *"there are definitely more advantages than disadvantages. There is a stigma around Open Access publishing, more accessible, your work is out there. All the measures are now in place to protect your research through DOI, ORCID, and Creative Commons Licenses. Nobody can steal your work, and I think that was the concern for many researchers before. The researchers want to be assured about visibility and reputable journals. Higher citations lead to higher ratings, and that is what researchers want. And I think the perception researchers have that is it is published in an OA journal then it is not accredited is beginning to subside now more and more, because most of the high impact factor journals are now part of the OA movement. Researchers want to associate their work with high impact."*

CPUL3: "*Some people don't want their work to be reproduced, they want to keep their work to themselves, and I don't see the point of that. To me, I just see the advantages of OA publishing."*

CPUL4: "*That is why the library is advising researchers to publish in the institutional repository to increase the visibility of the research."*

CPUL5: "*Previously publishing in closed access, there was only one cost. Now with hybrid journals, the author pays for OA publishing (which you find that to publish that article as OA is almost the same cost of subscribing to the journal) and the library pays subscription fees for access to the very same journal, this is a problem. So there is a continuous debate around how to handle this issue of hybrid journals. One researcher explained, as much as she would like to publish in OA, the costs are just too high, and trying to sort this out is delaying her research to be published. I know that some*

institutions are now opting for (like The Stellenbosch University Library) using an Open Journal System, where they host their own journals. This is a way of overcoming the issues."

Table 7.18 highlights the themes identified from librarians' responses to the promotion of Open Access being "Promote the institutional repository: At faculty board /departmental meetings" and "When researchers request assistance". As much as librarians are working hard to promote Open Access especially since CPUT currently has an OA and RDM draft policy awaiting approval from Senate, the themes: "Still new, we are still learning" and "Open Access Movement is a mind-shift" are linked to the reality of the situation. Getting the buy-in from faculty and researchers are difficult as mentioned before, and is revealed later on in the researchers' responses on Open Access publishing. Further comments were:

CPUL2: *"It is also a means of saving subscription costs when researchers publish Open Access, especially with the financial challenges faced, the institution is looking more into Open content. We source open content and recommend faculty to consider these for prescribing, for example we are currently running The Open Access e-books project, where the librarians are identifying core titles within our e-book collections and distributing links to the relevant lecturers or departments. This saves a lot of money. The Open Access movement is a mind-shift."*

CPUL4: *"This is the department that is up to date with creating visibility of their research by allowing us to publish the post-print in the institutional repository."*

Two librarians responded when asked about their knowledge and experience of Open Science, that they were not familiar with it. Table 7.19 highlight the themes that came out of the responses from the three librarians being: "Good to know what is happening in the world", "Risk of work being stolen before publishing", "SciVal / Scopus-good collaborative research practice", "Avoid re-inventing the wheel", "Competition – competitive advantage" and "Protected work". Some further comments were:

CPUL1: "*In a sense it is good to know what is happening in the world, who is doing research in a particular niche area. But on the other hand I don't think it is a good idea because people can steal your work and ideas…without acknowledging your idea and the hard work you put into a project, other people run with your idea and publish it before you can."*

CPUL2: "*I think it is a fantastic practice, especially looking at platforms such as SciVal and Scopus, what they are doing is really trying to link these researchers to encourage collaboration and collaborative research, to make a difference. The whole idea of research, as much as you want to own the project, you don't want to re-invent the wheel. Depending on the context, it is something new to put one's head around. For an institution, it is also about competition. If I look at the wine-project and the department looking for collaborators, there was an institution that declined the offer to collaborate, and as much as we were wondering why, each research department and institution wants to know "what is in it for me", and the reality is that there is always competition, each wanting their own competitive advantage."*

CPUL5: *"My view would be, As long as that work is protected…even with a unique identifier."*

The follow-up question asked librarians what role the library played in promoting Open Science. Table 7.20 illustrates the themes that stood out from one of the librarians: "Linking researchers with collaborators", "Step one in opening up the world" and "Librarians are on the web all the time". However the majority of librarians responded "I am really not sure" about the library's role in promoting Open Science". Librarians' responses are linked to the "Horizon2020 – Work Programme 2016-2017 Science with and for Society" which discuss the drive for open science practices (European Commission, 2017). Further comments were:

CPUL2: "*Well, when you visit other institutions, you take your expertise and knowledge with you and also draw from what you observe out there… As librarians, we are on the web all the time. When researchers request information from us about what has been done in a specific field, locally and internationally, we as librarians are already doing research for them in terms of guiding them with the information we gather in their research plan. We teach them how to link up with experts in their field for possible collaboration, we are going beyond providing them with the literature. For me, this is already step one in opening up a world for them."*

CPUL5: "*To be honest, so far we are promoting data and data management plans, our focus at the moment is there."*

With regards to librarians' knowledge and experience of Research Data Management and what role it played in supporting research, the themes from librarians' responses indicate that the library has started working on how to deal with this research trend. The main themes illustrated in Table 7.21 were: "The library busy with a RDM project", "Researchers are concerned about data security", "Librarians are attending workshops" and "Good research practice". Additional themes that only came from one librarian, is perhaps thought provoking since CPUT has a RDM policy in place and CPUT Libraries are currently in the process of preparing librarians to provide research data management services: "A policy in place- RDM plan to be included in proposal", "Librarians expected to be involved in RDM from January 2017" and "Librarians play a Pivotal role in RDM". However not all librarians were sent for training as pointed out by a librarian later on, even though all librarians are expected to provide this service from January 2017. The imbalance identified in the librarian's responses suggest that there is need for expanding awareness and training to all librarians. Librarians commented further:

CPUL1: *"I know that the library is busy with a project on RDM in a specific department. I think that RDM is a topic for further discussion…"*

CPUL2: *"Research Data Management are on the lips of all research and faculty librarians at the moment. It is one of the buzzwords in the field at the moment. At this stage, we do not do much with this, but in a year from now, I will probably be able to tell you something very different because by January 2017 it is expected that we be actively engaging in RDM Plans for the faculty. We have a policy in place, and researchers will now need to include their RDM Plan at proposal level. But to be*

honest, we do not engage with it actively at the moment, this is a work in progress. But in my opinion, a definite must. We do have a pivotal role to play within RDM."

CPUL3: *"OER workshop was run, there is a pilot with one group of biomedical researchers to upload their dataset in a separate repository, and they were assisted with the Data Management Plan… My thoughts or experience is that they [researchers?] don't feel safe about it, they are concerned about their data being secured."*

CPUL4: "*It is still a new thing. We are still attending workshops to understand and gain knowledge on Research Data Management. Currently we are talking about ORCID, bibliometrics, H-index, number of cited publications etc. The researchers need more awareness on this, because they are not keen on putting their data out there. But it will be a good thing for research"*

CPUL5: "*New developments to protect data. In my view, it should be made available, as long as it is protected. It increases research by having data accessible, improving and increasing research production. I wouldn't mind sharing my data, as long as it is protected."*

Mixed feelings were expressed by librarians when asked whether RDM should be a function of the library. Many referred to other research units in the university as Table 7.22 illustrates in the themes "Other stakeholders-Postgraduate support unit /research directorate" and "Library Not to take full responsibility", suggesting that the library should not take full responsibility of RDM. However, two themes that came out from one librarian was "We need to, but is still new" and "Library need to step up". This is open for further debate, considering this being one of the IFLA hot topics. Further comments from librarians were:

CPUL1: "*I think it is not a bad idea, but the postgraduate/research unit is also there. But for the library we will know what research is being done if we manage department's research data."*

CPUL2: "*Providing the space, but not taking the full responsibility, our role in assisting with RDM must be clear as there are many stakeholders involved."*

CPUL3: "*Mmmm… not really a function that the library should be managing, because we have the research directorate and the postgraduate unit. You know, when a postgraduate student graduates, they need to submit their thesis to all these unit, and to the library, but the library is always the last place for submission… they don't like that because they only want to submit the thesis at one place."*

CPUL4: *"I don't think that the library should take the authority, but rather collaborate with the research unit. I don't think we should duplicate things."*

CPUL5: "*We need to roll out Research Data Management services to our researchers, but we are at the early phase / stage, it is underdeveloped. We have piloted it with some researchers, and gathering from the feedback, it feels like it needs to be fully developed first before we put ourselves out there. But yes, the library should excel in this area, we should be taking on this role, we just need to step up."*

7.3.7 Rating of academic library research support services

Librarians' level of satisfaction with regards to the functionality of the library is thought provoking, reflecting on the themes illustrated in Table 7.23 being "Librarian and faculty collaboration

improved", "Room for improvement", "Still more reactive than proactive", "No management support to implement new activities" and "Heavy workload: Few librarians" that stood out. There is some level of satisfaction, however it was pointed out that there is room for improvement. . Only one librarian was not satisfied with the functionality of the library. The issue of heavy workloads, few librarians, and no management support suggests an area for further discussion. Librarians elaborated further:

CPUL1: "*within this departmental library, there is quite an improvement in the way the faculty is collaborating with the library, much better now."*

CPUL2: "*If you compare us with other departments within this institution, I would say yes. However a lot more can be done. It is still more reactive than proactive."*

CPUL3: "*I am not satisfied, because I want to reach the students to support their research, but you don't get the management support in terms of new activities. It always has to go through so many people, deputy director, DVC and so on, which delays things. Everything needs to be approved."*

CPUL4: "*With the new developments and trends, there is a lot of room for improvement, there are many changes. Faculty-librarianship relationship is good."*

CPUL5: *"Although I think we need to be on top of the game. Maybe it is my dream or vision. If I look at other university libraries, they have more staff personnel for a specific unit, whereas on our side, we have fewer staff, yet we have so much to do, we also want to be up there at the forefront, at the top of our game, however there is just so much we can handle considering our heavy workload and only a few librarians. But so far so good. Looking at the institutional research report, there is amazing work done there, and we can see ourselves playing a role in the institution's research progress."*

Later on librarians confirmed their level of satisfaction in the multiple choice questions, where librarians had an opportunity to rate the library from 3 to 10, with (3) being low and (10) being indispensable. Figure 7.2 illustrates that all librarians gave the library an above average rating in terms of research support and therefore did not have to answer the follow-up question which provided a list of possible reasons that librarians could choose from and also a space to provide other (reasons not listed) or additional comments if they rated the library low.

Of the library resources that faculty and students are using extensively specifically for research according to librarians' experience, "Still Rely on Print books" says something about the printed book far from being extinct as pointed out by Robert Darnton in a seminar held at the University of Bologna in 2014, "Google scholar" Very much linked to what was stated in previous study that students' first point of seeking information is Google (Kleinveldt, 2015). Other themes illustrated in Table 7.24 revealed that according to librarians, the library resources that researchers also accessed were "Electronic resources" and "Sage Research Methods". Further comments from librarians were:

CPUL1: "*Can I tell you, they make a lot of use of print books, as much as I try my best to promote our electronic resources, they tend to still come to the print books. "*

CPUL2: "*They are still highly dependent on Google Scholar, LibGuides, and ScienceDirect. I would like them to use Scopus more, Sage is a key resource that they need to access. Our researchers still rely very much on print resources*"

CPUL5: "*CHEM SPIDER is really making an impact*."

Table 7.25 revealed themes on other research support services offered by librarians in the past year being "Information Literacy Training", "Mendeley", "Advanced Information Literacy" and "Institutional repository- create researcher profiles / self-archiving". One comment that is thought provoking is:

CPUL3: "*assistance with Turnitin and SafeAssign (but now only lecturers have access to this now, librarians no longer have access because we fall under admin staff, not academic),"*

However Table 7.26 highlighted that librarians promoted "Electronic resources", "Libguides", "Sage Research Methods database", "institutional repository: DK [Digital Knowledge]", "Mendeley" and "Credo Reference database" to support research. Surprisingly, printed books are still promoted by one librarian, especially "Research methodology books". The more modern promotion came out in the response by another librarian "ORCID/research output/h-index". Librarians elaborated further:

CPUL1: "*LibGuides provides a list of databases relating to their discipline*."

CPUL2: "*On our LibGuide we created specifically for researchers, databases of importance, Guidelines, Accredited journal list, basically linking faculty information to the LibGuide."*

CPUL3: "*We have an E-resource Fair, which is an exhibition we have once a year to showcase electronic resources on campus for the university community*"

CPUL5: "*Right now we are driving ORCID, which links to the institutional repository, research output, and h-index. The interoperability of systems-clean-up project is what we are promoting at the moment."*

As described in Chapter 6, one question focused on possible research support services that acted as a type of 'wish list' that librarians could offer. Table 7.27 indicates a list of possible research support services in order of priority according to librarians' preferences. Librarians had to give a score for each research support service listed on the 'wish list' provided by either choosing: "very important" (which had a score of 1), "useful" (2) or "not important" (3). This meant that scores were calculated in such a way that the lowest number is more important (high ranking) than the higher numbers. The lowest score was "other" and therefore listed first. Here three librarians chose this option and specified "Supporting the whole research cycle" (CPUL3), "Face-to-face visits" (CPUL4) and

"Copyright and Licenses" (CPUL5) as "very important" research support services. All librarians scored the following possible research support services as "very important": "Ongoing updates on new information resources", "Advice on bibliographic referencing", "Database training" and surprisingly "Advice on Research Data Management". Last on the wish list for librarians are "Training on social media use for research" and "Training on mobile apps for research".

It is perhaps a step in the future direction of academic librarianship that librarians' wish list in terms of research support services includes both traditional and fairly new services. On the other hand it is possibly taken as the norm by librarians that users are Web2.0 /technologically inclined, therefore training on social media and mobile apps for research was placed last on the list of possible research support services. The NMC trend report somehow confirms this observation.

7.3.8 Competencies for conducting and supporting research

Librarians were asked what other areas in the research process they thought faculty and students need assistance with, which librarians or the library can offer in the future. Table 7.28 illustrates the themes from librarians' responses, with the main one being "First phase of research assistance". One theme that stood out in particular is "Library should assist / train throughout research process". This links to the literature by Fourie and Bakke (2013) on the research life cycle and where librarians fit in.

Table 7.29 represents the themes from librarians' responses about their training needs for supporting research being: "RDM", "We can always learn something new", "Understanding research methods" and surprisingly "Librarians have a heavy teaching workload". Other themes that stood out are "I am still new in this position", "The A-Z of research" and "Publishing data training". Librarians elaborated further:

CPUL1: *"Yes we can always learn something. But training depends on oneself, whether one wants to do it or not."*

CPUL2: "*Oh yes, I would like training on RDM (upcoming) it is very important that we are taken through this process in terms of what our role and responsibilities are in RDM, and also the publishing processes and understanding of research methods and what it entails."*

CPUL3: *"Yes, because I am still new in this field and position, and learn every day, so I still need support. Training on Research Methodology will be important so I can support researchers better.* "

CPUL4: "*I want to be in research, I want to know A-Z what is going on there so that I can get out of this Information Literacy training, to deal with researchers only. Research Data Management, Data Curation, Data Management Online. I have a problem that only certain people in the library can attend training on this. So I don't know whether my interest, or wishes will be satisfied. When the senior library assistants joined us, I thought that they were going to take over the teaching so that*

we librarians could focus fully on the research part, but, now the senior library assistants are more involved in the research support than the librarians. We are so behind because we have to teach. We are not attend training, new people are, and we have to beg to attend training on new developments so I really don't know…"

CPUL5: "*As much as we feel we should do this, looking at the staff capacity, overworked, heavy workloads… how do we balance this? The implementation phase is challenging just looking at the faculty librarians' heavy workload. But yes, for example Research Data Management is new, and I still need to find my way, so I need training. Also training in publishing data."*

The librarians' training needs are very much linked to the research trends, IFLA hot topics with "RDM" being the main focus for librarians. However the themes mentioned above: "We can always learn something new", "Understanding research methods", "Librarians have a heavy teaching workload", "I am still new in this position", "The A-Z of research" and "Publishing data training" are open for further discussion.

7.3.9 Research support in policy building

Librarians were asked in what way their research output or their support contributed to guidelines or procedures in the university. Table 7.30 highlights the themes identified from the librarians' responses, the two main themes being: "Current awareness" and "Promoting institutional repository- Contribute to research image of university". Other themes that stood out are: "Faculty consult librarians for assistance beyond traditional library services", "Librarians discussing a solution to link researchers' profiles: Researchers don't want duplicate activities", "Presentations at faculty board /departmental meetings – increased database usage statistics" and "Influences library colleagues- conducting research/ conference presentations". Librarians elaborated further as follows:

CPUL1: "*To make people aware of research in the university, create awareness of the library services and resources. I will share new developments in research with the departments."*

CPUL2: "*I would say within departments, through this back-dated research project we are working on. Sourcing publications and making it available on the institutional repository. Visibility improved, which was a huge change and improvement and contribution to the university. It contributes to the research image of the university. Researchers actually approached the library to assist in identifying collaborators, research partners, assistance in checking credibility of journals, the library is central in handling these queries. This is very important, and I think that our support is driving the research component of the university in the right direction. The fact that the faculty is asking us for assistance beyond our traditional services, is good."*

CPUL3: "*You know, the problem is that researchers don't have time, they just want to focus on their research, so they at times become discouraged when we introduce them to new platforms, for example our institutional repository, they feel like we librarians are giving them more work by asking them to upload their work in DK, they feel it is unnecessary or duplication because they mainly use Publish or Perish, or listed on Scopus…So now the researchers just want one platform, for example, if*

they upload their publication in ResearchGate, there should be a way to link it to the other platforms such as the institutional repository, and we librarians are discussing this and trying to find out the best solution to link it."

CPUL4: "*In my research findings, researchers want to access electronic resources but the problem was that they are not aware, or they found difficulty in accessing databases. So based on this I have promoted it at the faculty board meetings, advocating library resources, in each and every departmental meeting as well, spreading the word to promote electronic resources. Now we can see the changes in the usage statistics as we move from print to electronic, it's increasing based on my research findings and how I dealt with it at faculty to increase database usage."*

CPUL5: "*I am currently studying a Master's degree. So far I have produced a paper for LIASA conference, but it has not made that much impact… and participating in IATUL as well. So this influences our colleagues in the library."*

Librarians' marketing strategy of research support services through faculty board and departmental meetings have made a substantial contribution to guidelines in the university. The institutional repository and the uploading of theses in particular also being a main theme that stood out from librarians' responses as highlighted above, have become mandatory procedure in the examination process at CPUT which improves visibility of research. This is evident in the latest webometrics report highlighted earlier in the chapter, that there is a huge improvement in the ranking of the institutional repository, due to the good marketing and collaboration between librarians and faculty to make the university research visible and placing the university on the research map. This is crucial for this young university of technology developing a strong research culture based on its history where previously the focus was solely on teaching. The response to the Likert scale statements by librarians, researchers and students confirm that research visibility is fundamental.

A question asked librarians about their opinion on whether research support enhanced teaching and learning in any way and how. The majority of librarians agreed that their research support enhanced teaching and learning, only one librarian was not sure, that it is rather an improvement of knowledge. Table 7.31 indicates the themes that were identified from librarians' responses. The main themes identified are: "Improves knowledge", "Knowledge transfer: academic to student", "Information Literacy training", "Librarians keeping up to date" and "Update researchers on new research trends: Bibliometrics, Altmetrics, and RDM". Some comments from the librarians are as follows:

CPUL1: "*I'm not sure if it improves their teaching, but maybe improves their knowledge. Perhaps transfer of knowledge happens from academics to postgraduate students."*

CPUL2: "*especially when it [the research] is linked to the curriculum, it will build a greater knowledge, creating a snowball effect."*

CPUL3: "*there are so many trends in the academic library, so if we as librarians don't keep up with what is happening, we will lose track…for example the 2014 trends focused on bibliometrics, altmetrics, and at the time it was not practiced in all academic libraries. So I would say, by providing training on Mendeley, it improves researchers' bibliographic referencing, and it saves them time."*

CPUL4: "*By training researchers on library resources, it is transferred to the students through teaching. Lecturers need to know what is needed [in terms of information resources] to be a researcher."*

CPUL5: *"…our engagement in research support activities such as bibliometrics and altmetrics activities leads to enhancing ourselves, because we need to educate ourselves so that we can train our users. We assume that researchers are aware of research activities such as RDM, bibliometrics, but when we talk about it, we discover that the level of understanding among researchers are limited when it comes to these trends. We have run workshops with one of the professors that manages a research group that was very successful."*

"Information Literacy training" was highlighted as one of the main themes that stood out from librarians' responses to their research support enhancing teaching and learning. At CPUT libraries, IL has become one of the core duties, meaning that librarians spend about 80% of their time teaching due to the IL policy in place since 2009, the demand for IL training has increased drastically because now faculty need to have evidence of IL integration into the curriculum. Based on this, to support faculty, the library also offers an IL Certificate Programme since 2013, and carry credits. Although IL training is compulsory for all 1st years at CPUT, the course is offered to all levels up to PhD on request from the faculty. The library has also advanced, now offering the Advanced IL Training specifically to researchers and postgraduate students, which librarians also mentioned in their earlier responses. The other theme that was thought provoking is "Update researchers on new research trends: Bibliometrics, Altmetrics, RDM". This links to a previous comment by a librarian about the NRF requirement for researchers and their visibility. Therefore librarians are keeping up with trends and finding ways to support researchers with that, with the literature already discussed revealing that Bibliometrics and RDM very much are the contemporary research practice worldwide (IFLA, Horizon2020, NRF, CNR).

On the topic of librarians' research support contributing to student development and success, the theme as illustrated in Table 7.32: "Motivated students- Higher throughput rate", is thought-provoking, that librarians' research support makes a significant impact. This is evident in the number of IL training requests from postgraduates increasing by the year. The quote by CPUL5: "*That they have published at least. Publications should come up after our support, which is evident in the institution's annual research report"* supports the theme. Other themes that also stood out were: "Current awareness", "Information Literacy training" and "Increase their research visibility". Some further comments from librarians were:

CPUL2: "*A better quality researcher within the faculty is a catalyst for Teaching and Learning development which eventually, can create a better understanding of students which leads to a higher throughput rate. It also motivates students, it can also attract more students."*

CPUL3: "*I recently helped PhD students setup their profiles on Google Scholar, they get motivated when they see that their work is cited. Through increasing their visibility, improves their development."*

CPUL4: "*I am teaching students how to find reliable and relevant information for their information need, how to analyse a topic, search techniques /strategies so students acquire the skill to broaden or narrow their search by using the BOOLEAN technique and so on, which all form part of the Information Literacy Programme. I received a lot of requests from the faculty to train Information Literacy because it makes a huge contribution to student development and success."*

Regarding librarian research support contributing to community engagement, the theme "Faculty publications uploaded in various platforms / institutional repository: reaches community" as illustrated in table 7.33 form part of the Open Access movement and reaching out to the community. As mentioned earlier, the institution has an Open Access draft policy in place. One librarian mentioned that information provision and support is provided to the farmers, this way the library is going beyond supporting the university community, and elaborated further:

CPUL2: *"Remember this is an agricultural area, so there are a lot of extension activities taking place. What we would like to see is us becoming involved in the extension services, but also that the library become the hub for farmers to get together and come to the library for information support. This means that we not only focus on being an academic library, but go beyond, through community engagement, where the broader community can benefit."*

Some other examples of reaching the community that librarians mentioned are as follows:

CPUL3: *"One of the lecturers in the faculty has put the institution on the map by uploading his publications on various platforms, led to requests from outside the institution to do presentations. So I would say that it reaches outside through researchers presenting outside the institution about their work."*

It is perhaps thought provoking, that through open access, requests from outside the university are increasing as claimed by CPUL3 above. The following quote confirms this:

CPUL5: "*With the current project (bibliometrics and altmetrics), we are doing a clean-up, making the university output visible in the institutional repository."*

It is evident that the university's research output is visible through the institutional repository as mentioned earlier through the latest webometrics report, reaching out to the society. As mentioned in Chapter 6, the DOAJ announced recently that there are more strict criteria in place now for indexing OA journals. However, DOAJ makes it clear that the focus is not on impact factor of

journals. Perhaps this gives enough reason for the stigma, as established and prolific researchers very much want to maintain their status by publishing in high impact factor journals, especially in the sciences, and this comes out very strongly later on from researchers' responses. Although other literature shows that high impact factor journals are not ideal for measuring research impact. Another practical example of reaching the local community was mentioned by CPUL4 below, where the librarian is involved in supporting students with their research projects:

CPUL4: "*The knowledge that the university community as a whole gains from us, is easily spread to the outside community. I give them examples during my training, For example, students had a project on the use of generators, and students could go out to the schools and give information."*

7.3.10 Likert scale statements

As mentioned in Chapter 6, the aim of the Likert scale statements is to confirm or contradict previous responses by librarians by delving deeper into librarians' perception of their role in supporting research. Figures 7.3 to 7.15 represents the librarians' scores to the statements. The ones that stood out were the physical library space, research being essential to the job, international collaboration being key, Open Access, RDM, and social networking sites. It is perhaps surprising that the majority of librarians were undecided about the statement that researchers don't need to visit the physical library, especially when it was mentioned on more than one occasion earlier that the printed books are still heavily used, even though the library's collection development policy is geared to the electronic route. That the majority strongly agreed that research is essential to the librarians' job is to some extent confirming earlier responses where librarians indicating that they are currently pursuing their master's research, one librarian involved in an international collaborative research project that will lead to a publication. This is also in line with the future role of librarians supporting research. It also confirms the following statement that the majority of librarians strongly agreed that the university need to build a stronger research culture. As previously discussed as a background into this study, in order for knowledge society to develop, research is essential to move the university forward and reaching the community. It links to the vision and mission of the Chemistry and Chemical engineering departments mentioned at the beginning of the chapter. The majority of librarians agreed that international collaboration builds a stronger knowledge culture in the library. Evidence of this is in the RDM collaboration with TUM, in agriculture with Virginia Tech as mentioned in one of the responses earlier. The majority of librarians strongly agreed that Research Data Management is becoming an important practice in supporting research. This confirms the new support that librarians claimed will be offered to researchers at CPUT from January 2017 onwards. There is also a RDM policy in place. With regards to Open Access journals increase citation

counts, the majority of librarians agreed. However one librarian is undecided. This is open for further discussion.

The last statement attempts to affirm librarians' previous opinions on social networking sites and their visibility on the web. Here responses in Figure 7.15 confirms previous responses where librarians were very keen on being visible on the web or embracing SNS to support research. Two librarians strongly agreed, two agreed and surprisingly one librarian was undecided with the statement "having a research profile on social networking sites have increased the visibility of my work".

7.3.11 Additional Comments by faculty librarians

Librarians were given the opportunity to make additional comments on the topic of supporting research. Table 7.34 highlights the themes from librarians' responses. Only one librarian made no additional comments. The following comments stood out:

CPUL1: *"I think we need to stop being a separate library. My vision is that we be embedded in departments in order to know what the future is of the departments. There needs to be integration with departments and faculties. It is important to show what value libraries have."*

CPUL2: "*I think your timing is very good. There has been a lot of planning in terms of research support. Role clarification is important. We are looking at a Platform for RDM. There is a lot of positive going on. We are definitely on track in terms of research support. The library is taking the initiative in research, in positioning ourselves well in our research community by supporting and partnering*."

CPUL3: *"Maybe there is just one thing that I want to add… you know, Librarians do a lot of admin work, and many duties, we touch here and there and everywhere that sometimes we lose focus, especially with regards to research. I think that they [the library] should employ a certain person to upload publications on DK [Digital Knowledge: institutional repository], a specific person for that job. You find yourself doing ten people's work, one part of my job is lacking, and the other part is up there. There is another issue, stepping in other people's boundary… for example, if I assist a research from another faculty, it becomes an issue by that faculty librarian when I am being recognised or acknowledged for my help…it is like I am isolated, and limited to only supporting people in the faculty that I am responsible for, irrespective of the researcher's need for support at that given time…so what do you do in those cases. You don't get support from management, there is no rotation, and no exposure to other departments in the library, there is so much that we can learn from another. Because of all the admin, the other important part of our work is lacking…"*

CPUL5: *"My wish list is in research support, still focusing on Open Access publishing. If I look at where researchers are publishing, the majority are still publishing in closed access journals. And when I look at those journals, we as the academic library do not have a subscription to it… meaning that our access to researchers' publications are restricted to our university community. For example, one lecturer published a chapter in a book, and now she needed access to her own chapter, but the library did not have a copy of that book, and she had to go via Inter-Library Loans, which she was not happy about, but I explained to her it depends on the licensing agreement she signed when*

publishing. But I think the Open Journal System is the way to go. I found the workshop that I recently attended at the Academy of Science about OJS was beneficial."

7.3.12 Concluding remarks on academic librarians supporting research

Responses from librarians at CPUT Libraries revealed that an effort is being made to deal with the trends discussed in the literature. The policies that exist do to some extent assist the library in aligning to the research goals set by the institution. However the heavy workloads that were mentioned on more than one occasion has been flagged for future consideration by the institution as a whole in terms of the support needed for research and meeting the targets. Librarians however are open to learning and updating skills to support the research trends. The additional comments by librarians are open for further discussion.

7.4 Findings: The perception of Chemistry and Chemical Engineering researchers and PhD students

This section reports on the findings from interviews conducted with Analytical Chemistry and Chemical Engineering researchers and PhD students at CPUT. The sample comprised of:

- Seven Analytical Chemistry researchers coded as follows: CPUC1, CPUC2, CPUC3, CPUC4, CPUC5, CPUC6, and CPUC7. Researchers hold different positions from junior lecturer to full professor to create a balanced representation as described in Chapter 5
- Two Analytical Chemistry PhD students of which one is currently being supervised by a Chemistry researcher also interviewed in this study. Students are coded as CPUCS1 and CPUCS2, and are currently in their final year of their PhD programme.
- Five Chemical Engineering researchers who are coded as follows: CPUCE1, CPUCE2, CPUCE3, CPUCE4, CPUCE5, and hold different positions from junior lecturer to full professor to create a balanced representation.
- Two Chemical Engineering PhD students at CPUT were interviewed, who are supervised by Chemical Engineering researchers who did not participate in this study. Students are coded as CPUCES1 and CPUCES2, and are currently in their final year of their PhD programme.

Similar to the case of UNIBO, some researchers initially selected for the study as discussed in Chapter 5, declined to participate. This led to using a different approach, namely knocking on office doors to recruit participants for the purposes of comparing Analytical Chemistry and Chemical Engineering researchers' perception of the role of the academic library in supporting their research. Since CPUT is still a fairly young university of technology, more pressure has been placed on researchers to conduct more research when previously, the core function of the institution, before

2005, was to teach. The findings in this section is also compared where possible to some findings from the 2009 Master's research project conducted (Kleinveldt, 2009) to see whether there are vast differences or changes in research patterns and opinions since then. The following section is arranged in themes also used in the case of UNIBO in Chapter 6 in an attempt to answer the research question and sub-questions of the study. Tables and figures illustrating the analysis of the data referred to in this section are found in **Appendix B.**

7.4.1 The role of the researcher as prosumer

Participants were asked to describe their role as a researcher. Table 7.1A in **Appendix B** illustrates the themes identified from Chemistry researchers' responses. The main themes were "Assist students in lab and research projects", "Supervise Btech and Mtech students" and "Mentor undergraduate and postgraduate students". Three researchers indicated that they are pursuing their "PhD studies". However, one researcher pointed out "Basically a student". Some further comments from researchers were:

CPUC2: "*I started as an ordinary researcher in a research group. Now I am managing students in a research group. I also mentor undergraduate and postgraduate students. Before I was conducting active research, now I manage research."*

CPUC3: "*I am basically a student. I wouldn't say that I hold a research position*."

CPUC4: "*I am currently in the final stages of finishing my PhD studies. I have supervised a number of Btech and Mtech students in the past. One has just graduated. For the future, I am co-supervising a Masters student. And I am hoping to supervise my own Masters student next year*."

CPUC5: "*I think my role is completely misunderstood in this position in the department, I was appointed as a researcher. I am lecturing more than being a researcher. I am always evaluated on my research and not on my teaching, so it is problematic. I think my role should be to do research, but was diverted. I am doing two jobs because I am doing a lot of research for my career*."

CPUC7: "*My role is basically involves design and implementation of research projects. This involves students; assign research topics, guide them is proposal writing, designing experiments, and supervision. This involves assisting them with the requirements of the institution in completing their research projects."*

The remark by one Chemistry researcher stating the role as being a student is perhaps thought-provoking since the researcher has been employed at CPUT for many years, long before the merge. Whether the role is seen as 'student' is positive of negative is open for further debate. The point raised that researchers are evaluated solely on their research and not on their teaching also came out of responses in the case of UNIBO, which suggest that perhaps evaluation criteria needs to be considered. The concern for the way research is evaluated that is raised here and also in responses

later on is in line with Houghton's (2004: 171) findings of Australian researchers revealing similar experience and views regarding this.

Table 7.1B illustrates the themes identified from Chemistry PhD students' responses, both indicating their different roles. Two themes that stood out were "Apply knowledge to real-life situation" and "Review proposals for Btech and Masters Students". Further comments from students were:

CPUCS1: *"Basically our role as PhD students are to get scientific knowledge, to solve problems, apply, for society demands, working with industry to find ways of apply our knowledge to real-life situation."*

CPUCS2: "*My role is to review proposals of Btech and Masters students, and also assist with training students in the Biotechnology lab. I only trained two students in chemical engineering lab."*

Table 7.1C below illustrates the themes identified from Chemical Engineering researchers' responses. The main themes were "Currently busy with PhD studies" and "Supervising student research role". One theme that is perhaps thought provoking, is "Also conduct Research on Teaching with Technology". Some further comments from researchers were:

CPUCE1: "*I've just recently completed my PhD. So my research activities mainly focused on my PhD. My research area is on biomasses / bioprocessing. I am now co-ordinating research workshops for PhD students."*

CPUCE2: "*I am currently busy with my PhD studies. My research focus is on waste water treatment. I am also involved in research on Teaching with Technology, the use of emerging technology that can improve teaching and learning such as Clicker Technology, online learning environments.*"

CPUCE3: "*I joined the Chemical Engineering department here at CPUT in 2009, and since then, I graduated six students. I have a supervising role. I am involved in collaborative research especially with young researchers in the department to up their game in research so to speak. I also have industrial collaboration, writing proposals to get funding."*

CPUCE4: "*I currently lead research at various levels, Masters etc. in the department. I am also in the final phase of completing my PhD studies*."

CPUCE5: "*All staff are required to conduct research in the department, and there are many niche areas. My research niche area is in waste water management."*

Table 7.1D illustrates the themes identified from Chemical Engineering PhD students' responses, both indicating their different roles. A theme that stood out was "My role is to learn, write reports and present research". Further comments from a student was:

CPUCES1: *My role is to conduct research and contribute to the department's work as a whole. My role is to learn and write reports or present my work, on my topic inorganic chemistry – recycling spent batteries.*

Three out of the seven Chemistry researchers, and two out of the five Chemical Engineering researchers are currently busy with their PhD studies, which relate to the young university and the transition from the core function of teaching to a combination of teaching and research. The pressure to conduct more research was highlighted in the comments above. One Chemical Engineering researcher also revealed going the extra mile by also conducting research to enhance teaching and learning, not only focusing on the research niche area. It is perhaps thought provoking that there are a few researchers in the institution considering research areas over and above what is stated in their job description or role. There are perhaps various reasons for this, and underlying issues that lead people to stick to their niches areas only that was not revealed here. However some researchers in the case of UNIBO revealed that their research was not at all related to the subjects they were teaching, which also relates to the literature stating that evaluation of research is focused on more on quantity than quality (Houghton, 2004: 171). One Chemical Engineering researcher pointed out playing a mentoring role to encourage and assist younger researchers through conducting more collaborative research in the department. A good way of motivating and helping young researchers through collaboration. As pointed out in the literature, research has moved away from the silos to group research (Houghton, 2004: 171), and responses here and from UNIBO confirms this. On the side of PhD students, it is revealed by one Chemistry PhD student having a role of an academic, as part of the responsibilities are reviewing master's proposals and supervising students, which perhaps is thought provoking. However it is in line with the future direction of PhD qualifications to move more towards publication, and including mentoring programmes to equip PhD students for academia (Fung, Southcott & Siu, 2017: 175).

Participants were asked to describe their current research practices and how it has changed over time. Table 7.2A presents the themes from the Chemistry researchers' responses with emphasis placed on how research support practices have changed over time since they started conducting research. The main themes were "Things have changed: Huge technological changes: Everything is readymade", "Tedious previously", "Spent lots of time in the physical library before" and "Stay in my office now and access library's electronic resources". The theme "Heavy teaching load" from one of the researchers somehow links to the history of the institution which was previously the core business. It suggests that perhaps provision has not yet been made to handle the heavy teaching load with the additional research responsibility now in place. Another comment that stood out was from a chemistry researcher (CPUC5) pointing out that after becoming a rated researcher, funding

for research were received much easier to the point that research groups and projects are managed by the researcher instead of conducting the actual research. Due to the rapid advancement in technology, researchers are able to access information electronically in their offices in real-time, which has made a major difference in the lives of researchers in terms of saving time. Researchers elaborated further:

CPUC1: "*Not much has changed, but I struggled a bit in the beginning with how things are done, now I have adapted and know who to talk to on campus*."

CPUC2: "*Life was very tedious previously. Now everything is pre-made reagents, practically everything is readymade these days. We spent a lot of time in the physical library before because there was little Internet, now things have changed, staying in my office and accessing the library's electronic resources.*"

CPUC3: "*I started my research quite some time ago before the days of ScienceDirect, so I had to request papers from the library that took a long time to arrive, sometimes it was coming from London and it costed a lot of money, whereas now things are facilitated through technology, online resources like ScienceDirect. Previously we were way behind in accessing electronic resources*."

CPUC4: "*The computer part of the analysis is a huge change in my research. My interest has changed since I started my PhD research.*"

CPUC5: "*When I started practicing research, there were no funds for conducting research. I collaborated a lot with researchers to help me. Only when I was rated by the NRF (National Research Foundation), I then started getting research funds. Now I was able to build a research group. I am more a manager of the research group and the research in the department. Things have changed a lot in the sense that I rarely go to the lab anymore, am more of a financial manager of my research group*."

CPUC7: "*The practices has changed. I have days that I assigned for my research… because of my heavy teaching load*."

Table 7.2B presents the themes from the Chemistry PhD students' responses with emphasis placed on how research practices have changed over time since they started conducting research. Here students revealed complete opposite experiences with the themes "Not much changed" versus "My project changed drastically". Two themes that also stood out from responses are: "Built confidence to put my work out there" and "Using different methods: more advanced techniques". Further comments from students were:

Table 7.2C presents the themes from the Chemical Engineering researchers' responses with emphasis placed on how research support practices have changed over time since they started conducting research. The main themes were "Things are easier now: access to information" and "Library played a role in supporting my research". The ultimate goal of librarians training and supporting researchers is so that researchers may become independent, which links to the prosumer

concept. Although librarians remain updating departments of new developments, research tools that can enhance the research activities of researchers. A theme that stood out was "After PhD, different view, understand the research process better" which to an extent links to the discussion in Chapter 2 regarding librarians conducting research or pursuing PhD studies to better support researchers and to understand the research process fully. Another theme highlighted was "Level and content of my research evolved". The shift from individual research to collaborative research which linked to the literature discussed earlier by Houghton (2004: 163) is raised here by Chemical Engineering researchers as a change in research practices as well.

Table 7.2D presents the themes from the Chemical Engineering PhD students' responses with emphasis placed on how research practices have changed over time since they started conducting research. Here students revealed similar experiences the themes "Experimentation work in the lab" and perhaps very ambitious or showing evidence of innovation, "Through my exploring and discovery, helped the department grow".

Participants were asked how they felt about their profile and visibility on the web. Table 7.3A represents the themes identified from Chemistry researchers' responses. Three researchers indicated "No web visibility", another three said it is "A good thing", while two researchers indicated "Not active". The theme "Very little visibility at the moment: don't want to expose all my work yet" is somehow in contrast to the research trends in higher education and prosumer behaviour that has been discussed in chapters 2 and 4 whereas the theme "High quality work on my profile" confirms with the literature.

Table 7.3B represents the themes identified from Chemistry PhD students' opinion on their profile and visibility on the web. Here both students indicated "I feel ok / good". Two themes that are thought provoking are: "My profile viewed many times based on my research" and "receive local and international collaboration requests" suggests that students more involved in embracing the web and practicing prosumerism via social media as chapter 3 discussed. One student elaborated further:

CPUCS2: "*Well it is only recently my ResearchGate profile was viewed so many times based on my research being on there. It makes me feel good, people recognise your work. I can see who is reading my work internationally and locally, it tells me the location of the viewers, and I also received collaboration requests this way. Just yesterday I uploaded one paper and already received 50 readers."*

Table 7.3C represents the themes identified from Chemical Engineering researchers' responses. The majority of researchers indicated "I am quite happy". Themes that stood out was "ResearchGate has

increased visibility", "Received more contacts for collaboration" and perhaps surprising "Web of Science visibility" which links to the evaluation of research through bibliometrics. That a researcher highlighted poor visibility of research on the university website, says something as UNIBO researchers gave high regard for their university research profile versus social media. However the librarians have pointed out earlier that the institutional repository, DK, has been promoted to researchers which allow research profiles that increase visibility. Further comments from researchers were:

Table 7.3D represents the themes identified from Chemical Engineering PhD students' responses being "An area for improvement: postgraduate student visibility on university website" which links to responses above by a chemical engineering researcher about having a university profile and "Good for communication and building networks".

Participants were asked whether they were using social media or Web 2.0 tools for their research. Table 7.4A indicates that the two popular SNS for Chemistry researchers are LinkedIn and ResearchGate. It is surprising that the previous response, three indicated having no web visibility, but here, only one confirms with the previous question, the other two now indicated using LinkedIn and ResearchGate. One theme that stood out is "ORCID ID in process" which is in line with the research evaluation process for promotion purposes.

Chemistry PhD students also indicated their two popular sites used are "ResearchGate" and "LinkedIn" as illustrated in table 7.4B.

The popular SNS for research indicated by chemical engineering researchers as indicated in table 7.4C, are ResearchGate, LinkedIn and Academia. One theme that stood out is "PLoS1", a huge Open Access publishing platform. Researchers elaborated further:

Chemical Engineering PhD students also indicated that they use "ResearchGate" and "LinkedIn" as illustrated in table 7.4C. It is perhaps thought provoking that one student indicated "not for research". In the UNIBO case, PhD students had similar views that it was not used for research, which to an extent is in contrast to the literature suggesting that the younger generation being tech-savvy and embracing social media for research. It boils down to the point made by Wilson (1981) that it depends on the information need whether social media will be used. The comment by the student below confirms this:

CPUCES1: "*But I do have a LinkedIn account for work purposes, not really for research."*

Participants were asked whether they thought that social media enhanced their visibility on the web. Table 7.5A highlight the themes that were identified from Chemistry researchers' responses. The majority of researchers indicated "yes", that the use of social media enhanced their visibility on the web. The main themes were "Connect with researchers", "See who is publishing what", "Important" and "Easy communication: Saves time". Three themes that are perhaps thought provoking are "Make a contribution by people citing my work: authoritative", "Follow research trends" and "My students refer people there".

Table 7.5B highlighted the themes identified from Chemistry PhD students' opinion on social media enhancing their visibility on the web, and both indicating "yes". One theme that stood out was "Increase post-doc possibility through networks built". One student elaborated further:

CPUCS2: *"A lot yes. The ability to exchange knowledge due to these sites like ResearchGate, because it is a professional site. I also stand a better chance of doing a post-doc through the networks I am building."*

Table 7.5C highlight the themes that were identified from Chemical Engineering researchers' responses. Surprisingly all researchers indicated "yes", that the use of social media enhanced their visibility on the web. The main themes were "Good statistics", "Receive comments from researchers" and "Community that helps each other".

Table 7.5D highlighted the themes identified from Chemical Engineering PhD students' responses, both indicating "yes". One theme that stood out was "Increase citations" and the student elaborated further:

CPUCES2: "*It improves yes because people are accessing me, increases citations."*

Participants were asked how social media enhanced research practices. Table 7.6A illustrates the themes identified from Chemistry researchers' responses, the main ones were "Being connected is beneficial", "Discovering publications in my research area", "Through peer-learning: I can ask advice from others on these platforms" and "Collaborating with researchers". However two researchers mentioned "Not for research purposes" which links to responses above regarding the use of social media.

Table 7.6B illustrates the themes identified from Chemistry PhD students' responses to social media enhancing research practices, with the main one being "Share information and gain information". Another theme that stood out was "Rate myself against other researchers". Further comments from students were:

Table 7.6C illustrates the themes identified from Chemical Engineering researchers' responses to social media enhancing their research practices, the main ones being "Direct communication with authors", "Good for visibility of research", "It does through new publication matching", "Alerts to new developments in my field" and "Researchers contact me for my publications". However one researcher mentioned "I wouldn't say improve research practices".

Table 7.6D illustrates the themes identified from Chemical Engineering PhD students' responses to social media enhancing their research practices with the main one being "Learn from what other researchers are doing". Other themes that stood out were "Through Collaborating or getting in contact with researchers in the same area" and "Improves through people accessing your publications". Further comments from students were:

CPUCES1: *"I have met / seen student profiles who have related research on LinkedIn which is useful to my research. So I learn that way by what other researchers in my field are doing."*

CPUCES2: *"Improves a lot through publications, people get to know your work. You can also identify gaps in research this way".*

A question asked participants what their opinion was on the faculty librarian being a contact on their Social Networking Sites that they are specifically using for research. Table 7.7A represents the themes identified from Chemistry researchers' responses. Here researchers had mixed feelings as highlighted in the themes "Very good idea", "Not applicable", and "That is too much work for the librarian". Further comments from researchers were:

CPUC5: "*She is on my profile already yes. It is very important, we are friends on ResearchGate, and one of the most important persons actually on my account*."

CPUC6: "*That is a lot of work for the librarian, unless she has a computer system that updates her, otherwise no!!!"*

CPUC7: "*No, that one, I don't want it, it is asking the librarian too much. I can't expect the librarian to know each and everyone's research niche area*"

Table 7.7B represents the themes identified by Chemistry PhD students' responses about their opinion about the librarian being a contact on social media. Both students indicated "Very important" and "Good for sharing and collaboration between librarian and student". Further comments from students were:

CPUCS1: *"It is ok, positive, because the librarian might share some information for me. I can gain from this. I can also use that opportunity to share information with the librarian there as well that can benefit other students as well."*

CPUCS2: "*This is exactly what I was talking to my supervisor about. It will be very useful. Especially with our publications that need to be uploaded in the institutional repository."*

Table 7.7C represents the themes from Chemical Engineering researchers' views on the librarian being a social media contact. Here researchers had mixed feelings where three indicated "I strongly support that", one said "A redundant role", and another researcher responded "Not practical for librarian to be interested in all our research niche areas". Further comments from researchers were:

CPUCE1: "*I will strongly support that."*

CPUCE2: *"I will accept, it is about visibility. I don't have a problem."*

CPUCE3: *"It will be good, she will know what I am doing. That is one of the ways that the librarian can manage our output. It will avoid me from having to do the physical upload of my publications into the institutional repository, because I don't like that, I don't want to do this extra work."*

CPUCE4: "*Personally I feel that it would be a redundant role."*

CPUCE5: "*It depends on what her interests are. Our department has diverse research niche areas. I can't see her practically interested in all research interests. But maybe she could have input regarding information or ideas that we as researchers are not aware of that can benefit our research."*

Table 7.7D represents the themes identified by Chemical Engineering PhD students' responses. Both Chemical Engineering PhD students indicated that having the librarian as a contact on social media: "It could be useful".

7.4.2 Researchers' perception of the role of the librarian supporting research

Participants were asked to describe their experience of the library supporting research as well as their perception of the faculty librarian's role in supporting their research. Table 7.8A highlights the themes identified from Chemistry researchers' responses. The main theme regarding their experience of the library supporting research, as well as the librarian's role in supporting research, were "Very impressed with the library and librarian support" and "Librarian has always been helpful". One theme that was thought provoking was "I was not aware there was a librarian for support". Further comments from researchers were:

CPUC1: "*The library is trying, makes information available through subscriptions. I can't really say much about the librarian, I am only aware of her now."*

CPUC2: "*Library is very important. From the beginning with only print material until now that we have all these electronic resources. Without the library we cannot function. The faculty librarian is the pivot, without whose intervention you cannot go without, she is crucial*."

CPUC3: "*In the old days with Inter-Library Loans, it was very helpful with accessing journals. I have also consulted with [RISC staff member], he was very helpful and suggested me to implement Mendeley in my research practice. The librarian has always been helpful when I needed assistance*."

CPUC4: "*I have not used the library in this institution that much for my research. But I use [the university library where I am doing my PhD] and I am very pleased. I am being well supported by CPUT Libraries as well. The faculty librarian is willing to support me.*"

CPUC5: "*Since I came in 2008, it's changed drastically. I am very impressed. The library is very active, very good financial support that we as a department is struggling to spend. Honestly time is a problem, time to spend the collection budget. The library website is very good, I'm very impressed with the library and librarian's role. It is fantastic that we can access information off campus as well."*

CPUC6: "*I must say that I'm not a very library person. While I like holding books in my hand, I prefer owning books rather than borrowing them. I prefer my own print material, books and journal articles. But my dealing was when I couldn't access an article, I requested from my librarian. I think the library is a convenient place to go to, to escape, seeking peace of mind for writing. I think the library will lose its value in the electronic resources relevance due to Sci-hub.cc. [Illegal site]. When I am at home, I just use this site, rather than accessing electronic resources from the library. People can by-pass the library. If everybody knew about this site, nobody will use the library anymore.* "

CPUC7: "*I think the library has supported me very well, because I have asked them to teach my students the Information Literacy skills and this was done very well. They give us a monthly update on new books and journals. I send my students to the library because I know that they will get the proper support and access to reliable sources, I tell them exactly who they need to speak to in the library… The librarian's role is very important.*"

On the side of the Chemistry PhD students both indicated not interacting with the faculty librarian, but one student consulted the RISC (Research Information Support Centre) librarian. Students had different responses with regard to the library's role in research which point out positive and negative aspects. A theme highlighted in Table 7.8B that is perhaps thought provoking is "Institution not equipped to handle postgraduate students". Further comments from students were:

CPUCS1: *"The library has done fairly enough for me. Whatever I needed, I managed to get from the library, and this really helped me in my research. Especially the RISC area, the library has really given us a good space for postgraduate students. I have not interacted with the faculty librarian, but with the RISC librarian. I relied a lot on the RISC section of the library."*

CPUCS2: *"Honestly I am going to be straight out, I don't think the institution is equipped to handle postgraduate students. They don't care, they don't pay attention to postgraduate. You don't get what you need. The Inter-library loan services is not good, I had a bad experience where I couldn't get feedback on my ILL request, and I ended up contacting the author who sent me a copy. I don't go to the library. I have not used the faculty librarian yet."*

Table 7.8C highlights the themes identified from Chemical Engineering researchers' responses on their experience of the librarian supporting research. The main theme regarding their experience of the library supporting research, as well as the librarian's role in supporting research, were "Good working relationship with the librarian" and "ILL and OA are fundamental". Themes that were

thought provoking are “Librarian role is still more for teaching support, not research” and “Suggest the library website have a space for academics to post their wish list for collection development”. Further comments from researchers were:

CPUCE1: “*The library has been quite a useful resource and is my first point of call. Thanks to the ILL system, and thanks to OA systems I was able to access information I needed for my research. We have actually integrated the faculty librarian into our departmental family, because she attends our meetings. She is a member of the faculty board, we have a very good working relationship, and regularly updates us on library matters.”*

CPUCE2: “*Like I said, I am now an independent researcher. I do not at this stage need support from the library, only for the new services like assisting me with registering an ORCID ID, and accessing new library electronic resources. They already played their role in my earlier studies. But if there is a course or training advertised on new information tools, then I will go and attend yes. The faculty librarian role is still on teaching and learning, not much on research.”*

CPUCE3: “*I only go to the library for ILL requests. Recently I found assistance with my bibliometrics analysis, so the library is evolving and it is useful. The role of the faculty librarian is great*.”

CPUCE4: “*I must say that our libraries are very good, both online resources, Inter-Library Loan services and print collection. However the print collection needs to develop, but that is our fault, we are not recommending to the librarian enough core titles in our field. But overall I am very happy with the library. The faculty librarian – I have interacted with her mainly for requesting new material. I don’t think there was ever a time where I needed something but couldn’t get it, I always get good support from my faculty librarian. I would like to recommend that there be an area on the library website for lecturers to post their wish list for new resources/ databases etc. so that the library can review it when it is time for new subscriptions.*”

CPUCE5: “*I have made use of ILL, accessing theses and articles. The faculty librarian comes to our departmental meetings where we receive updates and guidance, which is very helpful, it gives us also an opportunity to ask for information*.”

Table 7.8D highlights the themes identified from Chemical Engineering PhD students’ responses on their experience of the librarian supporting research. Here one student indicated “Good library/librarian support”. Regarding the physical library space, themes were “Physical space for postgraduate students (RISC) is small” and “RISC is so important and a great support for postgraduate students”. Further comments from students were:

CPUCES1: “*The online library is very very helpful with regards to the vast amount of information resources available for us to access. The physical library space for postgraduate students is very small, I didn’t spend too much time there. Personally I was using the virtual library. I think the library is on a good support level. At times I cannot find some resources, and the librarian supported me well.”*

CPUCES2: “*As a postgraduate student, the Research Space [RISC] in the library helps a lot. I also use Inter-Library Loans services.”*

Participants were asked what they perceive the librarian's role to be in supporting their research. Table 7.9A highlight the themes from Chemistry researchers' responses. The main theme being "Librarians have the expertise to access information". Researchers elaborated further:

CPUC1: *"In the aspect of assisting with data processing, I am not sure whether the librarian could do this because sometimes we need support with this*."

CPUC2: *"The librarian should be a link with other research libraries, navigate, communicate, and be universal."*

CPUC3: "*You people [librarians] know how it works out there. Librarians have the expertise to access information*"

CPUC5: "*The librarian is the Ultimate support, train students. The visibility of the librarian is crucial*."

CPUC6: "*Getting the information in due time is the role."*

CPUC7: "*Ensuring the resources are there, especially books and articles. But with the guidance of researchers, the librarian will know what specific resources are needed, because that is very important."*

Table 7.9B highlight the themes from Chemistry PhD students' responses, indicating that both had a positive perception of the librarian's role in supporting their research. Two themes that stood out are "Librarian presence is critical" and "Book acquisitions should be based on research output". Further comments from students were:

CPUCS1: "*Supporting students with research should be part and parcel of the librarian's duties. His/her presence is critical. The librarian contributes drastically for example advice on scientific publishing."*

CPUCS2: *"It's a pity I didn't use them before. By updating the collection through identifying core research niche areas will play an important role in research support. Base the purchasing of new books on the research output in a department."*

Table 7.9C highlight the themes from Chemical Engineering researchers' responses on their perception of the librarian's role in research. The main themes being "Librarian provide us with knowledge about current research developments, beyond information provision" and "Librarian is the link between stakeholders, collaborators and access to material outside our subscriptions". Researchers elaborated further:

CPUCE1: "*I see a huge role. We only go to the library when we need information sources, but yet there are so many other resources that we as researchers do not know about. I see the librarian's role as bringing us knowledge on current research developments.* "

CPUCE2: "*Finding information sources will improve my research. I already acquired the skill from the librarian. I think the library needs to transform, embrace emerging technology, exploring options for access. For example electronic books and subscription options need to be looked at because I need all my students to have access to a particular book, because I started building my own internal textbook collection. For my particular prescribed electronic textbook, my department is covering the price per*

student to access this book. I feel that the library's collection budget should be spent on a needs-based system, look at what is the need in that department and focus on that, rather than just spending the collection budget and re-allocating it for the sake of it. We will get the value out of the specific collection, maximising use of resources."

CPUCE3: "*Maybe linking, suggesting collaborators, getting to know who works in my field."*

CPUCE4: "*The most important role is sourcing material that is outside our database subscriptions*."

CPUCE5: "*The librarian is doing far more than just providing information, but also Information Literacy and Quality Assurance which is very useful for our students."*

Table 7.9D highlight the themes from Chemical Engineering PhD students' responses on their perception of the librarian supporting research. Both had a positive perception of the librarian's role in supporting research. The theme that stood out was "Regular communication and engaging researchers". Further comments from students were:

CPUCES1: "*I think the librarians play an important role in supporting research by engaging with researchers and communicating regularly."*

CPUCES2: *"If they can be much more involved in the department to know what we are doing."*

7.4.3 Faculty-librarian Collaboration and communication

Participants were asked whether they were currently communicating with their faculty librarian about their research and to give examples of specific aspects they were discussing. Table 7.10A illustrates the themes identified from Chemistry researchers' responses. Surprisingly only one researcher indicated "yes", and "current awareness" being the main theme. Two researchers who indicated no, said "Do it myself". A theme that stood out was "But my students yes" and the researcher further indicated that the students communicated in connection with "ILL and literature review".

Table 7.10B illustrates the themes identified from Chemistry PhD students' responses on whether they were communicating with their faculty librarian about their research. Here one student said yes, the other said no. It is perhaps surprising that a theme from the student who said no, was "I think my supervisor is doing that on our behalf". There seems to be an assumption from the Chemistry Researcher's response above that students do communicate with the faculty librarian versus the student's assumption that the researchers are communicating with the librarian on their behalf. This is perhaps the reason for the little or no awareness that a librarian exists. Nevertheless the themes that stood out from the student who is communicating with the faculty librarian was

"Information provision" and "Uploading my documents into the institutional repository". A further comment by the student who is not communicating was:

CPUCS2: "*I think my supervisor is doing that on our behalf. But me, no, I have no experience of using / consulting a faculty librarian. This is based on my bad experience with ILL."*

Surprisingly as illustrated in Table 7.10C three Chemical engineering researchers indicated that they were communicating with their faculty librarian, but "Mainly for teaching" being the main theme identified from responses. A theme that stood out was "Open communication". Further comments from researchers were:

CPUCE1: *"Our lines of communication are quite open, I recently received some donations from the librarian."*

CPUCE2: "*Yes, in teaching and learning research on the online platform. The information from the librarian at our departmental meetings are still more on teaching and learning."*

CPUCE3: "*Yes, on bibliometrics and IL training for my students*."

CPUCE4: "*No there is no scope. We talk about library matters, book acquisitions for teaching and research."*

CPUCE5: "*Not on my research, but on information resources related to me research yes. But she has no idea what my research is, and I don't expect her to know or be an expert in my research area."*

Table 7.10D illustrates the themes identified from Chemical Engineering PhD students' responses on whether they were communicating with their faculty librarian about their research. Here one student said yes, the other said seldom. It is perhaps surprising that a theme from the student who said seldom, was "Independent researcher". A theme that stood out from the student who is communicating with the faculty librarian was "When needed, for information resources". A further comment by one student was:

CPUCES1: "*Not as often as I would like to. I feel there were times when I should have, instead of just consulting my supervisor only. Because I was using the virtual library, I didn't always feel the need to consult the librarian, I am an independent searcher."*

Participants were then asked whether their faculty librarian was involved in assisting their research. Table 7.11A highlights the themes identified from Chemistry researchers' responses. The majority indicated "In the past yes", and two researchers indicated "My masters students yes". Researchers elaborated:

CPUC6: *"In the earlier years of my research yes. But when I found my feet, I didn't bother her anymore."*

CPUC7: "*By training my students, giving them access to electronic resources*."

Here surprisingly both Chemistry PhD students indicated "no" when asked whether their faculty librarian was involved in assisting their research. CPUCS1 elaborating further that: *"Not with my research, but with access to information."* This remark somehow suggests that information provision is not seen as part of supporting research.

Table 7.11C highlights the themes identified from Chemical Engineering researchers' responses to their faculty librarian's involvement in assisting their research. The majority indicated "yes", and two researchers indicated "ILL/information resources". Another theme that stood out was "Now I recommend titles to my librarian more than before".

Participants were asked how they normally communicated with their faculty librarian. Table 7.12A illustrates the themes identified from Chemistry researchers' responses in order of preference. The preferred mode of communicating with the faculty librarian according to the majority of Chemistry researchers are through "email", "Face-to-face" and "Telephone". Only one researcher had no communication with the librarian. Some further comments:

CPUC2: *"In some way it is not good, because it means that we work outside of work hours, emailing the librarian during the night."*

CPUC6: "*I am a physical person, I rather walk to her office*."

Table 7.12B illustrates the themes identified from Chemistry PhD students' responses in order of preference. The preferred mode of communicating with the faculty librarian according to the one student is via "telephone", whereas the other student (CPUCS2) indicated "never" and elaborated further: *"I didn't know I had a faculty librarian, honestly."* Table 7.12C illustrates that the majority of Chemical Engineering researchers' preferred mode of communicating with the faculty librarian was through "Face-to-face" and "email". "Departmental meetings" received third place, which links to responses by librarians who claim successfully marketing library research support services through faculty board and departmental meetings. Table 7.12D illustrates that Chemical Engineering PhD students' preference was also via "email" and "Face-to-face", and CPUCES1 elaborated further: *"I prefer to go to the library depending on the need."*

Participants were asked what their thoughts were on librarians and researchers working together to enhance Library services for research. Table 7.13A illustrates the themes identified from Chemistry researchers' responses. All researchers indicated that it is "very important". The main themes were

"Librarian has the skills" and "We should work together". One theme that was thought provoking was "IL training is crucial: add datamining training". A comment that stood out was:

CPUC5: *"It is very important. We should work together. The way to go is postgraduate students. Looking into datamining, I think the librarian should give a class on this. IL training is crucial for all students, it will benefit everybody."*

CPUC7: "*There is no doubt about that, we need to work together*"

Table 7.13B illustrates that Chemistry PhD students thought it was "Very good idea", "Will lead to librarian knowing what students need" and "Important for planning training for students". Here one student made a recommendation to "Increase RISC space in library will be beneficial". Table 7.13C illustrates the themes identified from Chemical Engineering researchers' responses about their thoughts on librarians and researchers working together to enhance library services for research. All researchers indicated "I strongly support that". Themes that were thought provoking are "Librarian needs to know what the researcher needs and want" and "Still a communication gap". Further comments from researchers were:

CPUCE1: "*I will strongly support that. That is what should be happening."*

CPUCE2: "*I think that it will work. There needs to be a discussion on what the researcher needs and want, so that the librarian can respond. The gap is because of no communication. As much as the librarian is doing a good job in alerting us to new developments like OA and ORCID, there could be other things that a researcher need assistance with and this should be discussed so that the librarian will know how to respond, that way building a good working relationship."*

CPUCE4: "*I think it is a good thing to work together, especially in Research Data Management."*

CPUCE5: "*That is the aim. We are going in that direction. We have the librarian participating in our departmental meetings and that helps improve services."*

Table 7.13D illustrates the themes identified from Chemical Engineering PhD students' responses about their thoughts on working together with the librarian to enhance library services for research, with the main one being "Workshops improve communication between students and librarians". Further comments from students were:

CPUCES1: "*I think that we need to be reminded that the library plays an important role in research. By having workshops with the librarian, it will improve communication between postgraduate students and the librarian."*

CPUCES2: "*That relationship can help a lot."*

On the point of current collaboration with the faculty library to enhance library services for research, surprisingly the majority (five) of Chemistry researchers indicated not collaborating with the faculty

librarian. Themes from the two researchers (CPUC6 & CPUC7) who are currently collaborating with the librarian were "Library to provide access to data analysis software" and "Through my students". Further comments from researchers were:

CPUC1: "*I didn't know that we had a faculty librarian"*

CPUC5: "*But I want the students to be trained because the students don't know how to use the library. I didn't know that there is the Information Literacy Programme offered by the library, this is what my students need."*

CPUC6: "*On more than one occasion I made my complaints known. I'm not sure whether the library can provide us with access to software such as referencing, ChemDraw, data analysis software. I think that all the support units in the institution must be combined, in one click."*

CPUC7: "*Basically me personally, the faculty librarian helps me with training my students*."

Sadly, both Chemistry PhD students indicated that they are not currently collaborating with their faculty librarian to enhance library services for research. One student (CPUCS1) elaborated further: "*I am comfortable with library services, am an independent researcher now."*

Surprisingly the majority (three) of the Chemical Engineering researchers indicated not collaborating with the faculty librarian to enhance library services for research. The two researchers who said "yes" elaborated further:

CPUCE1: "*Yes, she is part of our team. We communicate regularly and she offers advice during meetings."*

CPUCE4: "*Just to note that the faculty librarian sit on the faculty board for updates which is very useful. On top of that, whenever I need assistance I go to the librarian."*

Sadly, both Chemical Engineering PhD students indicated that they are not currently collaborating with their faculty librarian to enhance library services for research. Students elaborated further:

CPUCES1: *"At this stage no. My research at this stage does not require as much collaboration with the library services as needed. This is mainly based on my type of research work and supervisor instructions."*

CPUCES2: *"No, I have not had that communication yet. If we knew that we could communicate then it will be beneficial."*

A question asked participants whether they discussed any library issues or ideas or new discoveries with the faculty librarian and to give an example. Three Chemistry researchers said "yes", two said "no" and another two indicated "not at the moment". Further comments were:

CPUC2: "*When necessary*"

CPUC3: "*Not in contact with the librarian at the moment. I have given feedback to [RISC staff] in the past on how I found things*."

CPUC5: "*I send emails, especially about Elsevier journals, to maintain these subscriptions. We will also be more in contact because we now need to send our publication directly to the library to be uploaded into the repository*."

CPUC7: *"Yes we do. Most of the time we always talk to you [them] about the library services, practices. Students really experience difficulties if they don't know about the library, so by the librarian training students is very important in research, and this is one of the areas I mainly discuss with the librarian. Training of students*."

On the aspect of discussing any library issues, ideas or new discoveries with the faculty librarian, one Chemistry PhD student said no, the other (CPUCS1) said yes, and elaborated further "*adverts of research seminars and scholarships I shared with the librarian to market in the library."*

With regards to discussing library issues, ideas or new discoveries with the faculty librarian, three Chemical Engineering researchers said "yes" and two said "no". Further comments were:

CPUCE1: "*Yes, on a regular basis. When there was a proposal to remove journal subscriptions and new subscriptions."*

CPUCE2: "*At the meetings yes."*

CPUCE4: "*Not really. The scope of the library should be more visible in the sense of what it can offer to researchers. If the library could make a 15min video available on the library website about what it has to offer researchers, it will be very useful."*

CPUCE5: "*Yes, during a departmental meeting I discussed the idea of having an extended orientation, and not just at the beginning of the year."*

One Chemical Engineering PhD student said no to discussing library issues, ideas or new discoveries with the faculty librarian, whereas the other student (CPUCES1) said "Only at the beginning of my programme".

Participants were asked how many times in the past year they had contact with their faculty librarian in connection with their research. Figure 7.1A highlights that four Chemistry researchers had no contact with the librarian. The highest number of contact sessions with a librarian was ten as indicated by one researcher (CPUC7). Figure 7.1B highlights that one Chemistry PhD student had contact with the faculty librarian four times in the past year. Figure 7.1C highlights that four Chemical Engineering researchers had no contact with the librarian in connection with their research in the past year. The highest number of contact sessions with a librarian was 30 times as indicated by

one researcher (CPUCE5). Figure 7.1D highlights that one Chemical Engineering PhD student (CPUCES2) had contact with the faculty librarian in connection with research four times in the past year, and the other student (CPUCES1) had contact with the librarian twice.

7.4.4 Chemistry and Chemical Engineering researchers and PhD students' perception of research trends

Participants were asked whether they published in Open Access journals and what was their opinion on the advantages and disadvantages of Open Access publishing. Table 7.14A points out the themes that stood out from Chemistry researchers' responses, with themes for disadvantages shaded in grey. In response to whether Chemistry researchers are publishing in Open Access Journals, five researchers indicated "yes" and two indicated "no". The main advantages of OA publishing which came out of researchers' responses were "Free access and reach a wider audience" and "Benefit those who don't have facilities or subscriptions". Surprisingly only two researchers indicated "OA increase citations". The main disadvantages were "Disadvantage is high author fees" and "No rigorous reviewing because the author pays", and others that were thought provoking were "Danger of plagiarism" and "OA publishing a betrayal to science due to low quality journals". Further comments from researchers were:

CPUC1: *"Open Access is free access, and reach a wider audience. For a researcher, the aim is to have as many people as possible to access your work, therefore Open Access is the way to go*."

CPUC2: "*Open Access give limitless access to research output. It helps especially in places where there are no facilities or subscriptions. But on the other hand, there is the danger of plagiarism. But in my opinion the advantages outweighs the disadvantages. Science should be made to serve the public, improve the quality of life*."

CPUC4: "*Generally no, but looking at one now. I actually don't know enough about Open Access. I am not sure which journals are OA, and also whether OA journals have a lower quality. And should we [the researchers] actually be paying for publishing Open Access…? The way it should work is when publishing in an OA journal, the subsidy money should just take that amount off before paying to the institution so that we as researchers don't need to be burdened with publishing costs, but then again the subsidy money comes from the government and not from the journal so that is another story, don't know how it could be worked out. At this stage I am not so keen on publishing in OA journals."*

CPUC5: "*No I don't. In my experience, the quality of Open Access journals are not good, because it is biased toward the author paying, the journals need that money. There is no rigorous reviewing behind it. Not good quality work are published in OA journals… Research published under my name must be published in good quality journals, I don't settle for anything less. Also, we do not have the funds to publish in OA journals*"

CPUC6: "*The disadvantages in my opinion are that they do not give a good critique of the work because you are paying to publish, it is treated as business, not going into the quality of the work. Anything can be published in Open Access journals. The advantages are that there are many scientists that do not have access to a library especially in Asia and Africa, so you have to publish OA*

so more people can have access to research. My most cited paper is an OA publication. Because more people get to read it. Economic issues are staring us in the face, as much as OA publishing is a betrayal to science in the sense of low quality journals."

CPUC7: "*Publishing closed access journals becomes a problem especially when co-authoring, and you find that now you have to purchase the article to get access, also limits the number of readers, as your work is only accessed through a subscription. OA is easily accessible, which is the most important thing. It is also cited more. I now have OA publications that have been cited several times*."

On the side of the Chemistry PhD students with regards to their thoughts on Open Access publishing, it is perhaps surprising as indicated in Table 7.14B that one student did not indicate any disadvantage. The main advantage of Open Access publishing for Chemistry PhD students was "Increase citations". Another advantage of OA publishing that stood out was "Researchers realise the benefit of OA for visibility of research". Themes for the disadvantages of OA publishing which are quite similar to the opinions of Chemistry researchers were "Disadvantage: possibility of plagiarism" and "If it is free, less valuable to research community". Further comments from students were:

CPUCS1: "*It should be a good thing to put your work out there, in the research world, to be cited by other researchers. It is ideal for young researchers. OA is key for someone like me. The disadvantage could be the possibility of plagiarism, take advantage of one's work, if there is no value [being freely available] attached to it [research work], it looks less valuable to the research community.*"

CPUCS2: "*Open Access is the future for me. If it is open, get more recognition, free access, and also get more people to cite my work. At first researchers were saying that OA is not the way to go, but now they are realising the benefits of publishing in OA journals for visibility of research."*

Table 7.14C points out the themes that stood out from Chemical Engineering researchers' opinion on Open Access publishing, with themes for disadvantages shaded in grey. In response to whether Chemical Engineering researchers are publishing in Open Access Journals, two researchers indicated "Not yet, considering it", one said "yes" and one researcher indicated "no". The main advantage of OA publishing which came out of researchers' responses was "Free access to publications". Surprisingly only one researcher indicated "OA publications increase citations". However, there were more advantages expressed by researchers than disadvantages, the ones that stood out were "Traditional publishing houses adopted OA" and "Accredited list includes OA journals ". The disadvantages were "High author fees" and "Low quality". One theme that is thought provoking is "I did not identify OA journals on the accredited list I can publish in". Further comments from researchers were:

CPUCE1: "*I prefer them actually. The obvious advantage is free access, the benefits for research. I experienced only getting access to a paper that I needed for my research, only two years after my*

initial search because it was closed access. The perceived disadvantage is that the standard is lower, which I disagree. Because traditional publishing houses have adopted OA as well."

CPUCE2: "*Not yet, but I am considering it. When I travelled to Europe, this discussion came up, that public funded research should be published in Open Access journals. The problem is, OA journals need to be DHET accredited. I just want to know when I publish in a journal, whether it is OA, that it is DHET accredited. Because those credits help me to further my research in terms of purchasing equipment or participating in conferences, because if I want to travel to an international conference, I am asked do I have credits. Which means, if I publish in journals that are not accredited in order for me to receive credits, then it is pointless because here we have rules, if we are sponsored for three conference trips, we must publish at least one article in an accredited journal before we can apply for any further sponsorship."*

CPUCE3: "*Yes. OA publications increases citations, and good on visibility. Researchers are now rated on number of citations, h-index. On the other hand some are low quality. That is why I am happy with the list of accredited journals, and some of them are OA journals. One don't just want to publish anywhere*."

CPUCE4: "*I would like to but at the moment no. The only problem is the publishing cost is high. The benefits however is exposure, free access to resources where researchers do not have access."*

CPUCE5: "*No, because of university policy – government subsidy. I have not identified OA journals that I can publish in that is on the accredited list."*

Table 7.14D points out the themes that stood out from Chemical Engineering PhD students regarding their opinion on Open Access publishing. Surprisingly only advantages of Open Access publishing were expressed by Chemical Engineering PhD students. The main advantage was "Students benefit from easy access". One theme that stood out was "One way of access". Further comments from students were:

CPUCES1: "*I don't have much experience working with it but I think it is a good thing. It does help many students. In my experience I found it very easy to access library resources."*

CPUCES2: "*Open Access is one of the ways we access content, because we find there are many publications that are locked in subscriptions. The advantage is that people have free access."*

With regards to whether Open Access publishing play a role in building a knowledge culture in the Chemistry field, Table 7.15A highlights the themes identified from Chemistry researchers' responses, with the main themes being "Free access to information" and "Benefit those who don't have facilities or subscriptions". Other themes that were striking are "Not building a knowledge culture: damaging the field", "Measuring quality versus quantity is problematic", "Inter-library loans is the option", "Important to publish case studies OA" and "OA teach students to read and write reviews". Researchers elaborated further:

CPUC1: *"When I see that message to pay for full-text article, I want to just run away!"*

CPUC2: "*It makes science open, free, and accessible to all without restrictions. We can learn more through access to full text*."

CPUC3: "*it is very helpful if one does not subscribe to a journal and you can now get access for free*."

CPUC4: "*With most researchers at a university, which means you have access to many resources. Even if we cannot access something through your university, there is ILL. I don't think that OA should make a huge difference."*

CPUC5: "*It is not really building a knowledge culture. I think it is damaging the field. It is distorted the researchers' profile, when comparing a researcher publish 5 papers in low quality journals versus a researcher publishing one high quality paper in a high quality journal, and measuring then becomes complicated, quality versus quantity. I am a bit negative about Open Access publishing. I think this issue can only be sorted out by the publisher. I think that the accredited journals and the government subsidy should make those closed access high quality papers available to the university community."*

CPUC6: "*Developing countries really benefit from OA content. OA is important when publishing case studies, so that people in that particular area can read about it*."

CPUC7: "*To us it's a God send, because subscriptions are expensive. With OA, we can actually teach students to read. Can refer students to OA material and get them to write reviews*."

Chemistry PhD students on the other hand had a positive mind-set towards the role Open Content played in their research project. Table 7.15B highlights the themes identified from students' responses, with both indicating "Play a vital role in my research" and "Easy access". Further comments from the students were:

CPUCS1: "*It plays a big role in accessing research articles. It makes research reference work easier. OA content makes us not to stress about the articles that are not freely available. The more OA content there is, the better."*

CPUCS2: *"Ease of access, more exposure. In the rural area, I could download on my phone."*

Table 7.15C highlights the themes identified from Chemical Engineering researchers' responses, with the main theme being "OA is essentially what knowledge sharing should be about". Other themes that were striking are "My OA publication received reviews immediately compared to my closed access publications", "University cannot subscribe to all the journals in the world", "OA play important role for students to access and absorb open content from home", "Researchers outside SA can benefit from OA publications from SA" and "Funding is an important, but selfish approach". Researchers elaborated further:

CPUCE1: "*It plays a great role. For example, me struggling to access a paper. My recent PLoS1 publication, I immediately received reviews, it is something that never happened before in the closed access journals due to only getting comments or being cited two years after publishing your paper in a closed access journal. For me, Open Access is essentially what knowledge sharing should be about."*

CPUCE5: "*The current situation in the department, funding is an important aspect… It is a bit of a selfish approach. So we continue to contact authors through ResearchGate to access full-text that we do not subscribe to through our university library."*

Chemical Engineering PhD students also had a positive outlook on the role Open Content played in their research project. Table 7.15D highlights the themes identified from students' responses, with the ones standing out being "Speeds up the learning process" and "We rely on open content for research". Further comments from the students were:

CPUCES1: "*It will make my research work easier, because I am able to access and learn quicker, will help my own research. It speeds up the research process."*

CPUCES2: "*It plays a major role as all the content I am using is Open Access. We rely on Open Access content."*

Somehow the comment above suggests, what was observed in the case of UNIBO as well, that students' perception is that all content retrieved via the library website is open content, because they are given access via library subscriptions.

Participants were asked about their knowledge, perception and experiences of Open Science. Here surprisingly the majority of Chemistry researchers expressed some perception, knowledge and experience of Open Science, with the exception of two. Only one researcher indicated "I don't know about it" and another "Not much experience". Table 7.16A illustrates the themes that came out of Chemistry researchers' responses. Perhaps it is thought provoking that the main themes were "Ownership of research: publish first to avoid people stealing your work", "Researchers keep their work to themselves" and "Important: science should be open". Further comments from researchers were:

CPUC1: "*It could be good where we can learn from one another, but now there won't be novelty as well. People want to keep things to themselves before publishing it, to be well established in ownership of the research before putting it out there to avoid somebody else stealing your work. So that is why researchers are sceptical about Open Science. The problem is patenting."*

CPUC2: "*It is important, science should be open. It is needed. Especially in methodology and methods, to reproduce research. It grows the communal knowledge."*

CPUC4: "*I don't know about it and don't like it."*

CPUC5: "*Money is not important in research. A great idea is key, but you have to keep it a secret, especially in Africa, it is crucial to carry an idea through to the publication, because we have less support, less facilities and resources than in the developed countries…and there is big competition in the world. I can't afford to put an idea out there, because someone will run with it. We are measured on the number of research output."*

CPUC6: "*It's a good idea, but it is very important that you are not lazy, because you have cases where people take over your work, that is the predicament. It is important that science is open for development. I think that is what the definition of science should be*."

CPUC7: "*I really don't have much experience on it. Only during conferences, or through collaboration. Through student exchange during their research to work in other labs."*

Surprisingly both Chemistry PhD students indicated Open Science playing "A major role" and "Open to advice, criticism, and share ideas". Table 7.16B illustrates the themes that came out of responses. Themes that are perhaps thought provoking were "ResearchGate facilitate Open Science" and another which is similar to Chemistry researchers' concern was "Disadvantage: people can steal your work before you publish". Further comments from students were:

CPUCS1: "*It plays a major role, we need to participate to share our work. We need to be open for advice, exposure to new ideas and criticism on our work in the field, even at conferences."*

CPUCS2: "*ResearchGate has a new feature now, where you can share what one is busy with at the moment. The advantage of this practice is adding more knowledge and increase collaboration. The disadvantage is that someone else do it and publish before I could finish."*

The majority of Chemical Engineering researchers also expressed having some perception, knowledge and experience about Open Science. Only one researcher indicated "Not yet, considering it". Table 7.16C illustrates the themes that came out of responses. Perhaps surprising that the main themes were "Competition don't allow us to put our ideas out there in the open" and "Tricky situation". Other themes that stood out were "It is what science is all about: better advance by being open", and linking to what one Chemistry PhD student remarked above "It is happening in ResearchGate" and "Received negative feedback when posting my idea: so I stopped". Further comments from researchers were:

CPUCE1: "*I have not had any experience. But I would like to because that is what science is all about, I support Open Science. Although people will have reservations on this, protected research. Science is better advanced through being open and by collaborating with others, provided there is a disclaimer because there are sensitive areas in one's research where one don't need interferences in objective."*

CPUCE2: "*It is happening in ResearchGate, one can post a question. But when you have an idea, you want to be the first one to publish a new discovery, to put it out there. I don't think people are willing to post their idea, the issue of trust, we are competing here, and this is the reality. But rather have a discussion on a research method yes, like when we are facing challenges with a reactor, we can discuss it. It is a tricky situation, I'm two-minded.*"

CPUCE3: "*That is a tricky one. The world that we are living in now, one can't put your work out there before maturity. I would not advise this. I will only share with my collaborator*."

CPUCE4: "*I have actually benefitted a lot by exchanging information like that at conferences. If that type of exposure could be facilitated online, it is fantastic."*

CPUCE5: "*Two aspects – research we are currently doing has commercial value, so we are hesitant to put it out there. The other one, we are busy with a new microwave – because I didn't know much about this, I put the idea out there on a blog to get some information on it, but received negative feedback on the blog from researchers in the field, saying it is a dangerous experiment. So I simply stopped putting my ideas out there."*

Surprisingly both Chemical Engineering PhD students indicated their perception of Open Science being "A good idea". The other two themes that are thought provoking as illustrated in Table 7.16D are "Research ethics important: consult supervisor first" and "A blog can help us". Further comments from students were:

CPUCES1: "*I feel that it is a good idea, it could make a contribution to research. However, ethics of one's work is also important, so better to consult with one's supervisor about this. Also at conferences, it is where this practice potentially takes place."*

CPUCES2: "*I think that it can work. But at the moment, we are not doing it externally, but internally yes. But a blog can help us a lot."*

The issue of commercial value research and proceeding straight to publication before making a new invention known suggests there is a problem. On the one hand, funders are pushing this initiative, but the reality with regards to research activities tells a different story altogether. Mirowski (2011: 303) also suggest that the notion of open science tend to "weaken academic science". The question is, whether funders are aware of these difficulties faced in a highly competitive world of research.

The follow-up question asked participants what role Open Science played in their field. Table 7.17A highlight the themes identified from Chemistry researchers' responses. With regards to the role, one researcher indicated "not at all" and another "no comment". The main themes were "Help people starting out" and "Avoid duplication of trial and error". However the theme "Scientists are secretive: they will hardly discuss future research" is perhaps thought provoking, but confirms the literature on the history of science research which states that scientists in the past mainly worked in silos (Crane, 1972; Servos, 1993). Further comments from researchers were:

CPUC1: "*Open Science will help people who are starting out, to get your footing. It will save time, and avoid duplication of trial and error."*

CPUC3: "*Well I must say that I have been assisted very much from other researchers, received training on techniques. That in a sense was Open Science because they shared their techniques and knowledge with me."*

CPUC5: "*There should be a role. If you can put out a profile (like ResearchGate), where people can see your output, that is very important."*

CPUC6: "*I must tell you that scientists are very secretive people… because of intellectual theft. Scientists hardly discuss their futuristic work. They will never tell you what they are doing at the moment."*

Table 7.17B illustrates that both Chemistry PhD students indicated that "We can learn: increase quality". The other two themes that are thought provoking are "Advice go a long way" and "Science is practical: department could benefit". One student elaborated:

CPUCS1: "*With conducting research, one is never really sure of everything, and advice can go a long way, so When we engage in this Open Science world, we can learn and find different ways of approaching our research."*

Table 7.17C highlight the themes identified from Chemical Engineering researchers' responses on what role Open Science play in their field. With regards to the role, one researcher indicated "Not yet been exposed". The main theme was "A virtual room to exchange knowledge is useful". Further comments from researchers were:

CPUCE2: "*Sharing the technology in the field is good. If there is a problem, an open discussion on how to solve a problem with researchers from all over the world is good. This is the role that Open Science can play. If I share something and not acknowledged for it, then I have a problem with that, and this is the reason why we publish first before sharing what new idea or discovery we made*."

CPUCE3: "*Maybe with teaching and learning it is fine. But for research, I caution against it, only share with your collaborators."*

CPUCE4: "*It would play an important part for young researchers to get access to expert advice. It is like putting people in a virtual room to discuss and exchange knowledge."*

CPUCE5: "*Apart from my negative experience, it is a useful forum. I have seen other people being helped along on other projects using these kinds of forums by experts in the field so it is a good thing or way of learning.*"

On the side of Chemical Engineering PhD students Table 7.17D illustrates that both indicated the role Open Science played in their field was "Important role" and "Building working relationships with researchers". The other theme that is thought provoking was "Sense of learning". Students elaborated further:

CPUCES1: "*I think is it important. It relates to a sense of learning and growth within the department and also building work relationships between other departments and universities."*

CPUCES2: "*It could play a major role. If you are designing something and you get stuck, you can get help from experts."*

Overall, researchers and PhD students' attitude towards Open Science are both positive with great concern from the researchers expressed regarding the competition, commercial value of research, and the risk of ideas being stolen before publication. These concerns however cannot be ignored when researchers face the pressure of research output that need to be increased, and the reality is that this is how researchers are evaluated.

One of the questions focusing on the research trends discussed in Chapter 2, asked participants what their perception, knowledge and experience of Research Data Management was and what role it played in their research. Table 7.18A presents the themes identified from Chemistry researchers' responses, the main ones being "Good for quality control: verify data", "Re-use data: interpret data different to create new research" and "Very important to share". Only one researcher indicated "I have not considered it". Researchers elaborated further:

CPUC1: "*I think it is a good thing, especially for quality control so that people can't just go around saying that they did something without the evidence. So somebody can actually verify. It also means interpreting data differently by other researchers for new research."*

CPUC2: "*If your data is correct and accurate, you should not be afraid to share. It should belong to the scientific community*."

CPUC3: "*I have not contemplated that. I must say in publishing now, they removed half of the data, so I don't know. I have not considered putting my data in a repository, but it could be good."*

CPUC4: "*In the Cambridge database, all our datasets are deposited there and is accessible*."

CPUC5: "*I believe that all funds, means that all the output needs to be publicly available. This is how you pay back to the society. It is very important to share whatever you did, in the form of output for society."*

CPUC6: "*It depends on the claim that you want to make, to the extent your data is susceptible to the claim. Last year I published two articles where I submitted the datasets as well. For verification, quality control. This is open for argument if you don't have the data to show. That is why it is important to attach the data files*."

CPUC7: "*RDM is very important, because students come and go. When students go, they leave with the data, so by having a data management plan, helps to plan the way forward with regards to reuse, and new research projects in the future, to avoid duplication of experiments. Secondly it saves us time, as supervisors we cannot spend 24/7 with the student, to see how active the students are. We can see what the students are doing, whether they are cheating, and this we are able to control very effectively in terms of quality control and verifying data through RDM."*

Table 7.18B presents the themes identified, with both Chemistry PhD students indicating that RDM "Play a major role", "Important in collecting data to analyse in research project" and "Data re-use: create new research". Another theme that is thought provoking is "Managing data is crucial: can publish data these days without the article". Further comments from students were:

CPUCS1: "*It plays a significant role. In collection of our results, we use specific software like SAS and ORIGIN8 for analysing data, to synthesise our data. Research Data Management is very important in our work from collecting data to the analysis."*

CPUCS2: "*It was something that we did not pay attention to, but now it is paramount. Managing data is crucial. If you mismanage your data, it is not good for your research. One can even publish*

datasets in journals these days without the article. Now we can also publish negative datasets [results]. I was working on an experiment and constantly got negative results, my supervisor advised me to publish the negative results, because another researcher will be able to work from that dataset to build on it and produce new research."

All Chemical Engineering researchers responded that they had some perception or experience, with one indicating "I have experience". Table 7.18C presents the themes identified from researchers' responses, the main ones being "It is good" and "Verify data". Themes that were perhaps thought provoking were: "Not in favour of being forced to upload datasets by publishing houses and university institutional repositories", "I don't think we have RDM services at our university" and "Useful for researchers to access data from a repository". Researchers elaborated further:

CPUCE1: "*It really depends on what one wants to do with the data. I support the idea of Open Access, science, the sharing of knowledge for the advancement of science etc. But there are instances where data needs to be properly managed. For example, when one make a certain findings in research that has commercial value, it should be left up to the author who has invested in the research resources. There are some practices that I do not support, where universities want to claim the rights to some data that a researcher produced, and also some journals that dictates that the research should provide the dataset as well regardless of the commercial potential of that data… So I support the author having control."*

CPUCE2: "*I think it is good. I believe that a project or method should be reproducible. When I read a paper and can't follow the method because it does not work, it could be that people are cooking /falsifying the results for what they want… You should be credible, and be in the practice of sharing data. If you are requested to put your work or your data out there, I don't think that it should be a problem, unless there is something to hide*."

CPUCE3: "*I know it is new. But one needs to verify data, it is very important. It is a good initiative*."

CPUCE4: "*The practice at CPUT is different than at Stellenbosch where I am studying my PhD studies. I don't think we have the services to manage data at CPUT as far as I know. At the moment I manage my own data. The only way a researcher can get hold of my dataset is by contacting me and requesting it. The other way is to upload my dataset on ResearchGate, which I will not do before publishing. At Stellenbosch they have a structured process where researchers archive their data regularly. Personally I will support the practice of Research Data Management in my department*."

CPUCE5: "*I have several experiences regarding this. When I checked the journal instructions, sometimes the article does not have the actual data / findings in it. Some of the publishers want to know all the information, so the data might be protected for a period of time, but then it can be accessed on another platform. It makes it very useful for us as researchers when data is accessible in a repository.*"

Table 7.18D presents the themes identified, with one Chemical PhD student indicating that RDM "Plays a major role in research" and "Had a workshop on RDM". Another theme that is thought provoking is "Informed about it late: should have worked on DM plan from the start of my research". Further comments from students were:

CPUCES1: "*It was an area where I had to learn to manage my data. I had to keep record of my data in print and electronically. I had to upload it into the university's repository where I was an exchange student. The only issue was that I was informed about it too late, I should have known and worked on the data management plan from the start."*

CPUCES2: "*We had a workshop on RDM but at the moment I am not there yet. But I think it plays a major role in research."*

Participants were asked what their opinion is on the library assisting with managing their research data, and whether they thought is should be a function of the library. Here the majority of Chemistry researchers seem to be in favour of the library managing research data. Table 7.19A indicate the themes identified from researchers' responses, the main one being: "Thesis /articles already being uploaded into repository, so also the data". However, two researchers indicated "No the library should not" with the following themes: "It is my research, my decision" and "Publishing houses already manage the data". A theme that stood out was "Library will do well in teaching RDM plans: incorporate in Advanced IL training". Further comments from researchers were:

CPUC1: "*I should think so. I think that the library should manage it. It is the only unit on campus that could do this. They are the unit we go to for information.*"

CPUC2: "*If it is in the scope yes, if it is not too cumbersome for the librarian. But if it is an extra burden, it becomes unnecessary."*

CPUC3: *"I would imagine that the library should. Just as your thesis gets put out there by the library, so too the data I suppose."*

CPUC4: "*No, because it is my research and I should decide."*

CPUC5: "*No I don't think the library should do this. In my case, I submit the research paper and supplementary information, and this is where I upload my dataset in the Cambridge databases or repository of the publisher. The data is already being managed by the publishing houses."*

CPUC6: "*I think that the library will do well in teaching Research Data Management Plans, it will go a long way. It could be incorporated in the first year PhD programme (advanced IL). It is not so easy for the library to handle various formats of data I would say, but rather teaching researchers how to manage data and plans. I think that the IL Certificate should be a requirement before the proposal is approved at Senate, which is what I would like to see."*

CPUC7: "*I think the library should yes, because they already manage the articles. So it would be good to be in contact and guided by the department to deal with the data management."*

Table 7.19B indicate the themes identified from students' responses regarding their opinion on the library assisting with managing their research data, and whether they thought it should be a function of the library. Here both Chemistry PhD students indicated "I think the library should". A theme that

stood out was “People don’t take their research data seriously”. Further comments from students were:

CPUCS1: “*Accessing these software is challenging. So yes, I will really propose that the library take over this function, and take the initiative in data analyses software as well will be very useful”*.

CPUCS2: “*Yes, to keep up with international standards. In some international libraries they play a more active role in this, for example in the Czech Republic one of my collaborators mentioned this, it is enforced. I think maybe if it is enforced, people would take their research data management more seriously. Because even now people don’t take their data seriously.”*

The majority of Chemical Engineering researchers indicated that “Researcher should take responsibility for RDM” as illustrated in Table 7.19C. Two researchers indicated “Library could assist to some extent”. A theme that stood out was “Librarian is pushing academics to upload publications in the IR”. Further comments from researchers were:

CPUCE1: “*As I said earlier, for me the managing of data should be the responsibility of the researcher themselves rather than being delegated to the library. I had the discussion with my faculty librarian around the issue of the library wanting us to upload our publications and data in the institutional repository, which in some cases was in direct contrast with the publisher, where the agreement is that if you publish with them, you may not put your work in any other institutional repository. On the other hand the library is pushing academics to upload our work into the institutional repository. I am of the opinion that the researcher should dictate what should happen to the data… rather than being forced. The faculty librarian clarified that the library is aware of the disparities and willing to work with us and the publisher to best deal with this. The library could manage data with the approval of researchers involved, I will put that as a strong disclaimer. For example with my PhD experience…I was requested to submit a disc with my research data and I completely disagreed with that because some of the data that I generated had commercial value, and I felt that I had the sole decision-making rights to say whether this data should be Open Access or exploited further for commercial use.”*

CPUCE2: “*At the moment we don’t know much about this, especially in what format the data should be for a repository, maybe it could. If there is a better way of managing data by the library, then we should welcome it*.”

CPUCE3: “*I think that the researcher should manage raw data. To some extent the library could assist, because you need to have the knowledge of what the data is all about*.”

CPUCE4: “*My first level answer is, it doesn’t really matter who does it, as long as it is done properly. The integrity of the data need to be maintained, and it is easier if this data is handled by people that understand the data, in the department. At Stellenbosch it is working very well because it is managed in the department and they have the technical support, its robust. If the data is managed by the library, there is so many risks. But I am sure that the library will find a way of managing data.”*

CPUCE5: "*No, I don't think the library should be managing data. It is not practical for a librarian to be handling our research data. Technical aspects are challenging. With the availability of computers and programmes, it is better for a researcher to do it oneself*."

Table 7.19D indicate the themes identified from Chemical Engineering PhD students' responses about the library assisting with managing their research data, and whether they thought it should be a function of the library. Here both students indicated "I think it would be a good thing" and "Assist in future research". Further comments from students were:

CPUCES1: "*Yes I think the library should be managing. The library can create a database for this. It will make research work easier."*

CPUCES2: "*I think in future if they have a team that manages data it will be useful."*

Participants were asked what percentage of their working year they estimate that they spend on research. Figure 7.2A represents the percentages indicated by Chemistry researchers, the highest being 50%. The further comments by researchers are thought provoking:

CPUC2: "*Before coming to Africa, I spent 50 % of my work time on research. Here in CPUT, there is not too much research taking place currently, it is developing slowly as it is expensive to build labs. So in the past I spent much more time on research, but like I said I moved more into managing research now."*

CPUC3: "*I am not classified as an academic, I am support staff, am a technical staff member. Vacations are my research period, 20-30%. One also gets interrupted during this time with other things, I would like to just concentrate fully on research."*

CPUC4: "*Research was really small. Teaching and admin is the bulk*."

CPUC5 "*30-40% unfortunately*"

CPUC6: "*It varies depending on the job description of the person. I am employed based on my PhD studies enrolled here, so my teaching load is reduced*."

CPUC7: "*Heavy teaching load*."

Figure 7.2C represents the percentages indicated by Chemical Engineering researchers, the highest being 40% in a normal work year, with the exception of one researcher spending 100% in the current year on research due to being on study leave to complete fulltime PhD studies. The further comments by researchers are thought provoking:

CPUCE1: "*A very small percentage, less than 10%. Teaching and administration take up a huge percentage. It is unfortunate, but that is our reality*."

CPUCE2: "*20% if I look at the normal work hours at CPUT. I use time outside my time, sometimes I leave here in the early hours of the morning. I only have one day allocated to me for research. I have a heavy teaching workload. My aim is to publish 2 per year… so actually 40%."*

CPUCE4: "*Actually very little [10%]. I am forced to do the bulk of my research after-hours because we are very much still teaching orientated. We have an extremely heavy teaching load. My research could go much faster if I had the same working conditions as my colleagues at Stellenbosch*."

CPUCE5: "*100% currently due to my study leave to complete my PhD project. But generally it is 30-40%."*

7.4.5 Faculty research informing policy or procedures

Participants were asked in what way their research output contributed to guidelines or procedures in the university. Table 7.20A highlights the themes identified from the Chemistry researchers' responses. Surprisingly the majority indicated "not yet". The themes that stood out from researchers who indicated their contribution are "Huge contribution: graduating PhD students", "Through my new marking scheme", "PhD student can't graduate without a publication". What stood out as thought provoking was "Qualification more important than the research at the moment" and "Forced by the library to upload theses". Researchers elaborated further:

CPUC1: "*Only when I am done with my research, I will be able to see*."

CPUC2: "*In the university, through mentoring and graduating students. Graduating one PhD student puts the university forward, it makes a huge contribution."*

CPUC3: "*It has not done any of that, as I am doing purely basic research*"

CPUC4: "*At this stage, my research has a specific goal, and that is to get a better qualification. And I feel at this stage, the qualification is more important than the research I am conducting. My research is more linked to a piece of paper [PhD qualification], because at this institution your piece of paper is more important than your experience, that is what is coming out very strongly, if you got the paper [qualification] you get the job, if you don't have the paper, you won't get the job. In the future, it will depend on how I will take my research forward in the future, but at this stage I first need to get there."*

CPUC5: "*From my research, previously the research projects marking was very weak and quite subjective in my opinion. When I was appointed and had to mark research projects, there were no marking schemes. My new marking schemes designed according to relevance towards research, was a good contribution. So our research are published mainly and not patented."*

CPUC6: "*I wouldn't say it has contributed to a guideline at the moment, or to policy-making, I don't conduct that kind of research at the moment. But I have raised the standard and quality of student work, I try to get students to do something meaningful.*"

CPUC7: "*In a number of ways, CPUT was previously not a research-orientated institution. However, CPUT was forced to allow postgraduate engagement. At the moment, a PhD student can't graduate without a publication. Presently we are forced by the library to submit theses soft copies."*

Table 7.20B highlights the themes identified from the Chemistry PhD students' responses. Both indicated their research contributions to guidelines or procedures being through the themes "Conferences and international exposure attract interest" and "I used a new technique, led to departmental implementation". Some further comments by students were:

Table 7.20C highlights the themes identified from the Chemical Engineering researchers' responses regarding their research output contributing to guidelines or procedures in the university. Two researchers indicated "My research has not had that kind of impact in the university yet" and one said "Through my research on teaching with technology my department can learn". The themes that stood out from researchers who indicated their contribution are "On environmental side my research makes a contribution: national level", "Created visibility for myself in the department: obtained 2013 teaching excellence award", "My research opened a new area to explore patenting". What stood out as thought provoking was "My research contribute to library matters: subscriptions and evaluating databases". Researchers elaborated further:

CPUCE1: "*My research has not had that kind of impact. We are trying as a department to move in that direction where research has impact. Looking at the institution coming from a teaching background and research only playing a major role now. So the committee I sit on is looking at ways of promoting research in the chemical engineering department, and also to get to know who does what. Once the department consolidates, I am positive that we will have a better free flow of information, sharing of best practices and so on. But for now we are not at a stage where we should be in terms of extracting from our research and having meaningful discussions.*"

CPUCE2: "*I wouldn't say as a whole. But I am the only one doing research on teaching with technology, so my department can learn from what I researched. I believe that these technologies have improved my teaching, and so by publishing about it, I share my best practices with colleagues or anybody who is interested in using technology to improve teaching and learning. I created a visibility for myself in the department because of this, and led to me obtaining in 2013 the teaching excellence award in the faculty."*

CPUCE3: "*I'm into applied research, not on the policy-making side. On a national context, I'm in the environmental side, so some of my work has made a contribution here."*

CPUCE4: "*The significant thing that has happened is that my research has opened up potentially a new area, critical field separation, a new field, which was not existing before. This new discovery led to the purchase of a multi-million rand pilot plant, which allows us to open a new research area, and explore the practice of patenting and intellectual property. To scale up to industrial scale. I am more interested in processes leading to patenting, and processes that have commercial value. CPUT is interested in spin-off companies."*

CPUCE5: "*The only way at the moment is by giving input on library matters, journal subscriptions, and feedback on evaluation of databases."*

Table 7.20D highlights the themes identified from the Chemical Engineering PhD students' responses regarding their research output contributing to guidelines or procedures in the university. One

theme that stood out was “My research led to registering a patent”. Some further comments by students were:

CPUCES1: “*It is early to say at this stage, but from the information that I gathered looks promising. My results led to registering a patent.”*

CPUCES2: “*At the moment it doesn’t have an impact.”*

Participants were asked about their opinion on whether research enhanced teaching and learning in any way and how. The majority of Chemistry researchers felt strongly that their research output enhanced teaching and learning. Table 7.21A indicates the themes that were identified from researchers’ responses, the main one being: “Conducting Research can help explain a topic better”. Two themes that is perhaps thought provoking are “Things work different: research different from what I teach” and “On the other hand, good researcher is not necessarily a good lecturer”.

All Chemical Engineering researchers felt strongly that their research output enhanced teaching and learning. Table 7.21C indicates the themes that were identified from researchers’ responses. Two themes that is perhaps thought provoking are “My research added interesting developments /aspects/ examples for students” and “Research is important for improving teaching”. Comments that stood out were:

CPUCE4: *“I don’t think there is a strong correlation between number of publications and teaching. But a strong correlation between research interest and teaching practice. Academics tend to chase number of papers published that have no impact. We need to focus on the quality of research, which has a significant impact. The transformation from teach-only to teaching-research orientated academic has had a huge impact on how I stimulate students in their thinking.”*

CPUCE5: “*Yes, definitely. In engineering we teach the basics, and application of skills. If you only lecture without research, teaching becomes boring. Research improves job satisfaction. Research makes the difference for us in our profession.”*

Participants were then asked how their research output improved student development and success. Table 7.22A highlights the themes identified from Chemistry researchers’ responses with the main one being “Students benefit by learning from what I am doing”. A theme that stood out was “I make sure students work on something that can be published”. Further comments from researchers were:

CPUC1: “*Based on the fact that I do my research here, students benefit by learning from what I am doing, I am supervising students as well*.”

CPUC2: “*The fact of graduating students is a milestone. I also place students in industry, and reporting on industry. Directing students*.”

CPUC3: "*Using our lab / research techniques, students were successful*."

CPUC4: "*I think it is still early days for me to comment."*

CPUC5: "*I want to believe that it improved alot. What I practice, I have limits [set targets] for masters and PhD students, and I am pushing them hard, but let them get to the point where they graduate. I am not in favour of students take many years to complete their Masters, so I let them work hard to finish."*

CPUC6: "*I have six students working with me, and I make sure students work on something that can be published and is meaningful. I mentor students and get to the point of publishing, and putting the work out there. When students see their names on a publication, is a boost to them, it encourages them to work. When a student applied for NRF grant, he was able to show his publications*."

CPUC7: "*I would say through a number of students graduating. It is important that they can think, to apply and evaluate. I take on a lot of students for in-service training, where they learn to troubleshoot, which is not taught theoretically, so application and critical thinking is important in the lab.*"

Table 7.22C highlights the themes identified from Chemical Engineering responses with the main one being "Engage students, motivate them to conduct research". A theme that stood out was "Through my research I improved my writing skills which led to transfer to student development". Further comments from researchers were:

CPUCE1: "*I try to engage students. It has an exciting, motivating effect when students decide to further their education and enrol for masters and PhD studies*."

CPUCE2: "*I would say for me as a lecturer, conducting research helps me to see my own blind spots – which means, I don't think I will teach the same thing as is the next year, based on my research findings and students' feedback on evaluating my teaching and performance. I write down everything that I reflected on, and things I have implemented. This way it make changes in student development*."

CPUCE3: "*From my research output, I motivate students to do postgraduate studies, I focus on the diligent students. Some graduates are managers in top companies*."

CPUCE4: "*I started very late, five years ago, to practice research, and output. I had to improve my writing skills and experimental planning etc. for writing publications. Now I can offer those skills to students at a much more refined level than I did before*."

CPUCE5: "*Personally what I have done is I applied for various funding for research. Part of that funding is capital development in the form of student development. So every year we have to develop postgraduate students. I have two Masters students who I am developing."*

Participants were asked how their research output contributed to community engagement. Table 7.23A provides themes identified from responses. Four Chemistry researchers indicated "yes" and two said "not yet". The main themes were "Community service: taking science to the village people",

"Important for community schools: crystallography" and "Increase student interest through growing crystals in my lab". Researchers elaborated further:

CPUC1: "*I mostly work in the lab, but my final results can assist policy makers for the community, in terms of how to control pollutants in the environment*."

CPUC2: "*We do community service / workplace learning. It is taking science to the people to the villages, bringing science down to earth. Science is not abstract, it is about life, about the food you eat, the water you drink etc.…"*

CPUC3: "*I have slanted the outcome particularly to addressing a problem in the rural communities*."

CPUC4: "*Not at this stage. But it is important for community schools, especially crystallography there is a huge interest in schools*."

CPUC5: "*I do crystallography which is beautiful and fascinating, and am growing crystals in the lab, just for the beauty. Local students love it! It is not a research project per se, but just to give students an idea of what we doing. Through this project students increase their interest in our field*."

CPUC6: "*Not yet, but in the future it should. You need to do research that concerns the local community. I'm in a position to let the world know about their problems*."

CPUC7: "*We have a project of visiting schools for science, and get them to visit the labs and to help students to see what we are doing and create interest*."

Table 7.23C provides themes identified from Chemical Engineering researchers' responses. One researcher indicated "Previously yes", two said "Not directly" and three researchers indicated "Currently conducting research which will impact the community". Researchers elaborated further:

CPUCE1: "*Not directly to be honest. My research in my Masters and PhD was a bit abstract. But now I am currently working on a research project producing electricity using waste water which will have a direct impact on the community. So I am shifting my research focus from abstract to more practical."*

CPUCE2: "*I would say on the waste water treatment research, yes. In South Africa we have a challenge with water. In the poultry industry, they use a lot of fresh water, and discharges a lot of waste, so I am trying to find a solution to treat waste water, to save water in the country. So my research has an impact on the social side of things."*

CPUCE3: "*Certainly, I did a research project in 2012 where I collaborated with other researchers which contributed to community engagement."*

CPUCE4: "*Absolutely. I am currently involved in two projects. One is directly designed for community engagement, which entails getting communities in farms to produce their own fuel –biodiesel… A different project is the one I am doing now, to investigate an essential oil, an opportunity to get involved in producing certain plants for the extraction of essential oils. So these research projects initially was not geared towards community engagement per se, but created opportunities as progressed for the community to get involved."*

Overall, researchers revealed that their research output correlate with their teaching activities, student development and success, and that the shift from abstract to more practical research which

impact society is taking place. It confirms what was already discussed in the literature review by the Horizon 2020 work programme and the SIS2016 conference on research impact on society emphasised, that research must have an impact in society, in the quality of life.

7.4.6 Competencies for conducting research

Participants were asked whether there were any areas in the research process that they needed assistance with, and whether they would like the library or faculty librarian to assist. Table 7.24A highlights the themes identified from Chemistry researchers' responses. The main theme was "Train PhD students as well". Other themes that stood out were "Librarian to support in all areas of the research process is crucial", "Improve communication with postgraduate students", "Train students to Read, interpret and analyse scientific articles", "Train students on Constructing a research topic, writing abstracts" and surprisingly a Web 2.0 tool is requested by "Librarian could provide podcasts". It is perhaps surprising that the majority of Chemistry researchers indicated the need for assistance with their postgraduate students. Only one researcher indicated needing training on Mendeley. Further comments from researchers were:

CPUC1: "*Not at the moment. Just improve communication for postgraduate students so they can know what the library can offer in terms of research support, because the focus is more on undergraduate students for orientation and so on. PhD students should get orientation and training as well."*

CPUC2: "*In all areas [in the research process] the assistance of the librarian is crucial."*

CPUC3: "*I'm currently struggling with Mendeley, [Risc staff member] has an open-door policy. I need more training on citation management, I need to work electronically. I need to wean myself off working with hardcopies."*

CPUC5: "*For the research there are two things that is important, Turnitin and SafeAssign, we should have direct access. It would be nice to have a programme for postgraduate students, advertise regular training sessions for postgraduate students throughout the year, on a monthly basis. An online course will also be good as I believe that is the future, both [face-to-face class and online] is good. Regarding the uploading of theses, there should be an option (on the submission form that is submitted to the library) to place an embargo for a year to allow papers to publish from the thesis…"*

CPUC7: "*I am not sure whether this is in the scope of the library, but many students struggle to read, analyse and interpret scientific articles, so training is needed in this area. As much as the faculty librarian train students how to access the scientific research, it is the next step that needs training on. The reading, breaking them down to understand what these articles are about and writing it up in the thesis is a problem that students face, it is a challenge for them. I wish there could be some handout, or link to a YouTube video for students, on how to construct a research topic, how to write an abstract, even if it is just podcasts that the librarian can provide on these thing, it will help a lot."*

Table 7.24B highlights the themes identified from Chemistry PhD students' responses. Two themes that stood out were "Data analysis/data management" and "Courses on scientific writing". Further comments from students were:

CPUCS1: "*in the data analysis / management area. It is a bit of a gamble to access these software. Maybe the librarian can assist."*

CPUCS2: "*Students are struggling with scientific writing, I saw this when reviewing the proposals in the department, so I think the library should introduce courses at faculty level."*

Table 7.24C highlights the different views and requests from Chemical Engineering researchers regarding any areas in the research process that they needed assistance with, and whether they would like the library or faculty librarian to assist. Themes that stood out were "Job description of the librarian should be known to faculty", "Library could play a vital role in analysis of data" and "Need for the library to be more actively involved in research process through workshops". Further comments from researchers were:

CPUCE1: "*The library is currently a place for information resources. But the library could play a vital role on technical resources, analysis of data, technical writing methods, methodology. Be more actively involved in the research process through workshops.*"

CPUCE2: "*Most things that I needed I already acquired. I know where to go when needed, librarian or statistician. At the moment I can't say that I need any assistance for my research. As long as I know where I can go if I need assistance is important. It is difficult if I don't know the job description of the librarian to know if the librarian can do more than just provide me with information."*

CPUCE3: "*Funding assistance, and research books that are not textbooks, but research specific books in my research field."*

CPUCE4: "*I need assistance with data archiving. I'm not sure whether the library should be the main one, but definitely somebody who I think can assist with this. It could well be the library.*"

CPUCE5: "*The only thing we need the library for, is to provide us with information. We want it immediately but it [inter-library loans] takes time. It is not a complaint, I am not aware of the logistics to get the resources from outside our university… because we always want things yesterday already but taking cognisance of the processes and costs involved."*

Chemical Engineering PhD students were asked whether there were any areas in the research process that they needed assistance with, and whether they would like the library or faculty librarian to assist. Table 7.24D highlights the themes identified from Chemical engineering students' responses. Two themes that stood out were "Access to other resources such as photographic equipment and video recording equipment" and "Improve communication through an internal blog, live chat facility". Further comments from students were:

CPUCES1: "*I think yes, through access to other resources like new types of resources e.g. Open Access In terms of other facilities such as photographic equipment and recordings. Providing equipment during my experiments for example, such a taking a video recording will be very useful."*

CPUCES2: "*There are many things, but I don't think it is something the librarian can assist with because it is much more on the specific research area. But build on communication will be beneficial through an internal blog for chemical engineering postgraduate students, it could be a live chat facility."*

Participants were asked whether they were engaged in a research project at the moment. Here the majority of Chemistry researchers indicated that they are. The two researchers who are not currently engaged in a research project added:

CPUC2: "*In the process of developing one*."

CPUC3: "*I am considering doing my PhD studies*."

On the other hand all Chemical Engineering researchers indicated that they are. One researcher elaborated further:

CPUCE1: "*in generating electricity, it's an integrated project."*

Participants were asked whether they were collaborating with other researchers locally and internationally in their field, and if so, how they got in contact with them. Table 7.25A illustrates the themes identified from Chemistry researchers' responses. Only one researcher is not currently collaborating with other chemistry researchers. The main themes which came out from the researchers who indicated that they are collaborating with other chemistry researchers are "Old contacts from previous job" and "Conferences". Table 7.25B illustrates that both Chemistry PhD students are involved in collaborative activities in the Chemistry field. The theme that stood out was "Research exchange at other university labs". Only one Chemical Engineering researcher is not currently collaborating with other chemical engineering researchers. The main themes which came out from the researchers who indicated that they are collaborating with other chemical engineering researchers are "Through my supervisor", "Through publications" and "Conferences" as illustrated in Table 7.25C. Further comments from researchers were:

CPUCE1: "*Not at the moment, but that is the intention. I am planning to go on a study visit to a research centre which is leading in what we are doing in the chemical engineering field, as soon as I can secure funding, I will get involved in collaborative research. That is what I am hoping for in the future.*"

CPUCE2: "*I have with Fundani and some international researchers*."

CPUCE5: "*Through journal articles, references. Aspects of the article that I need clarity on."*

One Chemical Engineering PhD student indicated being involved in collaborative activities in the Chemical Engineering field, while the other student "Not at the moment". The themes that stood out as illustrated in Table 7.25D were "In contact with PhD students in the department", "Through my supervisor" and "Conferences". One student elaborated further:

CPUCES1: "*At this stage no, but I am in contact with most of the PhD students in my department and I do seek advice and assists from time to time. They are very helpful."*

With regards to who provided participants with information on their research, Table 7.26A highlights the themes identified from Chemistry researchers' responses, with the main one being "by myself: electronic resources". It is perhaps ironic that five Chemistry researchers pointed out the human element for consultation purposes from various stakeholders whom did not include the librarian. It links to a previous observation that the librarian role in providing information is not perceived by researchers as supporting their research per se.

Table 7.26B highlights the main theme identified from Chemistry PhD students' responses being "information resources", and CPUCS2 commented that: *"Mostly I use journals and Google Scholar",* pointing to findings in a previous study that Google is the first point of contact by students when seeking information (Kleinveldt, 2015). No mention of consulting a librarian was observed, once again pointing to the library or librarian being the last resort (Wilson, 1981). Table 7.26C highlights the themes identified from Chemical Engineering researchers' responses, with the main ones being "mainly publications", "interaction with other researchers" and "search engines". Perhaps it is surprising that only one researcher mentioned "the library" as an information provider for research. The following comment was thought provoking:

CPUCE5: "*The Polymer research group at Stellenbosch University provide me with information on my research. Research is a very lonely process.* "

Table 7.26D highlights the themes identified from Chemical Engineering PhD students' responses. The main themes were "My supervisor" and "Myself". Only one student mentioned "the library" being an information provider for research. Further comments were:

CPUCES1: "*I would say it is a collaboration between my supervisor and I. A lot of the work comes from me. But when I am doing experiments, I do communicate with other researchers."*

CPUCES2: "*The first person I consult with is my supervisor. Then from there I do my own research, by accessing information from different universities and the library as well."*

7.4.7 Rating library research support services

Participants were asked how they use the library to benefit their own research. Table 7.27A illustrates the themes that were identified from Chemistry researchers' responses, the main one, indicated by all researchers was "Internet access / electronic resources". Two researchers also indicated benefitting from "Books". Further comments from researchers were:

CPUC1: "*At times I go there for the quiet environment to study"*

CPUC2: *"It is the only place to turn to."*

CPUC4: "*One of my colleagues in the department used the library services extensively in her research writing recently."*

CPUC5: "*Via my computer from home, I access remotely databases, and electronic resources. Honestly I don't have time to visit the physical library.*"

CPUC6: *"The library is always my first point of call for teaching my students, for accessing reliable information. If you want to be selective of information for example ScienceDirect, you must go through the library. That is where I start my research, the library electronic collection is so huge"*

CPUC7: "*Mainly through training my students on how to acquire the information literacy skills to conduct research and access reliable sources independently."*

Table 7.27B illustrates the themes that were identified from Chemistry PhD students' responses, with different themes identified. Themes that stood out were: "Publishing advice", "RDM project" and surprisingly "IL training". Further comments from students were:

CPUCS1: "*Access articles, publishing advice, and the Internet access, to find out the current technology and new developments in my field."*

CPUCS2: "*Five months ago, I participated in the RDM pilot project, entails how to handle your data in a safer way – bio resource engineering research group. I attended a course for postgraduate students at the library."*

Table 7.27C illustrates the themes that were identified from Chemical Engineering researchers' responses, the main one, indicated by all researchers was "electronic resources". Two researchers also indicated benefitting from "ILL". Further comments from researchers were:

CPUCE1: "*I use the library mainly for research articles which are not Open Access. The library is quite useful in providing me with articles*."

CPUCE2: "*remote access to e-journals and e-books is one of the good things*."

CPUCE3: "*Through journals, ILL and bibliometric analysis, it is motivating to know my research status*."

CPUCE4: "*My research is 99, 9% dependent on the library resources – to shine a light on the trends, allowing me to generate my own data and new knowledge."*

CPUCE5: "*I also use [another] University library resources as well because I am studying my PhD there*."

Table 7.27D illustrates the themes that were identified from Chemical Engineering PhD students' responses, the main one being "Electronic resources". Further comments from students were:

CPUCES1: "*When I need to access a specific book, and online journal articles."*

CPUCES2: "*The physical research space and facilities in the library, it is a place where I can focus on my work. I also use ILL and information resources."*

A follow-up question regarding library resources used by participants particularly for their research revealed electronic resources were the most popular among Chemistry and Chemical engineering researchers and PhD students. Table 7.28A highlight the themes identified from Chemistry researchers' responses, the main one being "Remote access to electronic resources". Some further comments from researchers were:

CPUC1: "*At times I go there for the quiet environment to study, Internet, books, but mostly I access online articles wherever I am*."

CPUC5: "*I also encourage my students to use the library resources…especially referencing tools and things that is beneficial for them*"

CPUC7: "*Sometimes I don't even know how to get something, I just ask, and I receive an email with the information, which is just amazing*."

Table 7.28B highlight the themes identified from Chemistry PhD students' responses, the main ones being "Electronic resources" and "Mendeley". Surprisingly one student indicated "Libguides". The student (CPUCS2) who indicated "ScienceDirect" elaborated further: "*databases is where I get 95% of my research. Sometimes I forget that it is the library that subscribes to the databases that I am accessing."*

Table 7.28C highlight the themes identified from Chemical Engineering researchers' responses, the main ones being "ScienceDirect extensively" and "electronic resources". One theme that stood out from Chemical Engineering PhD students' responses was "Computers" as illustrated in Table 7.28D.

Participants were asked whether they were satisfied with the functionality of the library and if not, how the library could be improved to support research. Here five Chemistry researchers indicated that they were satisfied with the functionality of the library. CPUC6 and CPUC7 indicated that they were not satisfied with the functionality of the library. Comments from researchers were:

CPUC5: *"It has improved a lot and it is very good."*

CPUC6: "*first of all, I don't understand why the library should close at 22:30, why the library is not open on weekends. When the library closes on a Saturday at 16:00, then I am still busy working!"*

CPUC7: "*No there is quite a lot that can be improved. Access especially. Me, I am not happy with the library that closes. We need physical access 24/7, it is still very important. For example, you search the online catalogue over the weekend and find a book that you want to borrow, but the library is closed, and Monday comes, you don't get a chance to get to the library because of teaching, then by Tuesday that particular book has been borrowed by somebody. If I had access over the weekend, I would have located the book, used it over the weekend already! I really feel that there must be a section of the physical library that must be open 24/7, otherwise one is stranded. In some cases I end up going to the UWC library*."

Only one Chemistry PhD student was satisfied with the library. The student who is not satisfied with the library, elaborated further:

CPUCS2: "*But I don't think this [my] issue lies at the library level, it should be taken up higher, at the institutional level. Maybe the library is not getting the funding to update the resources, I think the library is the victim because the institution should ensure the library has a good budget."*

Only three Chemical Engineering researchers indicated that they were satisfied with the functionality of the library, one researcher had mixed feelings and another researcher was not satisfied with the functionality of the library. Comments from researchers were:

CPUCE1: "*Yes I am, but there is room for improvement, especially on this campus, I think the library is quite limiting in terms of operating hours specifically for research. We would like a library that supports after hours research activities. Of course we understand that it causes many logistical issues and costs, but I don't see why a section of the library couldn't be made accessible to postgraduate students…"*

CPUCE2: "*It is difficult to say. Previously it was useful and good for me. I'm an independent researcher. I would say that I am in-between…"*

CPUCE3: "*No, 50% only. On the issue of loading my publications on DK, I am against it, it is additional work."*

With regard to Chemical Engineering PhD students' satisfaction regarding the functionality of library, one student (CPUCES1) indicated "Not all the time" and the other student (CPUCES2) said "Fine at the moment". Students elaborated further:

CPUCES1: *"Not all the time. If the library is more accessible then it makes it easier for researchers and here I am referring to the physical library, the physical space is smaller than what is expected, and this is limiting for students who need a space to work. But the online library resources I am satisfied with."*

CPUCES2: *"At the moment it is fine, But communication should improve, also expand the physical research space in the library to accommodate more postgraduates because most of the time the area is full."*

With regards to resources accessed from the library website specifically for research, Table 7.29A illustrates the themes identified from Chemistry researchers' responses, the main ones being "Articles" and "Databases". CPUC6 added that *"It would be nice to have more electronic books."* Table 7.29B illustrates the themes identified from Chemistry PhD students' responses, the main one being "Journals /databases". Another theme that stood out was "Wi-Fi is very important". Table 7.29C illustrates the themes identified from Chemical Engineering researchers' responses, the main ones being "electronic resources". Table 7.29D illustrates the themes identified from Chemical Engineering PhD students' responses, the main ones being "Electronic resources" and "Books". Other themes that stood out were "Physical space" and "Internet access".

Participants were asked to select from a list provided, library resources specifically used for their research in the past year. Researchers could choose more than one. Table 7.30A indicates that the most used library services for research in the past year by Chemistry researchers were "Used library's e-resources (e-books, online journals, databases etc.)", "Borrowed library's print resources", "Library's Inter-Library Loan & document delivery services" and surprisingly "Faculty librarian's reference / information services". Other themes that were thought provoking were "Used the library's quiet study area or Research Commons or computer lab" and "Attended a training workshop on e-resources or databases". Table 7.30B indicates that the most used library services for research in the past year by Chemistry PhD students were "Used library's e-resources (e-books, online journals, databases etc.)", "Used the library's quiet study area or Research Commons or computer lab" and "Attended a training workshop on e-resources or databases". The theme "Other: Thesis access" is perhaps surprising as it links to the use of the institutional repository or print copies of theses available in the physical library. Table 7.30C indicates that the most used library services for research in the past year by Chemical Engineering researchers were "Used library's e-resources (e-books, online journals, databases etc.)", "Borrowed library's print resources", "Library's Inter-Library Loan & document delivery services" and surprisingly "Faculty librarian's reference / information services" as well as "Attended a training workshop on e-resources or databases". Table 7.30D indicates that the most used library services for research in the past year by Chemical Engineering PhD students were "Used library's e-resources (e-books, online journals, databases etc.)" and "Attended a training workshop on e-resources or databases". One student added "Other: Used the department's collection" which is thought provoking. When compared to the 2009 research findings, it is worth noting that currently the use of e-resources, print resources and inter-library loans still remain the most extensively used library services for research.

Participants were asked to rate the library in supporting research by scoring between 1 for non-existent to 10 for indispensable. Figure 7.3A indicates that one Chemistry researcher rated the library "indispensable", five rated the library "good" and one "adequate". No researchers rated the library below five. Since no researcher gave the library a weak rating below 5, a follow-up question which listed reasons for low rating was not applicable. It is perhaps surprising that no weak rating was given by Chemistry researchers here, compared to earlier, two indicated not being satisfied with the functionality of the library. Figure 7.3B indicates that both Chemistry PhD students rated the library services for research being "good". Figure 7.3C indicates that three Chemical Engineering researchers rated the library "indispensable", one "adequate" and perhaps appalling, one rated the library "non-existent". Since only one academic rated the library lower than 5, the follow-up question gave a list of possible reasons for low rating as follows:

6. Collection in my area is not adequate
7. Network /databases too slow
8. The library website is not user-friendly
9. I do not know how to search for information on the library website
10. Other (please specify)

The researcher CPUCE2 chose number 5 (other) and specified: "*During my PhD and research I currently have never involved the librarian*".

Figure 7.3D indicates that one Chemical Engineering PhD student rated the library services for research being "good" and the other student rated it "adequate".

A follow-up question asked participants to give a score for each research support service listed on the 'wish list' provided by either choosing: "very important" (which had a score of 1), "useful" (2) or "not important" (3). This meant that scores were calculated in such a way that the lowest number is more important (high ranking) than the higher numbers. Table 7.31A indicates that the traditional library service "Ongoing updates on new information resources" is still placed high on Chemistry researchers' priority list of research support needed from the library or librarian. It is surprising that "Maintaining of research repositories" reached second place, a huge improvement compared to the findings in the 2009 study conducted where many researchers was not familiar or had no knowledge of the institutional repository, DK. It is perhaps surprising that "Training on social media use for research" received a higher ranking than "Advice on my research topic" which was placed at the bottom of the list. Table 7.31B indicates that Chemistry PhD students placed "Other: "Scientific software support (SAS /Origin)" (CPUCS1) and "Scientific writing and proposal writing workshops"

(CPUCS2)", the traditional "Ongoing updates on new information resources", "Advice on research proposal writing, "Advice on bibliographic referencing", "Database training" and surprisingly "Advice on Research Data Management" all at the top of their priority list. Ironically, research support services placed at the bottom of the priority list by students are "Providing a reading list on faculty and students' research topic and providing advice on their literature review" and "Advice on their research topic". Table 7.31C indicates that the 'new' research support services "Maintaining of research repositories" and "Advice on Research Data Management" are placed at the top of Chemical Engineering researchers' priority list of research support needed from the library or librarian. With regards to the repository at top position, is a huge improvement when compared to the 2009 study as indicated in Chemistry researchers' responses above. It is perhaps surprising that "Training on social media use for research" and "Training on mobile apps for research" received a higher ranking than "Advice on my research topic" , and surprisingly "Providing a reading list on faculty and students' research topic and providing advice on their literature review" which were placed at the bottom of the list. Table 7.31D indicates that Chemical Engineering PhD students placed "Other: "Open Science workshops (CPUCES1)", the traditional "Providing a reading list on faculty and students' research topic and providing advice on their literature review ", "Ongoing updates on new information resources", "Database training" and surprisingly "Advice on Research Data Management" all at the top of their priority list. Ironically, research support services placed at the bottom of the priority list by students are "Advice on their research topic".

7.4.8 Likert Scale Statements

The aim of the Likert statements was to confirm previous responses to research support services by the library, or whether there were contradiction. The Figures 7.4A and 7.4B in the **Appendix B** highlights the scores ranging from 'strongly agree to strongly disagree' indicated by the four groups. The statements that stood out are mentioned below.

With regards to the statement "Librarians do not have the subject knowledge to help my research", surprisingly one Chemistry researcher strongly agreed, five agreed and one was undecided. One Chemistry PhD student agreed and one disagreed that librarians did not have the subject knowledge to support researchers. Surprisingly the majority (three) of Chemical Engineering researchers disagreed, but one researcher strongly agreed, and another researcher agreed. One Chemical Engineering PhD student was undecided and one disagreed that librarians did not have the subject knowledge to support researchers. This statement revealed ambiguity, as some interpreted it as the librarian possessing Chemistry or Chemical Engineering qualification, which to some extent links to what was discussed in chapter 2 regarding some academic librarian positions requiring librarians to

hold a degree in a particular subject together with the Library Science qualification. On the other hand, the perception is perhaps that a librarian couldn't possibly be able to provide advice on Chemistry and Chemical Engineering subject without subject knowledge. The results are similar to the 2009 study, where quite a number of academics indicated that the librarian do not have the subject knowledge to help their research.

It is perhaps surprising that the majority of Chemistry researchers disagreed that because of the Internet they no longer need the library whereas Chemistry PhD students had different views. The majority of Chemical Engineering researchers strongly and it is perhaps surprising that one researcher was undecided. Both Chemical Engineering PhD students disagreed that researchers no longer need the library. The outcome from the group confirms several comments earlier pointing out the importance of the physical and virtual library in research, even to the extent of the increased demand for a 24-hour space.

The majority of Chemistry and Chemical Engineering researchers and PhD students strongly agreed with the statement that research is essential to their job. These responses are in line with the mission of the departments with regards to the direction of research.

Surprisingly the majority of Chemistry and Chemical Engineering researchers and PhD students agreed with the statement that international collaboration builds a stronger knowledge culture in the department. However, earlier, one researcher from each department, Chemistry and Chemical Engineering indicated not collaborating with any other researchers in their field. This correlates to previous comments about the research having commercial value and that scientist remain secretive about their work. It also suggests the tradition of working in silos very much still a reality today.

A statement which points to one of the IFLA hot topics in academic libraries supporting research, states that Research Data Management is becoming an important practice in conducting research, and probed the researchers' point of view on this. Here surprisingly, two Chemistry researchers strongly agreed, two agreed, two were undecided, and one researcher disagreed. Both Chemistry PhD students strongly agreed. Two Chemical Engineering researchers strongly agreed and three agreed. Both Chemical Engineering PhD students agreed. Surprisingly in the earlier responses, there were mixed feelings about RDM.

Surprisingly two Chemistry researchers strongly disagreed and one researcher was undecided about the statement that publishing in Open Access journals increase citation counts. One Chemistry PhD student strongly agreed and one agreed with the Statement that publishing in Open Access journals

increase citation counts. Surprisingly similar to the Chemistry researchers, two Chemical Engineering researchers strongly disagreed and one researcher was undecided. One Chemical Engineering student strongly agreed and one agreed. Previous comments from researchers and students confirm that OA increased citations, although some researchers had reservations about Open Access publishing because of the author fees and perception that OA journals are of lower quality.

The last statement attempted to affirm researchers' previous opinions on social networking sites and their visibility on the web. Surprisingly two Chemistry researchers strongly agreed, and three agreed. Both Chemistry PhD students strongly agreed. Four Chemical Engineering researchers strongly agreed, and one agreed. One Chemical Engineering PhD student strongly agreed while the other was undecided that having a research profile on SNS increased their visibility of their research. Previous comments revealed that there is a need for more visibility of research profiles on the university website, which relates to responses about the importance of the UNIBO staff profiles on the website highlighted in Chapter 6. However, there was a strong feeling from one Chemical Engineering researcher not wanting to upload work in the institutional repository which librarians are promoting for the researchers' benefit, as the researcher perceive it to be the task of the librarian to increase his/her research visibility, which is thought provoking.

7.4.9 Additional comments by Chemistry and Chemical Engineering researchers and PhD Students

Participants were given an opportunity at the end of the interview to add any additional comments. Table 7.32A illustrates the themes identified from Chemistry researchers' responses. All researchers highlighted different aspects. The themes that stood out were "Librarian should get mailing list of postgraduate students", "We find what others are doing through the librarian, then we must adapt to our context", "I suggest librarian do more presentations on what the library has to offer" and "Re-allocate subsidy money received from publishing to the library to increase subscriptions". With regards to academic promotion and the pressure placed on research and heavy teaching loads, one researcher pointed out that there should be evaluation and promotion criteria in place for both teaching and research, adding "Leave it up to the people who are passionate about teaching or research to choose their path". Further comments by researchers were:

CPUC2: "*Research in Africa is not adequately funded. As much as the librarian supports research and is very important, there might be problems due to limiting infrastructure, especially when you see what is being done in the US, Europe and you have an idea. The way forward, is the way forward, through experimentation, but needs funding, well-equipped lab for this. Things that are Africa-centric, this is crucial. We must not only read about wonderful things are being done in the world, but be able to do wonderful things here, adapt methods to the African context. Through the librarian, we find out what others are doing, we can adapt them to our context."*

CPUC4: "*. I would like to follow up at this institution in using research facilities more in the future. I must say that it was interesting to hear about this that I didn't know about during this interview session."*

CPUC5: *"What I have learnt from this interview session is that the biggest burden is communicating information. Communication should be clear. Social media could help. The other problem is time, which nobody has. With regards to DHET subsidy, re-negotiate the money, so that the library receives a percentage of this to subscribe to more journals that researchers are publishing in*."

CPUC6: "*The quality of research is based on the knowledge of the person conducting research… and that in turn is based on the information on that research. The library should ensure the students acquire the skill of finding reliable and relevant information. So the IL Certificate has to be incorporated in the requirements for proposal approval is important."*

CPUC7: "*The only thing I can add, is the promotion of research in the institution. The institution should have two streams, one being teaching, the other being research. This will allow people who are research orientated to focus their attention fully on their interest, and passion for conducting research. Those that are teaching orientated to focus on teaching. So that it doesn't become a situation where people are forced to do research for the sake of ticking boxes on a form or report that must be submitted to the department of faculty to show they have done some research. It really waste a lot of space, time, and money. Leave it to the people who are passionate about it [conducting research or teaching] to apply for promotion accordingly, meaning that there should be two promotion streams, teaching and research."*

Table 7.32B illustrates the themes identified from Chemistry PhD students' responses. The themes that stood out were "Increase visibility of the institutional repository" and "Still lots that needs to be done to increase research output in the institution".

Table 7.32C illustrates the themes identified from Chemical Engineering researchers' responses. All researchers highlighted different aspects. The themes that stood out were "Library need to provide regular research workshops" and "The role of the library and librarian must be clear". With regards to research and development in the chemical engineering department, the theme "We need more PhDs in our department" is thought provoking, but at the same time reveal the pressure of the department's transition from core teaching to research. Further comments by researchers were:

CPUCE1: "*I suggest that the library have [publish] their own journals, the library becoming the publishing house, because that will go a long way in promoting research. It speaks to the whole issue of visibility of research. An interdisciplinary journal especially for young researchers. It could even be small where researchers can share what they are doing in the form of a newsletter. It can build young researchers to establish themselves. It will remove this conflict between the publisher and our institutional repository, because we then publish directly in these institutional / library journal. The Research Day is not enough, the library need to organise research workshops on a regular basis where we can have cross-departmental discussions with researchers and PhD students."*

CPUCE2: "*I think we as researchers don't really know what the role of the librarian or library is. We need to bridge the gap between what the librarian can offer versus what the researcher needs and want. We need to have a research meeting with the librarian and the researchers. I think academics need to have library orientation as well. And most important, we need to learn to communicate!"*

CPUCE3: "*I would like the department to be more visible, especially for research. Our IT is poor. My wish is for everybody in the department to up their game. We need more PhDs in our department. The DK processes should be done by the library, because I am not going to do it."*

CPUCE4: "*It has just occurred to me now during this interview that probably there is a lot of library services that researchers are not using out of ignorance. It will be ideal if we all get a refresher on what the library has to offer, a workshop or seminar for the department will be good, or a Library Day. A person like me who thinks I know it all because I am an independent researcher, lose out on how the library has evolved. So I recommend we academics get a reminder of library services and resources.*"

CPUCE5: "*I have been lecturing for 27 years at several universities. I have been to universities overseas as well and I can say that we have a good setup here, with our electronic resources and all the facilities that our library provides. However there is only one thing, to have a 24-hour physical library service is needed for students. On the other hand I am not sure that if the library keep it open for 24 hours, whether it is viable. But I think the library should benchmark against international library services*."

Table 7.32D illustrates the themes identified from Chemical Engineering PhD students' additional comments. The themes that stood out were "Need for more research seminars to bring researchers closer to the library" and "We need to know at the start who is our librarian". Further comments from students were:

CPUCES1: "*I feel the library should be more engaging, more attractive. The library should offer more seminars, to bring researchers closer together with the library. When starting your research, it is crucial that we as students know who our librarian is. Overall the library is a very good support unit for researchers."*

CPUCES2: "*The library should have a workshop at the beginning of the year with postgraduate students to be familiar with the librarian and library resources."*

7.4.10 Reflection on researchers and PhD students' responses

Responses revealed that there is a need for library support in research. Both researchers and PhD students have pointed out what they need with regards to support in research, which will be discussed further in Chapter 8. Awareness of what the library has to offer is lacking and the communication gap was revealed throughout the responses. However, all researchers and PhD students agree that research is essential to their job, and visibility of their work is fundamental.

7.5 Concluding remarks

The chapter reported on interview responses from librarians supporting research in Chemistry and Chemical Engineering departments, as well responses by Chemistry and Chemical Engineering researchers and PhD students. Some similarities and some vast differences between librarians versus researchers and PhD student responses with regards to the trends were revealed. These significant findings will be discussed in more detail in the following chapter.

Chapter 8:

8 Discussion of the findings and conclusion

8.1 Introduction

Research being fundamental for the growth and competitive advantage in higher education institutions, this study focused on the perception of librarians' role in supporting and conducting research, versus the researchers' perception of the librarians' role in supporting research in Chemistry and Chemical Engineering departments. The purpose of this qualitative case study was to explore the position of communication and science academic libraries supporting chemistry and chemical engineering research at CPUT and UNIBO. Following chapters 6 and 7 which focused on the case studies of UNIBO and CPUT, this chapter discusses the findings in an attempt to answer the research question and sub-questions posed in this thesis. Therefore the interpretation of the case studies are organised according to the research questions. The chapter ends with a reflection on the project, recommendations and concluding remarks.

8.2 What is the role and current state of science academic libraries in research?

The roles of academic libraries have constantly been changing over time to remain relevant, but are also aligned to the strategic goals of their parent institutions. This section discusses the interview findings from librarians, researchers and PhD students about the role that the academic library is currently playing in supporting research.

8.2.1 Faculty librarian's involvement in supporting researchers and PhD students

There is disparity between researchers and PhD students with regards to communication with their faculty specifically for research at CPUT and UNIBO. Responses ranged from "open communication" by some CPUT Chemical Engineering researchers to "no communication" from one CPUT Chemistry researcher. This particular Chemistry researcher elaborated that not being aware that the librarian existed before the interview session, which one Chemistry PhD student (CPUCS2) also revealed. However a CPUT Chemical Engineering PhD student (CPUCES1) indicated preferring to go to the library for support. The pattern being observed to an extent says something, if the researcher communicates with the librarian, it filters down to the students and vice versa. On the UNIBO side, according to the findings hardly any communication takes place between PhD students and librarians regarding research.

Regarding faculty librarian involvement in supporting researchers with their research, two CPUT Chemistry researchers indicated that librarians should be more involved in supporting their master's students. This suggests that the focus by librarians should be shifted towards postgraduate students and young researchers with regards to research support. Information provision, although mentioned several times as the main reason for consulting the library and librarian, is not defined by all researchers or students as forming part of research support. Chemical Engineering researchers tend to see it as such compared to the Chemistry researchers who see information provision separate from research support components.

8.2.2 The role of Library Associations

Here the role of the library associations who keep librarians updated on trends is very important for the development of the librarian profession in supporting the diffusion of research and the development of knowledge based on research. However, as highlighted in the findings, only one librarian at UNIBO is a member of AIB, and only two librarians at CPUT are a member of LIASA. The question remains, how do the rest of librarians keep updated, and what does this say about the current state of academic librarianship? The economic crisis hindering active membership in library associations were revealed by librarians at UNIBO and CPUT. Aspects raised that suggest there are underlying issues at both higher education institutions were that membership fees are high, and librarians don't have the freedom to attend all workshops or activities offered by the library associations, as they need to get permission from so many channels in the organisation. They feel it is not worthwhile paying membership fees when they can't participate. The other reason is that librarians don't see what the library association could do for them; for some reason what is offered and promoted is not enough to convince librarians. Surprisingly on the other hand the assistance from the library association for the librarian profession is acknowledged, for helping academic librarians to support research by the only librarian who is currently a member of AIB.

8.2.3 The role of the library as space / place

Considering the case studies present two very different higher education institutions, each with a unique culture and structure in this thesis, what stood out as still being key at CPUT and UNIBO is the physical library space. In the 2009 study which focused on CPUT researchers, the Research Information Support Centre (RISC), which is similar the research commons described in Chapter 2, was found to be a space that was not so high in demand at the time, as the focus of the study was on academics who indicated that they preferred working in their offices. Moving on to the current findings, what came out strongly from responses by researchers was the need for a bigger RISC space in the library for their students. PhD students in particular at CPUT concur and pointed out

the high demand for a quiet physical space, ideally open throughout the night, specifically devoted to research. In previous research, interview findings from the research librarian at the time revealed that "RISC was established in response to the pressure on CPUT to increase its research output. CPUT needs more young researchers, and students need to be encouraged to pursue postgraduate studies" (Kleinveldt, 2009: 29). Currently a building project is taking place at CPUT Libraries, Cape Town campus, to expand the RISC space in order to accommodate more postgraduate students. The new research space will also offer Masters and PhD students a coffee bar facility; following international academic library trends. The introduction of coffee shops as informal meeting places in academic libraries have been found to enable knowledge sharing through social interaction (Gayton, 2008; Forrest, 2009 & Twait, 2009). At UNIBO, researchers pointed to the reading room playing a crucial role in building networks with potential collaborators, which is in line with Crane's (1972) description of invisible colleges for the creation of new knowledge and science. However UNIBO researchers are saddened a bit by the change which led to no longer enjoying the luxury of paging through the new print journal issues due to the shift from print to electronic resources. Some comments later on in Chapter 6 from researchers supports this, as much as researchers are working more independently, the traditional reading room space as well as the informal but traditional "coffee conversations" which many academic libraries have introduced (Gayton, 2008; Forrest, 2009 & Twait, 2009) is still very much appreciated.

Overall it was clear from the responses in both case studies that the concept of 'library as place' not only as 'space', is still crucial in the 21st century in the area of research. The demand for face-to-face interaction for the sharing of ideas, reading lists, building new partnerships and networks in a physical library space remains high in the digital age, especially since research practices have moved from isolated to collaboration. 'Hybrid' or 'blended' research practices, where physical interaction combined with technology is the current trend at the two higher education institutions.

8.2.4 The Open Access Movement

Print material especially books are still highly regarded at CPUT and UNIBO. It is perhaps an area for further consideration for libraries transforming spaces, since collection development policies are moving all towards the shift to electronic resources, which in Chapter 2 was discussed as one of the major changes occurring in academic libraries over time. However with regards to e-journal subscriptions, academic libraries face major challenges too with the increasing high fees forcing many cancellations, which led to the recent case of Germany, Peru and Taiwan taking a stance in 2017 to cancel Elsevier subscriptions (Schiermeier & Mega, 2017). The solution for academic libraries as the literature suggests is the Open Access movement which has been promoted globally through

Open Access Week activities during the month of October every year. Also, the rise of the institutional repositories offering the green route option in response to OA movement shows promise, as the recent webometrics report discussed in both cases reveal improved visibility of universities' research output. However, it is perhaps thought provoking that at this stage quite a number of UNIBO and CPUT researchers' view on Open Access publishing reveal that the disadvantages far outweigh the advantages. The stigma that Open Access journals are of far lower quality came out strongly from Chemistry and Chemical Engineering researchers' responses at UNIBO and CPUT. There is still pressure to publish in high impact factor journals and for CPUT, publishing in accredited journals for subsidy purposes is an imperative for prestige, status and funding.

Considering the current state of affairs, there is a clash between the academic library promoting the Open Access movement and researchers being under pressure to publish in high impact factor journals, which to a large extent are still closed access. At UNIBO, some researchers even remarked that their concern is not to have research output available to the world, that they are only targeting an elite group that can afford subscription fees in order to access their publications. On the CPUT side, some researchers are more favourable to free access to scientific papers and the importance of research output on the African continent being more visible internationally for growth and development, as well as for competitive advantage. That researchers only comply with public funders' (Horizon 2020 and NRF in particular) policy to publish Open Access suggests that the mind shift process is still very slow with regards to the Open Access movement. This is perhaps so due to Chemistry and Chemical Engineering researchers at UNIBO and CPUT revealing that their research mainly have commercial value. Therefore the idea of Open Science and Research Data Management currently do not sit well with researchers in the two case studies. However, during the October 2017 Open Access week the OpenCon2017 presented that researchers globally are getting on board rapidly, and that academic libraries are at the forefront of providing dynamic and innovative research support services which talks directly to Open Access, Open Science and Research Data Management. No longer is the institutional repository only accommodating theses and dissertations, and publications of researchers only, but also the research data, and offers a space for Open Science activities to take place. Academic libraries provide research data repositories such as OpenAire and Figshare that is directly in line with the research trends and technology trends discussed in chapter 2 (IFLA, 2015, 2016, 2017; Johnson et al, 2015, 2016, 2017).

8.2.5 The advantages and disadvantages of Open Access

Findings revealed that librarians' views at UNIBO and CPUT are remarkably in contrast to the researchers with regards to Open Access. According to CPUT librarians the advantages of Open Access far outweighs the disadvantages in the themes: "Increase researcher visibility", "Free access to information", "Higher citations, higher ratings, and High impact journals part of OA movement", "Good for the researcher" and "Definitely more advantages than disadvantages". However librarians pointed out two key points which hinder researchers from publishing in Open Access journals being "OA publishing stigma: Researchers concerned about reputability of OA journals and work being stolen" and from another librarian "Hybrid journals: author and library pay high costs". When considering CPUT Chemistry researchers' responses to OA publishing, the disadvantages for them being "No rigorous reviewing because the author pays", "Danger of plagiarism" and "OA publishing a betrayal to science due to low quality journals", suggests that there is confusion among researchers and a need for OA education. Although the idea that Open Access will increase plagiarism is mentioned in the literature, software makes it easier to detect plagiarism in open content (Grotschel, 2017: 243). Researchers face the challenge of Open Access publishing models which are found not to be conducive to scholarly communication, and on the other hand digital academic publishing threatens the progress of science (Taubert & Weingart, 2017: 1). The complexity of OA publishing worldwide with regards to Hybrid journals and the Gold versus Green Route options have been raised by one UNIBO librarian (UNIL3) as well. This is directly in line with the latest statement released by Tiedonhinta.fi. ("The cost of scientific publishing must not get out of hand", 2016) on the issue raised in Finland about publishing and costs, and the negotiations that are currently taking place. However there seems to be some conflicting views on this issue as librarian UNIL5 claimed that both Green and Gold OA publishing is advantageous, whereas librarian UNIL3, although mentioning that Open Access publishing is a complex matter, claimed that the Gold Open Access model is more problematic. Whether the publishing processes differs across disciplines with regards to OA publishing as the themes above seem to suggest is perhaps open for further debate. Although it is important to point out that researchers' perception on OA publishing do differ from discipline to discipline (Rosenbaum, 2017: 48).

Based on the author's experience of recently publishing in an OA journal, a rigorous review process was followed, which led to a higher quality publication. This is in line with the new DOAJ journal quality control implementation which led to many journals being removed that did not meet the criteria as previously discussed in the literature review (DOAJ, 2017). It would thus be detrimental if rules differed between disciplines such as the techno-sciences versus social sciences and humanities,

but this is open to further research. The researchers' concern that OA publications will increase plagiarism practices is perhaps thought provoking, as the use of any work without acknowledging the source, whether it is published or unpublished, is plagiarism. On the other hand not all efforts are lost, as one CPUT Chemistry researcher agreed with librarians that the advantages of OA publishing outweighs the disadvantages, and further said that for improving the quality of life, science needs to be open to the public, which is in line with the Horizon2020 work plan and NRF statements already mentioned in chapter 2. It is noticeable that the majority of CPUT researchers and PhD students indicated in the Likert scale statements that OA increased citations compared to the majority of UNIBO researchers being undecided. Considering the bibliometric study conducted on CPUT and UNIBO researchers for the purposes of selecting the target audience for the study, the initial sample size as illustrated in Chapter 5 reveal that OA publishing among the researchers in this study is still a slow progress, where on average CPUT and UNIBO researchers in the sample had one or two OA publications during the period 2011-2015, and some had none.

Once again the debate is ongoing regarding hybrid journals and high subscription costs that academic libraries can no longer afford as every year the budgets are cut worldwide. As highlighted in Chapter 2 and above, the decision made in October 2016 already by Germany, Taiwan and Peru to cancel their Elsevier subscriptions (Schiermeier & Mega, 2017), are but a fraction of the world taking drastic action to hopefully reach a solution that will benefit society with regards to access to research. On the other hand, this action has heightened the practice of accessing illegal websites by researchers in Peru as the *Nature News* article unfolded, who are constantly under pressure to conduct more research, and now found other ways to access research and information while the battle between libraries and publishers continue. Using illegal sites as a resort came out from responses in UNIBO and CPUT cases, with one researcher predicting that digital libraries will become extinct. This opens up a situation of treading on dangerous grounds, as the copyright infringement might spiral out of control. Negotiating with the publisher so that researchers are allowed to upload for example post-print versions if not the published versions into the institutional repository which is open source is what librarians try very hard to encourage. On the other hand, researchers are not completely to blame when considering the issue of predatory journals raised in Chapter 2. With all the pressure with research output and evaluation of research, researchers at CPUT and UNIBO pointed out that it best to stick to high impact closed access journals for publishing to avoid additional burdens. Therefore the conversation around the OA publishing dilemma needs to involve all stakeholders in the university; especially librarians, researchers, top level decision-makers of the university and publishers. Perhaps the solution for all will be academic libraries taking on the role of

publishing houses as discussed in Chapter 2 (Raju & Schoombee, 2013). The conflict is brought about by the challenges that libraries face with high subscription fees and budget cuts, the OA movement is a solution to provide wider and free access, and the libraries cry out for this. On the other hand it clashes with publisher models and therefore the researchers are against it because 'why must they pay'. From the author's point of view it remains a battle.

Responses by librarians on the topic of Open Science confirms the above dilemma as all librarians indicated that they had no experience or knowledge thereof, and that the focus at this stage is on Open Access, not Open Science. This is in line with the statement by the European Commission (2016: 20) on the acceptance of Open Science being quite different from discipline to discipline and that researchers are not clear on how to integrate it into current research practices.

8.2.6 Promoting Open Access

UNIBO librarians claimed that they are promoting Open Access to Chemistry and Chemical Engineering departments. The theme "Horizon2020 programme on website" suggests that the university community should be aware of the new research developments with regards to H2020 and OA, Open Science and RDM. However responses later show that many (including librarians claiming to post H2020 documents on the university website) are not familiar with terms or concepts such as Open Science and RDM. In some way this is in line with *The London School of Economics and Political Science Blog* post (2016) referred to earlier regarding the gap and conflict between current developments in research practices and the university community's knowledge thereof. The comments by librarians UNIL1 and UNIL4 triggers a problem in the university community as a whole with regards to research:

UNIL1: "*No, this happens at the university level and not really from our departmental library. All news about various disciplines are posted on the website for the university community, so professors will read deeper when it relates to their field. It remains the decision of the professors where to publish. I can inform them about free archives, basically just transferring information to researchers about Open Content."*

UNIL4: "*We try to share information about OA, in particular, making available the list of OA journals on the library website. We post information about the programme Horizon2020 of the European Community on the website. Chemistry researchers are not in favour of OA publishing as they should be; I think it is because they are involved in commercial research. This is my experience: Chemistry researchers publish OA only if they have to because of using public funds."*

To unpack this problem, it is perhaps important to observe the current research activities taking place among the stakeholders involved. Researchers want to maintain the freedom to publish where they want as mentioned before, and was later pointed out by researchers in both cases. Library associations guide librarians to encourage researchers to follow the Open Access route with the aim

to improve access to information, as the agencies which provide financial support more often these days request that researchers publish in Open Access Journals. However, publishers have strict conditions for both OA and closed access publishing. Finding a way for stakeholders to address these issues is complex in reaching an agreement that will benefit the whole knowledge society (Grotschel, 2017). The follow-up news report on the Germany versus Elsevier case revealed that free access to electronic resources was provided in 2017 by Elsevier while negotiations are still taking place (Schiermeier, 2018).

Successful promotion of OA has got a lot to do with having policies in place. As already mentioned, UNIBO do not have an OA policy, which one librarian pointed out contributes to the challenges faced in promoting Open Access publishing whereas CPUT has an OA and RDM draft policy awaiting approval at Senate level. For CPUT being at this level of the policymaking process for OA and RDM, reveals the future direction of research practices adapting to the trends. CPUT Libraries are strategically aligned to support the university community with research through promoting OA via the Institutional repository, DK and providing research support services such as bibliometrics, altmetrics, ORCID profile promotion, and future RDM services. However buy-in remains a challenge at both institutions as highlighted by librarians and researchers during the interview session. The current state of affairs was recently observed in the Applied Sciences faculty at CPUT where the issue of no available funds for author fees was found to be the main limitation for researchers to publish in Open Access journals. Until provision is made at an institutional level to introduce an author fees model as one Chemistry researcher suggested during the interview, most researchers will continue to publish in closed access journals. There is an expectation that CPUT authors use the 20% subsidy received for publications in DHET accredited journals for covering OA author fees. However, this creates another problem as researchers are unable to then utilise funds for any other research activities. Therefore researchers tend to stick with publishing in closed access journals where they do not have the burden of paying author fees as mentioned earlier. In terms of sponsorship for researchers to participate in conferences and covering any research related expenses, researchers rely heavily on DHET subsidy received for publishing in accredited journals. What the two CPUT Chemical Engineering researchers pointed out about the pressure to publish in accredited journals is the reality of the situation at CPUT and UNIBO. However one CPUT Chemical Engineering researcher identified OA journals included in the accredited journal list to publish in, which links to the hybrid journal model introduced by some publishers. There is evidence though of a constant clash between librarians promoting OA publishing, and the challenges that researchers face regarding the funds issue. This confirms interview responses from those researchers at UNIBO

and CPUT who indicated that the disadvantages far outweighed the advantages of Open Access publishing.

Perhaps the main reason for resistance to OA publishing is because it has interfered with the "traditional methods of content dissemination" (van Schalkwyk & Luescher, 2017: 6). However some CPUT researchers dismissed this point and mentioned that in the future they plan to publish more in Open Access journals as there is a need for research output visibility on the African continent. Although some CPUT researchers had reservations about OA publishing and argue that they perceive the research community to view it as less valuable, Chemistry PhD students both highlight the importance of the visibility of their research, and that through OA publishing this objective is ultimately achieved. Output of scholarly research must essentially permeate throughout the country for the "sustainable development of society" (Ngulube, 2007: 130), and this directly links to Horizon2020's work programme "Science with and for society", which aims at: "engaging society, integrating the gender and ethical dimensions, ensuring the access to research outcomes and encouraging formal and informal science education" (European Commission, 2017: 6), which is envisioned to be achievable by driving the Responsible Research and Innovation (RRI) initiative (European Commission, 2017: 6). It is worth pointing out that for Africa and many developing countries, the challenge of disseminating research output widely has got to do with the limited indexed journals that researchers are compelled to publish in, which accepts only a limited amount of articles, the rejection rates are so high, meaning that the publishing process is slowed down tremendously (Rosenbaum, 2017: 50; Ngulube, 2007: 132). With regards to accessing scientific publications in developing countries, one Chemistry PhD student (CPUCS2) mentioned a crucial point: "*Ease of access, more exposure. In the rural area, I could download on my phone*." The support from the librarian play a crucial role in promoting the institutional repository to ensure researchers upload their work for access.

The remark "I think that this issue can only be sorted out by the publisher" (CPUC5) to some extent links to the current situation with the Elsevier publisher discussed above regarding OA publishing model negotiations. As pointed out in Chapter 7, in the January 2017 webometrics report, CPUT's institutional repository DK was ranked 12th in South Africa, 22nd in Africa and 970th in the world (Ranking Web of Repositories, 2017). Compared to the previous study in 2009 where DK was still unknown to many researchers at CPUT, these statistics show huge progress and outcomes of promoting DK to the faculty by librarians which is in line with the Open Access movement as well as research output initiative for research evaluation (NRF, 2017; European Union, 2017). Evidence of participating in Open Access activities were revealed by CPUT Chemistry PhD students who indicated

that they communicated and collaborated with the library about uploading their work into the institutional repository, since it is mandatory for theses to be uploaded before graduation. UNIBO holds a similar policy for PhD students. The UNIBO institutional repository, AMS Acta, was ranked 14th in Italy, and 569th in the world. This repository hosts both publications and research data of the university community and is H2020 compliant. However, UNIBO have other repositories too which hosts the PhD and Laurea (first degree) theses. The difference observed between the two higher education institutions in this study, is that CPUT's DK is managed by the library whereas UNIBO's AMS Acta is managed by one of the support units, the research office. That AMS Acta is handled by another support unit, is perhaps the reason why UNIBO librarians responded not having much knowledge and experience with Research Data Management services, and Open Science practices. One Chemistry librarian's response at UNIBO points out that units within the university work in isolation, and that it is difficult to get information about what each unit is doing as units do not communicate with one another, suggests that this is an area that needs attention. This has been pointed out by the librarian as a huge problem. The major change revealed by researchers with regards to research practices was the transition from individual to collaborative group research, which the literature pointed out being the trend in science research in particular for a long time now (Servos, 1993; Crane, 1972). Therefore it is fundamental that collaboration also takes place between support units like the library and research office within the university to ensure the smooth running of research processes.

8.2.7 Perception and experience of Open Science

There is a misconception regarding electronic resources accessed freely via the library's website. This was observed in both case studies, as some users don't realise that it is through library subscriptions that all content is open. The perception of Open Science among CPUT Chemical Engineering researchers is that: "it is happening in ResearchGate" and later a suggestion that "a virtual room to exchange knowledge is useful" was revealed. These responses link to the prosumer concept discussed in Chapter 4, and to some extent they suggest the sharing of resources as "the next generation" ILL. The prosumer concept has perhaps brought about a battle between IR and SNS (Kleinveldt, 2017). Chemical Engineering researchers' themes: "OA is essentially what knowledge sharing should be about", "My OA publication received reviews immediately compared to my closed access publications" and "University cannot subscribe to all the journals in the world", somehow sum it all up with regards to the need for disseminating new science through OA. It confirms to an extent what some researchers were saying how open content improved students' skills in reading and writing reviews.

However, as pointed out in Chapter 2, there is evidence of a few Horizon2020 projects that have already incorporated Open Science activities (Pulverer, 2014; Swan, 2014; and Winfield, 2014). Librarian UNIL3 commented further that: *"I think that in general it is important. However, especially for chemists it is a problem, they prefer to preserve their research product (for example choosing the filing of patents)",* which CPUT researchers in their responses also confirmed. This directly links to researchers' strong view presented later on the matter of protecting their work through publishing or patenting first before making their work open for running the risk of being stolen by somebody. But it is argued that "closed science is unethical" and that "science without borders" should be promoted, because it is through Open Science that society can be reshaped (Swan, 2014 and Pulverer, 2014). Although claiming no knowledge or experience, librarian UNIL4 stated that: "*I read the Horizon2020 reports and some articles. In Bologna, all researchers who publish using public funds must publish in OA journals. I have not experienced any group who are busy with Open Science."* This somehow confirms what the European Commission (2016: 20) claimed that researchers and academics are experiencing a skills gap in practicing Open Science. The awareness of Open Science is perhaps linked to what was previously mentioned by librarian UNIL4 being on the "*American Association of Research Libraries for Chemistry Librarians*" mailing lists or the library association mailing list. Perhaps the practice of Open Science in the librarian profession has not yet been realised as such, since information on new developments, best practices and trends are shared among librarians which also leads to collaborative projects. Responses by two librarians on the role that the library plays in promoting Open Science corroborate with the "Training on Open Science in the European Research Area" section of the Horizon2020 work programme 2016-2017, Science with and for society document (European Commission, 2016: 20) as stated below:

UNIL3: *"I think that it [Open Science] should be linked to OA initiative. Talking of it to our researchers could open their minds, especially with our November* [2016] *workshop".*

UNIL4: "*We are promoting Open Access, not Open Science at this stage".*

It is perhaps ironic though that researchers are not as keen on the Open Science concept as discussed earlier where researchers made it explicit that scientists are secretive about their work due to commercial value attached to it and the competition out there with regard to new discoveries. In the past it was to some extent common for scientists to work in complete solitude (Crane, 1972; Servos, 1993). However, with regards to research data, one Chemistry researcher remarked that data should be shared and belong to the scientific community. This is in line with the statements by Horizon 2020 (2017) and NRF (2017) on Research Data Management. Another Chemistry researcher elaborated that this is how researchers give back to society, which is in line

with discussions by McCallum (2016) that took place at the 1st conference on the social impact of science (SIS2016). However, on the side of Chemical Engineering researchers, one concur with the argument on open science regarding data that has commercial value should not be shared. But the majority of Chemical Engineering researchers at CPUT support the idea of managing research data. However on the side of the librarians, it is perhaps surprising that only one UNIBO librarian indicated needing to be trained on Open Science.

8.2.8 Perception and experience of Research Data Management

With regards to Chemistry researchers' perception of RDM, there is realisation among some researchers that the ultimate objective of RDM is for verifying results and for data re-use to produce new knowledge and science, which is directly in line with the literature discussed (Crane. 1972; H2020, 2017; IFLA, 2017). A comment by a CPUT PhD Chemistry student regarding the publishing of negative data links directly to the SIS2016 conference presentation on PLOSOne encouraging researchers to publish negative results (McCallum, 2016). It also links to re-using data for new research. One Chemical Engineering PhD student at CPUT mentioned a very important point about being informed about RDM too late in his/her project, and that the DM plan should have been completed at the start of the research project. It connects to previous responses from librarians who indicated that the library is in the process of offering a service to support researchers with data management plans, and that it is becoming far more important for librarians to support all stages of a research project.

A remark from a CPUT Chemistry researcher regarding the library assisting with RDM through incorporating it into the Advanced IL training, links to what a Chemistry librarian at UNIBO mentioned that a data literacy module was included in their IL training with PhD students. The difference between UNIBO and CPUT regarding IL training identified in this study, is that UNIBO focused on training PhD students whereas CPUT's main focus is training undergraduate students due to the IL policy making it compulsory for all first years. Even though the Advanced IL training is offered to postgraduate students at CPUT, it is not compulsory for PhD students at this stage to attend IL training. As discussed in Chapter 2, the focus at university libraries in other countries, as for example in Ireland, has shifted over time to training IL to PhD students (Patterson, 2009: 91), which UNIBO librarians confirm is priority.

It was observed that the younger researchers are more open to the library offering RDM services at CPUT than the established researchers. In contrast, some Chemistry and Chemical Engineering researchers at CPUT and UNIBO do not want to be dictated to about research trends. They want to

retain control over their publications, data and research practices. With regards to RDM being a service offered by the library, the remark (CPUCE1): "*The library could manage data with the approval of researchers involved, I will put that as a strong disclaimer*" confirms this argument. Commercial value of research is the main factor determining whether researchers in general want to participate in RDM. One key point raised by one CPUT Chemical Engineering researcher (CPUCE4) regarding RDM services provided was: *"it doesn't really matter who does it, as long as it is done properly"* and another remark that show disparity in one department's thoughts are (CPUCE5): *" It is not practical for a librarian to be handling our research data."* Based on what the literature suggests in Chapter 2, that academic libraries should be providing RDM services (Prokopcik and Kriviene, 2013: 192), researchers and to an extent librarians as well at CPUT and UNIBO showed mixed feelings.

8.3 What is the role of the researcher as a prosumer in the contemporary university?

Researchers and PhD students indicated that they had different roles in research. Surprisingly one CPUT Chemistry researcher remarked possessing the role of a student in the department, which might be interpreted as the nature of the job being a lifelong learning experience where new discoveries are made all the time. However this may also suggest some underlying issues not made explicit during the interview, especially since this is a researcher who has been employed for a number of years when the institution was still a Technikon. On the other hand, the theme "Review proposals for Btech and Masters students" from a Chemistry PhD student's response suggest possessing the role and responsibility of an academic in the Chemistry department. This seems to be the future direction of PhD programmes at universities to better equip students for the workplace (Fung, Southcott & Siu, 2017: 175).

The differences observed in responses by both librarians and researchers at UNIBO and CPUT to an extent has to do with the culture of the higher education institutions. UNIBO being a traditional university, seems to stick to old practices such as literature searches and handling reference queries as interview responses revealed, whereas CPUT being young and dynamic, seems to be more open to exploring new avenues for example training researchers and students in Mendeley and the plan to roll out RDM services from 2017 onward. These disparities are also experienced among the cadre of participants in this study, the established versus the fledgling researchers and librarians.

In LIS education, rethinking the curriculum is currently being discussed to prepare library science graduates for dealing with trends in the workplace (IFLA, 2017). Since keeping up with trends have already been raised as a concern by aging librarians who pointed out that their qualifications of

yester-year has not prepared them for the new developments in academic librarianship and changing demands from users (Cavaleri, 2017; Rasetti, 2017), reinforces the need for redevelopment of the LIS curriculum at a global level (IFLA, 2017).

8.3.1 Visibility of research output versus embracing Web 2.0 tools and social media in research

UNIBO librarians and two CPUT librarians revealed that their physical visibility was far more valuable to researchers than them being visible on the web. When considering the UNIBO library structure, libraries are situated within the departments and at some of the smaller CPUT campuses, the same applies. CPUT librarians' responses to the physical visibility confirms this:

CPUL1: "*I don't get a lot of feedback on my visibility on the library website, but I do get feedback on my Libguides because my visibility is prominent here. But at this campus, I increase my visibility more by physically visiting the departments, it is very much more effective at this small campus".*

CPUL2: "*Well it links strongly with your visibility in the department and faculty. It is challenging, they will only know what the librarian can do if we market ourselves and communicate it properly to the faculty. The faculty is not interested if something is going to take up their time. They [researchers] need to see the benefits of the librarian becoming a research partner, and they need to understand my role. Researchers need to see the value in what I have to offer that can support their research".*

Researchers at CPUT and UNIBO confirmed at different points during the interview that physical contact with a librarian is fundamental. It is perhaps thought provoking that the majority of UNIBO librarians are not keen on having a librarian profile on the web, since some librarians mentioned that they observed more online activities taking place between researchers on Social Networking Sites (SNS) like ResearchGate for research and wondering how librarians fit in. A news flash by *Democracy Now* (2016) posted on 27 December 2016 revealed US officials requesting foreign travellers to disclose their social media profiles at customs and border gates. The introduction of this new protocol have huge implications on cyber security and privacy, as well as freedom of expression (Democracy Now, 2016), which could have an effect on the use of social media for research. Perhaps the strong feeling that UNIBO librarians expressed about not wanting to embrace social media, and to rather stick to the traditional communication modes, could be interpreted as 'playing it safe'. However, it was revealed by one librarian who is based at a satellite campus that policy issues is also limiting librarians at UNIBO to embrace social media to interact with researchers. Another issue raised was that the staff capacity at UNIBO libraries restricts the use of social media in marketing library research support services. This is in line with findings in chapter 3 which pointed out social media use in academic libraries is high maintenance and particularly challenging for small staff capacity (Winn, Groenendyk & Rivosecchi, 2015). As discussed in Chapter 4, university concerns around ethics leading to policies on social media for research also play a role (Fenwick, 2016).

The main Web 2.0 tools and Social Networking Sites used by CPUT librarians to support research are Mendeley, ResearchGate, Facebook, LinkedIn, Academia.edu, Google+ / Calendar / Drive, and WhatsApp points to the direction academic libraries are taking in dealing with the technology trends highlighted in the NMC Horizon reports which focused specifically on higher education technology trends (Johnson et al, 2015, 2016, 2017) discussed in Chapter 2. The point that Wilson (1981) made about the information-seeking behaviour of researchers depends very much on the information need and when interaction takes place socially for retrieving information for research, is confirmed by the following librarian response:

CPUL2: "*It is dependent on the departments we support. I asked researchers how they are communicating with collaborators, and they are still using the traditional way of communicating, via email. We do advise about various Web 2.0 tools that researchers can use, but at the end of the day, it really depends on the research co-ordinator and team, what will work best for them, whether it is Mendeley that they choose to use as a communication tool for example."*

The comment by CPUL3: "*Researchers in the institution consult me more since I registered on ResearchGate/ LinkedIn"* suggests that more interaction are taking place among CPUT librarians and researchers via social media.

CPUT Chemistry PhD students' observations: *"My profile viewed many times based on my research"* and *"receive local and international collaboration requests",* relates directly to the 21st century role of the researcher as prosumer concept presented in Chapter 4. A key point raised by Chemical Engineering PhD student (CPUCES2) using social media in research was that it assists in identifying the gaps in the research field. A remark by a Chemical Engineering researcher (CPUCE3) regarding the opinion of having the librarian as a contact on social media for research, somehow suggests that it will take away some of the researcher's responsibilities: "*It will avoid me from having to do the physical upload of my publications into the institutional repository, because I don't like that, I don't want to do this extra work."* As mentioned earlier, the sharing of resources are already taking place by researchers via ResearchGate, which has implications for librarians promoting the institutional repository which is in line with NRF and Horizon 2020 criteria for the evaluation of research. It raises questions though and remains an area for further debate. In a recent article about the IR versus SNS (Kleinveldt, 2017: 20), the author writes about her experience where a UNIBO digital librarian urged PhD students during a compulsory course, to refrain from uploading full text publications onto SNS but rather to do so in the IR. This seems to be in contrast to the current practices observed by researchers at CPUT and UNIBO, but also globally since SNS prompts researchers to do so. The response "*I can't see her practically interested in all research interests"* (CPUCE5) suggest that

librarians cannot be expected to deal with each researcher's research in depth. This came out of UNIBO researchers' responses as well.

8.3.2 The use of Web 2.0 driving prosumer-research practices

As much as the literature highlights the rise of Web 2.0 and social media leading the prosumer concept and that it was found to be beneficial in research practices (Singh and Gill, 2015), responses from researchers at CPUT and UNIBO reveal that social media does not drive prosumer behaviour. Researchers are very much following the traditional way of making contact with potential collaborators via publications and then contacting individuals via email, through conferences and seminars, through colleagues and meetings. One point that stood out was the librarian's influence in prosumer behaviour, since some researchers pointed out that through previous training conducted by the librarians, researchers became independent information-seekers and only consult the librarian where there are full text access problems. However the responses by librarians reveal that there is some interaction between librarians and researchers taking place at CPUT, but not specifically about their research, with a librarian CPUL1 commenting further that: "*I think people use social media, but I'm not sure for research purposes. But Mendeley is a good tool for researchers, so yes"*. There is evidence from responses in chapter 6 that UNIBO librarians contribute to researchers' prosumer practices mainly through training and current awareness of electronic resources. One UNIBO librarian revealed the approach to supporting young researchers has changed. However, other responses from librarians indicate that the shift from reactive to being proactive library services has taken place, which these Web 2.0 tools have facilitated. The following competency for research librarians by ASERL (2000) stating that: "the research librarian knows the structure, organization, creation, management, dissemination, use, and preservation of information resources, new and existing, in all formats", supports this statement**.** The theme "English Language competencies" which came from UNIBO librarian's responses on the issue of competencies needed to support research is an area which is becoming essential at higher education institutions worldwide. At CPUT, the language committee focuses on supporting language barriers in teaching and learning through a number of workshops and activities including compiling multilingual glossaries. Faculty librarians at CPUT form part of the language committee and offer support through the IL programme and participate in language committee workshops. The importance of addressing language barriers in higher education has been discussed in Chapter 2 (Catana, 2014b: 345; Thelle & Nanna, 2011: 576; Yaman et al. n.d.).

Although in both case studies researchers point out that the use of social media for research purposes were not common practice, and did not improve research practices per se, it indeed

increased their visibility and made it easier to identify other researchers worldwide in their field. As other research findings reveal, researchers in the natural and engineering sciences regard digital publications and technological development much higher than researchers in humanities disciplines (Rosenbaum, 2017: 39).

The evaluation of researchers has been highlighted in both case studies as a concern. Researchers are evaluated solely on their research output and not on teaching and community engagement. Rosenbaum (2017: 38) points to performance measurement being very much focused on bibliometric measures and journal impact factor, which exclusively links to research practices. Yet researchers have heavy workloads. The feeling is that evaluation criteria for promotion is skewed, and was flagged as an area for consideration in the future. Researchers' concern about the evaluation of research is in line with the literature, especially since changes in research practices in the way knowledge is produced, being more interdisciplinary and collaborative have been occurring over time (Rosenbaum, 2017: 37; Taubert & Weingart, 2017: 3; Houghton, 2004: 163). It is worth pointing out as mentioned in Chapter 2, that e-research practices entails the combination of using social media, bibliometrics, data analysis software as well as referencing tools like Mendeley by researchers today (Thomas, 2011: 38-39).

8.3.3 Time spent on research

Time has been flagged in the responses from both case studies to be a crucial factor in research with everything expected to happen in real-time. However looking at how many researchers and students in a department, not to forget how many departments within a faculty, with one faculty librarian per campus, raises questions regarding a handful of librarians meeting the demands of the entire faculty at once. The high expectation of access to information in real-time no matter the format or where it is physically located in the world has been highlighted in both cases by researchers. As pointed out in Chapter 2, improving Inter-Library Loan services in Ireland remains challenging in the digital age (Patterson, 2009: 90). Considering technology trends, the pressure of conducting research over and above the heavy teaching loads, are perhaps understandable factors increasing the demand by researchers for real-time service delivery. The NILDE system used by the UNIBO community acts as the 'next generation' ILL service, where researchers and librarians across Italy interact via the system for resource sharing, which has been observed as saving time.

Regarding the percentage time spent on research in a year, overall it was appallingly low with regard to CPUT researchers. The highest percentage in a normal working year was only 50%. Heavy teaching loads was revealed several times throughout interviews as being the main factor affecting slow

research progress among academics. Discrepancies in relation to distribution of duties were revealed, where in some instances a researcher's teaching load is reduced when pursuing PhD studies as indicated in a response. However this has been found to be dependent on non-academic versus academic positions and guidelines within higher education institutions. The literature and previous research suggests that librarians need to obtain postgraduate qualifications to support research. Considering the situation and the importance of academics obtaining PhD qualifications, suggests that there needs to be provision made to deal with workload versus pressure from the institution on academic staff to focus on getting PhD qualifications. Several comments from researchers at CPUT and UNIBO revealed that research activities took place after working hours due to the heavy teaching load. To an extent, the perception pointed out by some researchers that the library demand too much from researchers specifically in relation to uploading their publications on the institutional repository at CPUT, is an area flagged for taking into consideration. Some UNIBO librarians revealed not wanting to bombard academics with too many things. The following response is perhaps an area identified for faculty heads and library management to consider (CPUCE4): "*My research could go much faster if I had the same working conditions as my colleagues working* [at another university]." The importance of learning from case study research to improve current research practices (Woods and Booth, 2013: 10) mentioned in Chapter 3 links to this point.

With regards to changes in research practices, the theme "After PhD, different view, understand the research process better" by CPUT Chemical Engineering researchers somehow links to a finding in the 2009 study that states that in order for a librarian to successfully support research, it is necessary to obtain a PhD to understand the full process. The competencies of an academic / research librarian discussed in Chapter 2 supports this (Raju, 2017: 12-13; Pickton, 2016: 107).

8.4 How do the researchers perceive the role of the library in supporting research?

Overall researchers' perception and experience of the library and librarian is positive, and the role of the librarian in particular is valued. However, the reference to the illegal site Sci-hub in both case studies suggests that researchers will try other avenues of tracing and accessing information sources no matter the consequences. Considering the Elsevier subscription cancellation situation in Peru (Schiermeier & Mega, 2017) as mentioned before, confirmed that researchers will go to any lengths to access published sources. Whether this is a threat to academic libraries is questionable considering the Open Access movement that is promoted by libraries worldwide. Instead one of the strengths of the librarian is guiding users to reliable sources bypassing the illegal sites which to a large extent is unreliable. One UNIBO librarian argued that their PhD students actually preferred consulting the librarian instead of using illegal sites. A response by a CPUT Chemical Engineering

researcher supports the argument that illegal sites are no threat to the library, as ILL services and OA material provided by the librarian was highly regarded in research. Further elaboration by this particular researcher highlights that the library is the first point of contact and the librarian is fully integrated into the department, which is in contrast to a previous study which found that among students, the library is the last resort when it comes to seeking information (Kleinveldt, 2015). However as already pointed out earlier, Wilson (1981) argues that individuals' information seeking behaviour differs depending on the information need. One Chemistry PhD student at CPUT remarked that the institution as a whole was not equipped to handle postgraduate students and chose not to make use of the library due to a bad experience with an ILL request. The emotion expressed at the time of responding illustrated the student's deep level of disappointment which points to the importance of libraries in general maintaining good customer service. That both Chemistry PhD students never consulted their faculty librarian points to the communication gap already identified as an area in this study for improvement in the future.

One of the themes from CPUT Chemical Engineering researchers which stood out was "Librarian role is still more for teaching support, not research" is to a large extent the reality of the situation. Faculty librarians at CPUT currently have a heavy teaching load because of the IL certificate introduced in 2013 to support faculty with IL integration into the curriculum. This has led to 80% of the faculty librarian's job being to teach. It is perhaps the reason why postgraduate students are not aware of the faculty librarian because the main focus has been on undergraduate students. With the research trends increasing the demand for librarians to shift their attention to the research pillar of the university, comes with challenges as librarians pointed out in chapter 7. As revealed in some responses, in order to support research fully, IL training load will need to be taken away from faculty librarians. Although two Chemical Engineering researchers remarked that they are independent researchers and that the librarian's support was useful in the past, they welcome support on the research trends with regards to visibility of their research output through ORCID. This confirms faculty librarians' responses that ORCID is one service that is currently being promoted at CPUT Libraries which is on par with IFLA (2017) trends and the future role in research support.

The remark by a Chemistry PhD student: "It's a pity I didn't use them before" emphasise the vital role that a librarian play in supporting postgraduate students. The need for faculty librarian's involvement in supporting PhD students in particular has been highlighted several times during the interview which confirms the literature on shifting the attention to postgraduates (Patterson, 2009: 91).

8.4.1 Librarian's thoughts on how researchers perceive their role

When librarians were asked about what they thought the researchers' perception of the librarians' role is in supporting research, the theme "Students are lazy - my perception", is perhaps thought-provoking, and links to an earlier discussion on information-seeking behaviour of students, and how it differs based on the information need (Wilson, 1981). The theme "Librarians speak their 'research language'" links to a blogpost in May 2017 addressing the problem with marketing library services, that librarians need to "speak about why libraries exist, not what they offer" (Stavick, 2017) in order to get researchers to fully understand how the library or librarian for that matter fits into the research landscape. This further suggests the competencies are key for the future role of the librarians supporting research (Raju, 2017; ASERL, 2000).

On the other hand, the theme "Pivotal role – save them time" has been confirmed by a UNIBO researcher who indicated that one day spent in the library can save up to six months on a project or an assignment. In contrast to this, it is perhaps sad that a few researchers and students at UNIBO and CPUT indicated not being aware that a librarian existed to support research before the interview which somehow links to the communication gap identified. The importance of policy and guidelines that clarify the role of librarians in supporting research was mentioned in Chapter 3 as being fundamental, as researchers need to understand this when seeking research support (Murphy & Boden, 2015: 74-76; Webb, GannonLeary & Bent, 2007: 130).

8.5 How do the librarians perceive their own role in supporting research?

Librarians perceive their role as research partners when supporting researchers. However, discrepancies in the librarian positions and qualification requirements has been observed, which to an extent contributes to the challenges faced in supporting research. At UNIBO, it is not a minimum requirement to possess a Library and Information Science qualification for a librarian position whereas at CPUT it is a minimum requirement, and moving towards a master's degree being advantageous. The fact that librarians at CPUT are pursuing and some already obtained Master's degrees in Library and Information Science, is in line with the direction of academic libraries positioning themselves to deal with the research trends discussed in Chapter 2. The themes presented from librarians at CPUT in Chapter 7, "Ensuring researcher visibility through ORCID IDs /Scopus promotion", "Bibliometrics /altmetrics reports: Evaluating research output: lecturer promotion process assistance", "Institutional repository – upload theses assistance", "Publishing assistance: Open Access guidance", and "Grant proposal assistance" confirms the librarians' knowledge and experience in research trends and how they are playing a more proactive role in supporting researchers. One librarian (CPUL2) revealed being involved in a research output

evaluation project which assists academics with choosing journals to publish in, as well as revealing the visibility of research. The librarian further mentioned that CPUT being a young university of technology, research activities are still fairly new and that librarians are also in a learning process in terms of supporting researchers with research trends. This to an extent makes it an ideal time to build good working relationships between librarians and researchers, especially in the shift from a reactive to proactive role pointed out in responses. However, the literature also presents the discrepancies in library professional positions (IFLA, 2017) where not all academic librarians possess a Library and Information Science qualification, which was evident in the case of UNIBO.

The roundtable discussion regarding the future of LIS Education at the IFLA 2017 conference suggests that academic libraries globally face a dilemma with clarifying their role in supporting research. It is becoming more noticeable that in order to support research, one needs to have experienced conducting research and have full knowledge of the research lifecycle, which previous studies have pointed out (Kleinveldt, 2009; Hart & Kleinveldt,2011). It increases the challenges for librarians in keeping abreast of trends. One of the difficulties already mentioned is staff capacity where the library profession sits with an aging cadre of librarians, the closing of library schools, and LIS education of yester-year have not equipped library professionals for the new demands (Cavaleri, 2017; Rasetti, 2017; Kleinveldt, 2009; Hart & Kleinveldt, 2011). What has added to the challenge is the workloads have become heavier over time, the concept of 'doing more with less' very much the reality in many organisations today (Schroeder and Boughan, 2018: 28). The comments by CPUL2 in Chapter 7 confirms the staff capacity issue versus the demand to keep academic library services in research relevant: "*as a branch librarian, my challenge is how to position staff in the branch library to our core business in the changes and new developments taking place, as we also need to support teaching and learning."*

At UNIBO, one librarian claimed playing a role in each phase of the research cycle, training data literacy a fundamental module incorporated into the IL training provided to PhD students, and in line with the librarian competencies needed to support research (Raju, 2017). On the other hand, another librarian indicated her role to be undervalued. As much as there are differences in the role of librarians in supporting research, the scope, points of view and assessments depends on the position that the librarian holds which is evident in the sample selection of librarians in this study as described in Chapter 5, ranging from managing a branch library, to handling operations on the floor, or representative on the faculty board for example in terms of reaching out to the university community beyond service or information provision. To some extent it very much confirms the old image of librarians stamping books, and this still seems to be the image held by researchers in the

21st century at both a traditional university library and a younger university of technology library as observed in some researchers' responses.

However this could be debated considering the qualification levels of librarians in positions which have increasingly high expectations for supporting research as the literature suggests in Chapter 2, when most indicated not having conducted a research project before that can equip librarians with dealing with research processes. An earlier study by Kleinveldt (2009) pointed out that there is a need for librarians to obtain at least a Master's degree to be able to support research. Librarians at CPUT have indicated during the interview that they are currently pursuing Masters Studies, and some have already obtained it, confirming this statement and in line with the trends in academic librarianship. On the other hand, some researchers do state that they do not expect the librarian to have knowledge of their field, that providing them with access to the information they need is more than adequate. This is perhaps questionable at this stage, considering the current state of academic libraries, the trends, hot topics and advances in librarianship highlighted in Chapter 2.

8.5.1 Transformation in research support practices / services

With regards to changes in research support services over time, CPUT librarians revealed "Evaluating research output", "Ensure Research visibility on the web- ORCID, Scopus, PoP, ResearchGate", "Drastic change in how we support research", "Individual training increased: in researchers' space/office", "Institutional repository – upload theses assistance", and "Importance of librarians supporting research realised" being areas over and above the existing services provided. They are in line with the research trends discussed in Chapter 2 (IFLA, 2017). The CPUT (2018) Open Access draft policy and the Statement on Open Access to Research Publications from the National Research Foundation (NRF)-Funded Research (NRF, 2017) have to a large extent assisted librarians to market research support services. As pointed out by a librarian in chapter 7, promotion of library services for research increased tremendously, and elaborated that:

CPUL3: *"I'm glad that you ask this question, because I had a meeting with two researchers this morning who are busy applying for ad hominem promotion. One of the requirements are that researchers be registered or should be listed on Scopus/ORCID/ institutional repository, but I discovered that they were not listed, and so I assisted the researchers with these. Only one researcher had a publication listed on Scopus, and several on Publish or Perish. They were so excited when I introduced them to the institutional repository and ORCID because now their work is being cited compared to before, their work was not being cited. Researchers now realise the importance of librarians supporting their research, they are now more visible. Since I started this position, lots have changed."*

Changes in research support practices pointed out by UNIBO librarians was the shift from print to electronic, and this led to two librarians (UNIL3 and UNIL5) embracing new tools such as

bibliographic databases like Web of Science and Scopus now offering new features for evaluating research. Librarians now have to provide new services such as bibliometrics and altmetrics to researchers which fits in with research trends for promotion and rating of research. The Consiglio Nazionale delle Ricerca (CNR) announced the National Council for Research Statute which came into effect since 1 May 2015, stating that Science and Technological research be promoted through visibility for competitive advantage (CNR, 2015: 3), which links to researchers now more than ever relying on bibliometric and altmetric reports. However the majority of librarians are not yet involved in providing research support services such as bibliometrics, assistance with researcher profiles to increase visibility of research which linked to the research trends. It is perhaps the case due to current structure of UNIBO library, and the research office at the university taking on the responsibility of providing research support services. Nonetheless librarians pointed out that they are in need of training on these new services that is now expected of them to provide to researchers, which once again links to ASERL (2000) addressing this issue as well to prepare librarians for changes taking place within the university community.

Another change that was highlighted from an existing service, Inter-Library Loans, is the building of new networks through the Network for the Interlibrary Document Exchange (NILDE) system which is an expansion of the traditional ILL service, as now researchers and librarians network through an online platform for the sharing of information resources which is very much in line with the shift from print to electronic, as well as the prosumer concept where the researcher is actively engaging in the ILL process. The “liquid” metaphor discussed in Chapter 2 that was described by Bauman (2012) to be “change is the only permanence”, fits in very well with the changes observed in the research process.

That only one UNIBO librarian actually mentioned that the Central Library Office is providing support with OA publishing and RDM services during the interview perhaps confirms the communication gap between support units and clarification on who supports these services. Later on the same librarian mentioned though that there is no communication between the support units within the university and that roles and activities are not clarified. One librarian claimed that according to her knowledge no RDM is practiced at the university. However, the ALMA Acta institutional repository at UNIBO which is managed by the research office highlights the research output and data of the university community. On further inspection, it is worth noting that some UNIBO researchers have complied with university regulations to upload their data in ALMA Acta, stating clearly that the purpose is promoting RDM at UNIBO, which to an extent contradicts researchers’ showing resistance to RDM practices during the interview.

8.6 How does research output (publications) inform policy and programmes in universities?

CPUT Chemistry researchers' theme: "Forced by the library to upload theses" could be seen as a positive remark in terms of OA and visibility of research or perhaps as a burden, which do come out from Chemical Engineering researchers' responses mentioned before. The pressures of obtaining a PhD degree for academics at CPUT has been identified, the following comment confirms this:

CPUC4: "*because at this institution your piece of paper is more important than your experience, that is what is coming out very strongly, if you got the paper [qualification] you get the job, if you don't have the paper, you won't get the job in the future,"*

Chemistry PhD students' themes which inform policy and procedure were "Conferences and international exposure attract interest" and "I used a new technique, led to departmental implementation". A Chemical Engineering PhD student pointed out "My research led to registering a patent". These themes indicate PhD students' contribution to innovation, which is a benefit to the university as a whole.

With regards to quantity versus quality of research and its influence on teaching and learning was expressed in the following comment which links to the SIS2016 conference held in Barcelona where the discussions focused on the impact of research conducted:

CPUCE4: *"I don't think there is a strong correlation between number of publications and teaching. But a strong correlation between research interest and teaching practice. Academics tend to chase number of papers published that have no impact. We need to focus on the quality of research, which has a significant impact. The transformation from teach-only to teaching-research orientated academic has had a huge impact on how I stimulate students in their thinking."*

Regarding research contributing to student development and success, a Chemistry researcher (CPUC2) mentioned: *"I also place students in industry, and reporting on industry. Directing students*." Based on the academic's reputation, led to good placements, which is a strength that came out from UNIBO researchers as well.

CPUC5: *graduate. I am not in favour of students take many years to complete their Masters, so I let them work hard to finish."*

In both case studies, some researchers revealed that the research projects that they conduct do not relate to subjects they teach, and some mentioned this being unfortunate. The impact of research on society, and the quality of life being improved through science, is emphasised in the Horizon 2020 work programme and during the SIS2016 conference discussions. Nevertheless some responses from both Chemistry and Chemical Engineering researchers at CPUT revealed that the focus of their research is moving more in the direction of impact on teaching and learning, student development

and success, and community engagement. However on the side of informing policy, there is room for improvement, as only a few researchers' output at CPUT and UNIBO contributed to procedures in the department and industry. Some UNIBO Chemical Engineering researchers pointed out that their research has direct impact on processes and procedure with regards to environmental issues, one example highlighted during the interview was the contribution made to new regulations in firefighting.

With regards to librarians' research support contributing to policies and procedures, in both cases librarians' responses suggest that there is a top-down approach with regards to adopting new guidelines. In the CPUT case, one of the librarians pointed out that there was not much scope to implement from the bottom-up, no management support, with a long channel to get new policies approved. Nevertheless, librarians at CPUT and UNIBO revealed some participation in research activities, collaborative projects and conference presentations that contribute to the library profession. As the literature suggests in chapters 2 and 3, there is need for practicing librarians to conduct more LIS research. However the reality on the floor with the heavy workloads remains a challenge for librarians who indicated that they would like to conduct research in the future.

Considering that the literature suggests that the creation of new knowledge and science is not determined by the number of publications, but rather by the number of times a publication is cited (Crane, 1972), opens up another challenge in academia. Information overload has led to new practices such as text / data mining, which somehow suggests that reading publications no longer takes place. A blog confirms that many publications by academics are never read beyond the reviewers and editorial boards of the journals it is published in, which says something about the gap between research output and contribution to society. However this observation leads to another debate that is not the intention of the author to address here.

8.7 Where do the library fit into the research cycle in the digital age?

With regards to collaboration, the theme from Chemistry PhD students "I think my supervisor is doing that on our behalf" suggest there is confusion about who should be consulting the library. Some responses from a Chemistry researcher and student reveal that there is an assumption that the other party (researcher or student) is communicating with the librarian on their behalf. It is perhaps one reason why a communication gap is still experienced, since researchers and students are not discussing research support provided by the librarian. It is an area identified for the librarian to play a proactive role to promote current awareness from the start of the PhD programme as a possible solution to bridge the gap.

The one Chemistry student who is communicating with the faculty librarian remarked that it was about information provision and uploading documents into the institutional repository which relates to the Open Access movement and activities. On the other hand, Chemical Engineering researchers claim that the lines of communication are open, but mainly for teaching and learning. Only one Chemical Engineering researcher discussed Bibliometrics which relate to the research trends in evaluation of research with the librarian.

With regards to Chemical Engineering PhD students, responses were similar to Chemistry PhD students, where one communicated mainly about information provision, and the other hardly communicating with the librarian due to being an independent researcher. The second response suggests that through information literacy training in the past at undergraduate level, prepared students to become confident information seekers, which is in line with the prosumer concept. Chemical Engineering researcher (CPUCE4) revealed the need to collaborate "*especially in Research Data Management."* The importance of the librarian at departmental meetings was stressed here.

The following comment CPUC5: *I didn't know that there is the Information Literacy Programme offered by the library, this is what my students need"* links to an earlier discussion regarding units within the university who are not working together or sharing information. As this response comes from a content lecturer, there is no awareness that the group of students attending the Communications subject in the programme do attend IL training. Nevertheless, this points to exactly what librarians and faculty are battling with, the integration of IL across subjects. What is taught in Communications should not be forgotten when the student works in the Chemistry subject for example. The IL skills acquired in the Communications subject needs to be applied throughout and lecturers need to work together with librarians to ensure that students can realise the importance of IL elements throughout their career and life. This is the point. The majority of Chemistry and Chemical Engineering researchers indicated that they were not collaborating with the faculty librarian to enhance library services for research. However, as the literature revealed, collaboration was mainly regarding Information Literacy. On the side of the PhD student in both departments, nobody collaborated with the librarian, but one Chemical Engineering PhD student added not being sure that students could. The comment CPUC6: *"I think that all the support units in the institution must be combined, in one click"* suggests the need for all support units to collaborate as pointed out in the Master's thesis (Kleinveldt, 2009: 29) and make each role clear and known to the university community. The remark by one student (CPUCS1): "*I am comfortable with library services, am an independent researcher now"* links to the researcher as prosumer which to an extent is the outcome

from the librarians training students to become independent researchers and lifelong learners as previously discussed.

The importance of the librarian sitting on the faculty board at CPUT came out from responses, because that is the platform to get through to everybody since all important matters concerning the faculty are addressed there, and therefore it is the ideal forum to enhance awareness of library research support services. The librarian is thus a partner of the faculty in research. At UNIBO however, librarians pointed out that it was challenging to get an invitation to attend departmental and faculty board meetings, there is no model for librarians to interact with researchers at that level.

When comparing this to findings in the CPUT study conducted in 2009, it is ideal to reiterate that there were contradictions in the nature of librarian supporting research. Findings of the study revealed that the role of the research librarian was mainly for information provision, but later it was pointed out that research support stretched to posting research notes on the library's website, involved faculty librarians as well as the whole library. In analysing the findings, questions about who CPUT researchers consulted about research, as well as whether librarians supporting research should possess PhDs were flagged (Kleinveldt, 2009: 29).

Surprisingly one CPUT Chemistry PhD student indicated "Libguides" being a library resource used in research. One theme that stood out from Chemical Engineering PhD students' responses was "Computers" being a library resource used in research. These themes suggest that it is not just the information resources that is important, but also the hardware that the library provides for supporting research.

8.7.1 Satisfaction with the general functionality of the academic library

In both cases, librarians revealed mixed feelings regarding their satisfaction with the functionality of the library. However, looking at why there is a low satisfaction is understandable, pointing out the reality of the situation, along the lines of heavy workloads and doing more with less (Schroeder and Boughan, 2018: 28) as discussed in Chapter 2. Librarians face the challenge in wanting to do more but their hands are tied; there is just so much that they can do, but the demands are increasing at a rapid pace. Expectations are high in terms of what librarians should be doing especially in response to the research trends when their workload is already so heavy. New duties are constantly added to the existing, fundamental duties of librarians as pointed out in the IFLA trend report 2016 update (IFLA, 2016) and new competencies that librarians need to possess in order to support research (Raju, 2017; Pickton, 2016), and with no consideration in higher education institutions it seems for increasing staff capacity or restructuring.

With regard to whether researchers and PhD students are satisfied with the functionality of the library, different aspects were mentioned. That researchers and students at CPUT were dissatisfied with the library hours once again points to the importance of the physical library space for a researcher in the 21st century. Even though the majority indicated using electronic resources extensively, which can be accessed remotely, it is interesting that the physical library hours are a problem. The theme 'computers' suggest that there is still a need for the library facilities. The following quote confirms this (CPUC6): "*first of all, I don't understand why the library should close at 22:30, why the library is not open on weekends. When the library closes on a Saturday at 16:00, then I am still busy working!"* The need for a 24-hour postgraduate physical library space was once again emphasised (CPUCE1): "*Yes I am, but there is room for improvement, especially on this campus, I think the library is quite limiting in terms of operating hours specifically for research. We would like a library that supports after hours research activities. Of course we understand that it causes many logistical issues and costs, but I don't see why a section of the library couldn't be made accessible to postgraduate students…*" That both CPUT Chemical Engineering PhD students emphasised the need for a bigger research space in the library show the extent of the research requirement. The need for increased communication between students and librarians relate to an earlier discussion that perhaps it is time to shift the focus from undergraduate to postgraduate students. The following response suggests an expression of sympathy towards the library resources not being adequate by choice due to budget cuts (CPUCS2): "*But I don't think this [my] issue lies at the library level, it should be taken up higher, at the institutional level. Maybe the library is not getting the funding to update the resources, I think the library is the victim because the institution should ensure the library has a good budget."*

CPUC6 added that *"It would be nice to have more electronic books"* and is in line with the research practices in the digital age. Another theme that stood out was "Wi-Fi is very important" is in line with a presentation held at UNIBO in 2017 on science education research revealing that the Next Generation student's biggest fear is being in an environment without Wi-Fi (Beames, 2017).

That print material is used practically as much as electronic resources definitely says something about reconsidering collection development procedures that have followed an e-strategy approach. At UNIBO, print material is still highly regarded. Physical space highlighted by two Chemistry researchers says something. It is perhaps interesting that only one attended a training workshop. Compared to UNIBO, nobody attended any training in the past year. It suggests that established researchers no longer need to be updated on new information tools acquired by the library. One Chemistry PhD student's theme "other: thesis accessed", stood out and could perhaps be referring

to the institutional repository or the printed theses that the student accessed in the physical library. One Chemical Engineering PhD student added "Other: Used the department's collection" which is becoming more common as academics build their own collections in the department using research funds.

Surprisingly the theme "Maintaining of research repositories" reached second place on Chemistry researchers' priority list of possible library services for research. This is perhaps an indication of the visibility of DK improving over time that it falls in the top three important research support services for Chemistry researchers. When compared to the 2009 study, the majority of researchers did not know what DK was as mentioned earlier. It also links to how the library and librarians in particular played a pivotal role in marketing DK, again evident in the webometrics report showing a huge improvement in the institutional repository activities and that the university research output having an impact by being open to society at large. This is in line with the prediction made that researchers will start relying more on library expertise in organising and archiving of their scientific research in future (Hart & Kleinveldt, 2011: 49). However some despondence is revealed which is in contrast to the research trends as the following comment by CPUCE3 suggests: "*No, 50% only. On the issue of loading my publications on DK, I am against it, it is additional work*."

Responses to the Likert statements revealed that Chemistry researchers rated social media and mobile apps training for research higher than RDM. The practice of prosumerism in the modern sense as it is discussed in Chapter 4, which increased rapidly due to the rise of Web 2.0 and social media, seems to be confirmed by chemists here. That RDM is a fairly new practice for researchers, and that it was also revealed that their data has commercial value could be a reason for the lower RDM ranking. However, surprisingly, it is ranked higher than the traditional library support services: "providing a reading list" and "advice on research topic".

Emphasis has been placed on specific software support and scientific writing workshops by Chemistry PhD students at CPUT which is an area flagged for future consideration as they were placed at the top of the priority list for research support services. Similarly, "Maintaining of research repositories" and "Advice on Research Data Management" were placed at the top of Chemical Engineering researchers' priority list of research support needed from the library or librarian at CPUT.

Since the aim of the Likert statements were to confirm earlier comments, it is quite evident here that researchers have to an extent reconsidered their opinion on RDM. However some researchers

admitted at the end of the interview that the questions opened their mind to new possibilities and that more details on research trends from a librarian will be welcomed.

8.8 What is the gap between what researchers need and want from the library to support research and what research support they are currently receiving, and how faculty librarians perceive their role in supporting research?

Although there is quite a bit of effort made by librarians at UNIBO and CPUT to market library services for research in departments, there remains a communication gap. At CPUT and UNIBO, some responses indicated that they did not know that a faculty librarian existed. PhD students seem to be the group where a disconnection is experienced at both UNIBO and CPUT, despite research workshops and presentations conducted within departments for postgraduate students and researchers. Perhaps the disconnect has to do with the timing of workshops conducted with PhD students, for example late registrations lead to missing early workshops as experienced by some at CPUT. Recently UNIBO implemented a compulsory workshop for final year PhD students, although the author felt that it was held too late in the research process as valuable information should have reached PhD students earlier, ideally in the second term when students are more settled. Considering that the preferred mode of communication at both institutions are still traditional via email and face-to-face, suggest that there is room for exploring another communication platform, especially since these traditional communication modes are not reaching the whole community as the responses suggest. One Chemical Engineering researcher at UNIBO concurs, and suggested that the university could have a platform available on the website where all research related activities and news can be accessed. Wilson's (1981) description of individuals' information seeking behaviour fits in here, as it is suggested that the communication mode that a researcher choose at a given time depends on the information or research need. This further suggests that the communication mode within research could possibly change depending on the research lifecycle and how researchers choose to produce knowledge (Rosenbaum, 2017: 39; Houghton, 2004: 163; Crane, 1972). This makes it challenging to bridge the communication gap between librarians, researchers and students.

A Chemical Engineering researcher (CPUCE2) acknowledged that there is a communication gap, and although the librarian keep them abreast of research trends such as OA and ORCID, there is a great need to have more one-on-one discussions with the librarian about research needs. However at some point, the need to consult with a librarian for research decreases depending on the stage in the research process as pointed out by one CPUT Chemical Engineering PhD student. On the other hand, the following comment confirms that there is a need for librarian intervention (CPUCES2): *"No, I have not had that communication yet. If we knew that we could communicate then it will be*

beneficial." In contrast, a UNIBO Chemical Engineering PhD student remarked that there is no need for communicating with the librarian because research is perceived to be conducted in isolation, which to some extent reverts back to the old research practices which Crane (1972) pointed has changed. Collection maintenance is still highly regarded as the following comment suggests (CPUC5): "*I send emails, especially about Elsevier journals, to maintain these subscriptions".* The importance of the library, and the IL teaching role of the librarian once again came out very strongly in the following comment (CPUC7): "*Students really experience difficulties if they don't know about the library".*

There is a difference in library research support services offered at UNIBO and CPUT identified. At UNIBO, reference management tools like Mendeley was highlighted by librarians as an area that they would need to provide training on to researchers in the future. When compared to CPUT, training on reference management tools like Refworks and Mendeley by librarians have been occurring for the past ten years. This observation suggests that there are disparities between academic libraries moving with the times versus resistance to change highlighted in Chapter 2. However it has been noted that most research support services aligned to the trends are provided by the research office at UNIBO and not by the library.

It seems that these new developments in terms of what the contemporary academic library has to offer are not known to the university community. Clearly there is a gap, and whether it is widening is uncertain. Ekstrøm**,** Elbaek**,** Erdmann and Grigorov (2016) pointed out that although the gap exists, the chances of changing this approach depends on the institutions' planning strategically in creating better partnerships between librarians and faculty in supporting research, as the future of the research librarian is said to be already here. Already in 2000 the Association of Southeastern Research Libraries (ASERL) indicated the competencies of a research librarian as a guide for stakeholders in higher education institutions dealing with the changes in research, and how the academic library can play a role specifically supporting research in the future. One of the competencies that addresses the point above is stated by ASERL (2000) as: "the research librarian understands the library within the context of higher education (its purpose and goals) and the needs of students, faculty, and researchers". As pointed out in chapter 2, the current list of competencies for South African librarians supporting research (Raju, 2017) have grown tremendously and speak directly to the research trends.

8.8.1 So what do researchers and PhD students say they want from the library in terms of research support?

Reflecting on the interview responses from both universities regarding research support, this section highlights what researchers and PhD students said they need and want from the library to support their research.

The suggestion made by a UNIBO Chemical Engineering researcher that a space be made available on the library website for academics to post their wish list could perhaps be linked to a solution to the communication gap issue which has been identified. A CPUT Chemical Engineering researcher suggested that there is a need for videos to be embedded in the library website which clearly states what the library has to offer researchers. The themes "Train PhD students as well", "Librarian to support in all areas of the research process is crucial, Improve communication with postgraduate students", "Train students to Read, interpret and analyse scientific articles", "Train students on Constructing a research topic, writing abstracts" and surprisingly a Web 2.0 tool also mentioned "Librarian could provide podcasts" suggests research support needed is leaning towards librarians teaching research methodology in the future. In a previous study it was pointed out by one academic that the librarian might as well become the communication lecturer (Kleinveldt, 2015). Chemistry PhD students indicated the need for: *"Data analysis/data management, Courses on scientific writing".*

Chemical Engineering researchers pointed out that the job description of the librarian need to be made known to the faculty. They are also recognising or identifying the potential of the library or librarian to expand research support services beyond the traditional information provision to include analysis of data, technical writing methods and methodology, which somehow answers the author's question raised in Chapter 1, whether researchers are expecting the library or librarian to support the whole research process. With regard to seeking funding assistance indicated by one CPUT Chemical Engineering researcher suggests some overlap, since the postgraduate unit and research directorate units already deal with funding assistance. This further suggest that role clarification of all support units at CPUT and UNIBO need to be made clear to the university community. Data archiving, relating to RDM was pointed out by a Chemical Engineering researcher as something the library might be able to do. The demand for real-time service delivery was revealed in both case studies. The expectations remain high without taking into consideration other factors. At UNIBO, researchers also mentioned the demand for receiving inter-library loans in real-time, which suggests that due to the digital age, expectations with regard to access are on the increase. The need for

information to be completely 'liquid' (Bauman, 2012; Ritzer, 2011: 5) which was discussed at the beginning of Chapter 2 is revealed in both case studies.

Specific research support needs expressed by CPUT Chemical Engineering researchers below show that the traditional services as well as new services are welcomed:

CPUCE1: "but yet there are so many other resources that we as researchers do not know about. I see the librarian's role as bringing us knowledge on current research developments.

CPUCE3: "*Maybe linking, suggesting collaborators, getting to know who works in my field."*

CPUCE4: "*The most important role is sourcing material that is outside our database subscriptions*."

CPUCES2: *"If they can be much more involved in the department to know what we are doing."*

CPUT Chemical Engineering PhD students pointed out the need for access to other resources such as photographic equipment and video recording equipment, to improve communication through an internal blog with live chat capabilities. It links to academic libraries in the States, which the author observed during previous studies at the University of Illinois Urbana Champagne where the lending out of various electronic devices such as laptops, iPads and so on to users formed part services provided. Academic libraries are also moving towards lending robots to users especially in the area of coding (Public Library Connect, 2018). Chemistry PhD students also indicated the need for the library to provide data analysis software.

A comment by a Chemistry researcher (CPUCE5): "*Research is a very lonely process"* suggests that all the more so, research support makes the difference. As much as there are many ways to acquire information, the actual research that an individual conducts depends on the individual. It still remains an isolated process, especially PhD research. Nevertheless support from the library could ensure reaching the goal quicker.

The dichotomies revealed in the needs and wants of researchers with regard to library research support once again links to the culture and practices of the specific higher education institutions. Some of the traditional habits traditions of working in isolation, the notion of departments and units keeping to themselves as a way of feeling protected, and the fear to be exposed, came out from responses. Another observation worth noting is that at UNIBO, librarians working on the floor seems to be living in the old world while the new generation of librarians are completely outside the library, situated in a central office, with new plans for the future, but nowhere close to what is happening on the floor as revealed in librarian responses that there is no communication between

these units. At CPUT, librarians still face difficulties with full acceptance in departmental meetings and faculty board, as some departments still 'forget' to invite librarians to their meetings where awareness of research support services can be presented. On the other hand, a response from a researcher at CPUT pointed out how important the librarian is in connecting researchers to the world, especially since there is a need for more 'African-centric' research so that the world can learn about Africa instead of Africa learning from the world. Additional comments from researchers and PhD students in both cases reveal the realisation that there is a lack of awareness regarding what the academic library can do to support research, which links to the discussion in Chapter 2 about bridging the gap between what the library is actually providing versus the user perception thereof. A point worth noting, which came out in both case studies, is the discrepancies in promotion only focusing on research, and there is a need for promoting academics on the basis of teaching and their engagement with the community. The following quote emphasised this issue which calls for higher education institutions to consider in the future:

CPUC7: "*The only thing I can add, is the promotion of research in the institution. The institution should have two streams, one being teaching, the other being research. This will allow people who are research orientated to focus their attention fully on their interest, and passion for conducting research. Those that are teaching orientated to focus on teaching. So that it doesn't become a situation where people are forced to do research for the sake of ticking boxes on a form or report that must be submitted to the department of faculty to show they have done some research. It really waste a lot of space, time, and money. Leave it to the people who are passionate about it [conducting research or teaching] to apply for promotion accordingly, meaning that there should be two promotion streams, teaching and research.*"

A suggestion was made by a CPUT researcher for the academic library to become a publishing house, and by hosting an interdisciplinary journal could be a way of encouraging research practices and increase dissemination of university research output. Somehow this point links to the practice of science communication starting within the parent institution and then filter to the public. Another point that is worth considering was a researcher suggesting that all academics need to attend library orientation and refresher training sessions offered by the library. The need for the university community to learn how to communicate was pointed out, directing the discussion to the following section, which attempts to recommend a possible solution for the two cases.

8.9 Developing a Research Communication Framework: Theory and Practice

The main aspect that was observed by the researcher during the interviews conducted with participants in both case studies, is the communication gap that still exists between librarians, faculty, students and other support units. Discrepancies in librarian positions versus other support units at the two institutions plays a part in the confusion between the roles and expectations

regarding support for research as the discussion in this chapter portrayed. Therefore, the researcher recommends a research communication framework to address the problem. Taking into consideration that both institutions incorporated the online learning environments for developing blended learning, makes it an ideal place to implement research support services and communication network. The research communication framework will require all stakeholders which include librarians, IT department, research offices, postgraduate office, faculty, postgraduate students and registration office to collaborate to ensure the smooth operation of bridging the communication gap. The framework should entail meetings on a quarterly basis for sustainability and future development. In terms of practice, the design of a research communication toolkit, embedded in the online learning environment of UNIBO and CPUT is recommended. The toolkit should entail an automatic messaging setup that is linked to the student registration process. In other words, as soon as a student registers for a postgraduate programme, the online learning environment at CPUT and UNIBO, will send an alert to the student email, and their mobile phone that will link to research support services that include librarians, research office information and so on. These alerts should occur on a monthly basis to create and maintain awareness of the various roles of support units in research. Further to this, a research toolkit should be embedded in the research modules within the online learning environment. This will allow faculty and students to have access to the resources within their virtual spaces, and allow them to interact with support units as well. Further recommendations in the development of a research toolkit to be taken into consideration are:

- Infrastructure of research needs to be considered in developing a toolkit
- Designing a research support system (RSS)
- Full integration of research support within the university's e-learning environment
- Each PhD student registered should automatically be added to the system, per course/programme, and it is essential that all academics, researchers, librarians and other support units affiliated to the particular course be included as well. This could possibly be the new virtual space for research support services provided by all support units.
- Online learning environments already provide features that facilitate collaboration, sharing, live chats, which all speak to research trends and which might enhance existing research practices
- This design will avoid issues or challenges with obtaining mailing lists from faculty, and make it much easier to schedule workshops or meetings which respondents highlighted as an area for improving, the demand is high for regular contact and workshops

- Marketing strategies for research should include awareness of altmetrics and bibliometric reports of university research output
- When considering that the focus has been on building very good working relationships with the academics since the approval of the CPUT IL policy in 2009, and that this was very successful, it is perhaps time now to shift the focus more to research support particularly for PhD students. Incorporating data literacy modules in IL training for PhD students as UNIBO has incorporated will add value and increase awareness off RDM.

The following recommendations made by participants during the interview is worth taking into consideration in the research communication framework:

- *CPUCE2: "I feel that the library's collection budget should be spent on a needs-based system, look at what is the need in that department and focus on that, rather than just spending the collection budget and re-allocating it for the sake of it. We will get the value out of the specific collection, maximising use of resources."*
- Chemistry researchers: "IL training is crucial: add datamining training".
- Chemistry PhD students: "Increase RISC space in library will be beneficial"

8.10 Recommendations for future studies

The PhD research project revealed that there are underlying issues that hinder the smooth running of research support services within the two higher education institutions. The following recommendations are made to get a deeper understanding for future development of research output:

- Conduct interviews with all support units in the university to understand the role each unit play in supporting research
- A qualitative study across all faculties in a university, focusing on the perceptions of research trends and what support is needed
- More comparative studies between universities will help practitioners to learn about best practices and solutions to global challenges regarding research trends
- An in-depth study focusing on research data management practices among researchers across faculties will be beneficial for academic libraries taking on the role of supporting and providing RDM services.

8.11 Concluding remarks

The study focused on the role of the academic library supporting Chemistry and Chemical Engineering researchers at two very different higher education institutions. UNIBO being a traditional university versus CPUT that is still a young university of technology in the area of research, their libraries are still highly regarded for the provision of information. 'Library as space' still remain an imperative at both institutions in the digital age. Interviews conducted with librarians, researchers and PhD students revealed that there are some underlying issues affecting both research support service provision by librarians versus the pressure on researchers to conduct more research which to an extent are in contrast to what the literature portrayed in this study. Heavy workloads and staff capacity issues presented in both case studies are making it very difficult for librarians and researchers to keep up with trends. That the utilisation of social media and Web 2.0 tools for research is a direct result of researchers being prosumers, was found not to be the case. Instead, social networking sites like ResearchGate that some researchers indicated they had profiles on, only makes research output more visible. The practice of the researcher as a prosumer has always been in existence long before the rise of social media and Web 2.0 tools and researchers' responses confirmed this. Communication and collaboration between all stakeholders involved in research remains fundamental. Sadly the communication gap which exists came out strongly in both case studies. Therefore the communication framework is recommended for both higher education institutions to create a better research environment. Overall the enthusiasm revealed by librarians to keep relevant to provide state of the art research support services which speaks to the trends show promise for the future role of the academic librarian. However, in working towards shifting the attention to postgraduate students, calls for a time to consider the increase of academic librarian capacity in organisational structure. Further qualitative research in the area of research support services across all disciplines will make a stronger contribution in the field of Library and Information Science.

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10 Appendix A: Data Analysis of UNIBO (Chapter 6)

6. UNIBO Librarians

6.1 Librarians' perception of their role in conducting LIS research and supporting research

Table 6. 1 The role of the librarian supporting research in chemistry and chemical engineering

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Service provision	X	X			
Academic /researcher service provision	X				
Postgraduate and undergraduate service provision	X				
Provide documents /materials for research	X	X	X		
Inter-Library Loan services	X				
Journals / periodicals	X				
Handle queries		X	X		
Collection development		X	X	X	
E-resources		X	X		
Teamwork		X			
Liaise with faculty			X		
Manage library website			X		
Support research lifecycle – play different role per research phase				X	X
Head of Library /Manage library				X	X
Information literacy training				X	
Conduct Literature reviews				X	
Teaching Data literacy / methodology module for postgraduates				X	
Copyright guidelines				X	

Publishing advice				X	
Collaborate with library staff on repository services				X	
Citation metrics support				X	

Table 6. 2 Current work and changes in research support practices

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Provide documents /materials for research	X				
Provide more training on electronic resources	X				
Main focus on retrieval of online information: Switch from print to electronic resources: quick and easy access	X	X	X		
Inter-Library Loan services: Library Network - NILDE services	X	X			
Building Research networks		X			
URL link resolver: single sign-on integration		X			
New tools: Online bibliographic databases – Web of Science / Scopus			X		X
Changed approach to supporting research			X		
Researchers work independently			X		
Co-ordinate research support practices				X	
Digital world is important				X	
Mixed feelings				X	
Identify researcher needs				X	
Practical research activities				X	
Data literacy / methodology module for postgraduates				X	
Institutional repository					X

Reading room still important					X
Appointment-only research support					X

6.2 Researchers' perception of the librarians' role in supporting research: from the librarians' point of view

Table 6.3 Librarians' experience of supporting faculty and PhD students' research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Provide materials /documents	X				
Library is the last resort / point of contact	X				
Limitation : researchers rely on the Internet only	X				
Library /librarian role not understood in supporting research	X				
Best long term users – PhD students		X			
PhD student progress		X			
Build knowledge		X			
Information Literacy Training		X		X	
Strong library users: faculty		X			
Positive faculty attitude		X			
Close collaboration with faculty			X		
Don't know faculty perception			X		X
Only the faculty I work with have positive attitude			X		
Faculty board representative				X	
Faculty information requests				X	X
Previously no librarian professional recognition				X	

Table 6.4 Librarians' support benefitting research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Assist when needed	X				
No feedback on effectiveness of my research support	X			X	
I don't know		X			
Providing information		X			
Collection budgeting			X		
Ensuring access: Negotiating subscriptions with publishers			X		
Accuracy /quality of bibliography				X	
Information Literacy training				X	
Room for improvement					X
Create awareness					X

6.3.3 Technology trends in communication and supporting research

Table 6. 5 Librarian profile and visibility on the web

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
No web profile	X	X			X
Contact details available on library website only	X				X
I don't feel like being visible	X				
Not much visibility		X			
Chemistry Library Facebook Page			X		
Important			X	X	

Good interaction [with students] via Facebook page (Good interaction)			X		
Different modes of communication: Preferred way by users				X	
Improve capabilities to answer questions				X	
Digital conversations				X	
I don't like this					X

Table 6. 6 Social media / Web 2.0 tools used to support research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Librarian mailing list	X				
ResearchGate		X			
Academia.edu		X			
Google+ / Calendar / Drive		X		X	
Online tutorial participation		X			
NILDE [Network for the Interlibrary Document Exchange]		X			
"Sebina You" –interactive catalogue			X		
Library Facebook Page			X		
Skype			X		
Personal Facebook but not for research				X	
LinkedIn				X	
Mendeley				X	
None					X

Table 6. 7 The use of social media to enhance research practices

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
More user-friendly for young researchers	X				
Entertaining	X				
Librarians forced to adapt eventually	X				
Improve networks		X			
Improve knowledge of professional practices		X			
Information tool			X		
Invisible college			X		
Some doubts			X		
Library visibility				X	
Citation management tools promoted				X	
Peer-to-peer group activities				X	
I don't know					X

Table 6. 8 Librarians communicating with faculty about research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Handle /respond queries	X	X			
Remote communication	X				
Literature mainly	X				
Promote information sources: Current awareness		X		X	
Facebook page			X		
Blog: Participate by handling requests on blog			X		
Research group website: Participate on website				X	

Newsletter on website					X

Table 6. 9 Mode of communication between librarians, faculty and students

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Email	X	X	X	X	X
Face-to-face		X	X		
Telephone	X				
Skype			X		
Depending on the query			X		

Table 6.10 Librarian being a contact on researchers' social networking sites

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
I don't know	X				
I don't have profiles	X				
Communicate via email only	X				X
Positive		X			
Clarify legal position		X			
Important			X	X	
Future librarian's role			X		
Understand protocol of SNS for research				X	
Switch from social media to email				X	
"Ask a librarian" on library website					X

6.4 Librarian-faculty collaboration in research

Table 6.11 Librarians and researchers working together to improve library research services

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Not in this library	X				
Occurs in higher structures	X				
Introducing /improving services	X				
Happy to collaborate		X			
Not sure how		X			
Very Important			X		
Need to work together			X	X	
Collaborate in collection development: Budget planning			X	X	X
Useful					X

Table 6.12 Librarian-faculty-student collaboration to improve library research support services

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Through main library	X				
Scientific committee		X			
Research Project Participation			X		
Information Literacy training			X	X	
Collection development				X	X
Difficult					X
Member of governing body					X
Library budget					X
Library hours					X

New services / processes					X

Table 6.13 Librarians discussing library matters and ideas with faculty and students

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
New resources	X				
Faculty board meetings /governing body	X				X
Scientific library referee		X			
OA initiatives			X		
Optimising the budget			X		
Familiar with researchers: Informal coffee conversations				X	
Loan rules shared on university website					X

6.5 Librarian collaboration in LIS research and Library Association

Table 6.14 The role of the library association in research support

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
AIB mailing list	X	X			
Information forum /discussion about profession	X	X			
Useful			X		
Enhance member profiles			X		
Colleagues don't see the advantage of AIB			X		
Commission for research libraries / interest group				X	
Promote OA/OS				X	
Organise courses for librarians				X	X

Publish documents on librarian role /guidelines for supporting research				X	
Economic crisis- not much activity					X

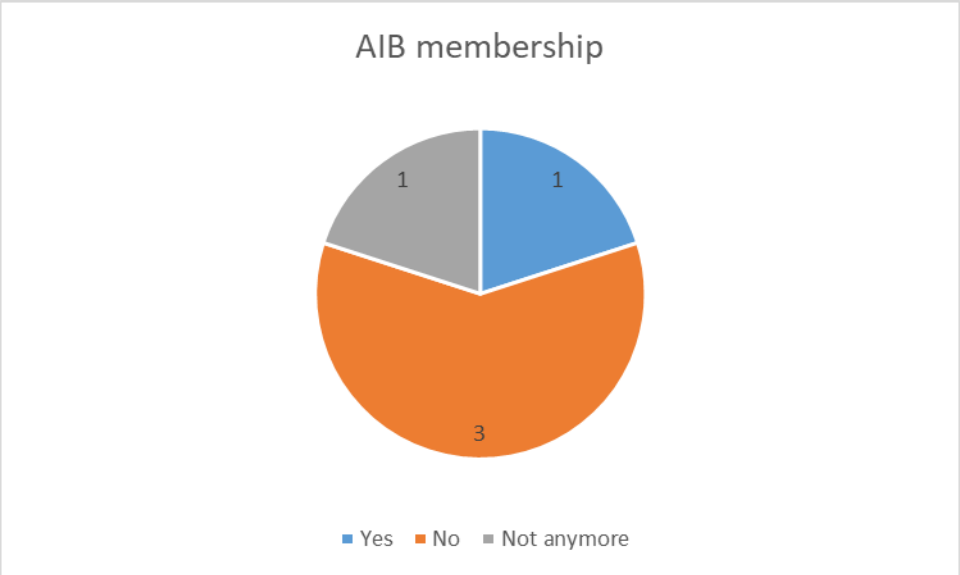

Figure 6.1 AIB Library Association membership

Table 6.15 Librarians conducting research to improve research support services

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Useful and important	X			X	X
Develop new techniques / Offer New services	X	X			
Exchange best practices	X				
Very important		X			
Change accordingly		X			
Know the needs of researchers / Involvement in research			X	X	
No policy			X		
Referee needed for initiatives			X		
Learning process				X	

Real life experience				X	

Table 6.16 Librarian -librarian collaboration to support research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
None	X				
Through NILDE		X	X		
Mailing list – Italian Chemistry librarians				X	
Mailing list - American Association of Research Libraries for Chemistry Librarians				X	
UNIBO- cataloguing antique books					X
Architecture interest group					X

6.6 Academic library trends in supporting research (OA, OS, RDM)

Table 6.17 Advantages and disadvantages of Open Access publishing

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Less direct costs	X				
Reduced budgets	X		X		
Free access to information	X	X		X	
Wider audience	X	X		X	
Author /researcher risk /disadvantage	X				
Complex matter		X	X		
Impact factor issues / Low status		X		X	
Author costs are high / who must pay?		X		X	
Hybrid / Gold Open Access Model problem: double costs			X		

Horizon2020 and other European directives			**X**		
Worldwide problem			**X**		
Green option free and more open			**X**		
Negotiate with publishers			**X**		
Good / Very important				**X**	**X**
Innovative				**X**	
Benefit developing countries / institutions who cannot afford subscriptions				**X**	
Predatory journals				**X**	
UNIBO DL (digital library)					**X**
Library promotes Open Access publishing					**X**
Green and Gold options					**X**

Table 6.18 Promoting Open Access to university community

Theme	**UNIL1**	**UNIL2**	**UNIL3**	**UNIL4**	**UNIL5**
University initiative – website-AlmaDL	**X**	**X**	**X**		**X**
Current awareness of Open Content	**X**			**X**	
Researchers' decision where to publish	**X**				
Promote institutional repository		**X**			
Open Access publishing workshop			**X**		**X**
Horizon2020 programme on website				**X**	
Chemistry researchers not in favour				**X**	

Table 6.19 Research Data Management and the role in research support

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
No experience /knowledge	X		X		X
institutional repository –handle thesis uploading		X	X		
CNR, the Italian National Research Council		X			
Managed by Central Library Office			X		
Support information only				X	
Cooperation needed from library coordinating level – ASDD				X	
No data repository				X	
Departmental internal RDM				X	

Table 6.20 Library assisting with managing research data

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
I don't know	X				
Not enough knowledge: no experience	X		X	X	
In need of RDM training		X		X	
The library should /could		X	X	X	
Bibliometric assistance			X		
Library to get involved in new areas			X	X	
Learn in future				X	
No comment					X

6.7 Rating of academic library research support services

Table 6.21 Librarians' satisfaction with the library function

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5

Never	X				
Doing the best we can	X				
The more the better	X				
Staff capacity	X		X	X	
Partially		X	X		
Room for improvement		X			X
Need more visibility		X	X		
Build institutional relationships			X		
Faculty-librarian collaboration			X		
Yes				X	X
Towards digital services				X	

Table 6.22 Library resources mainly used by faculty and students for research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Databases	X		X	X	X
Books for teaching	X				
Journals for latest research	X			X	
Printed books		X			
Web of Science / Scopus		X	X		X
SciFinder			X		
ACS: American Chemistry Society			X		
Catalogue			X		
Compendex					X

IEEE					X
ScienceDirect					X
Standards					X

Table 6.23 Research support services offered in the past year

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
ILL	X	X			
NILDE		X			
Information Literacy training		X	X	X	X
Reference services		X			X
Library resources			X		
Copyright seminars				X	
Guides / pamphlets					X

Table 6.24 Library resources promoted for research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Database and Catalogue training	X	X	X		
PhD seminar every year	X				
NILDE		X			
New acquisitions, changing of platforms, standards.		X			
Institutional repository: theses searching			X		X
Journals				X	

EBooks (handbooks, research books, reference books).				X	
subject specific databases (SciFinder)				X	
Information literacy training					X

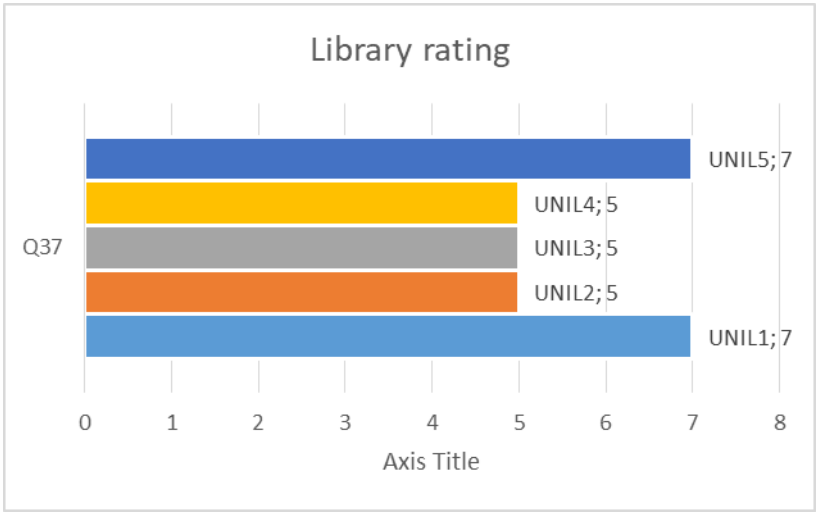

Figure 6 2 Library rating for research

Table 6.25 Possible research support services

Possible Research Support Services	**Score**
Other	1
Ongoing updates on new information resources	5
Database training	5
Advice on Open Access publishing	5
Advice on bibliographic referencing	6
Advice on their research topic	7
Maintaining of research repositories	7
Providing a reading list on faculty and students' research topic and providing advice on their literature review	9

Training on mobile apps for research	9
Advice on Research Data Management	10
Advice on research proposal writing	12
Training on social media use for research	12
TOTAL	**88**

6.8 Competencies for conducting and supporting research

Table 6.26 Librarian training needs to support research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Reference management tools	**X**				
Research reports from Scopus	**X**				
Bibliometrics /Altmetrics	**X**				
RDM		**X**		**X**	
Open Science		**X**			
New searching developments		**X**			
Publishing process: especially OA publishing			**X**		**X**
Creative Commons licenses			**X**		
English Language competencies				**X**	**X**
Social Media					**X**

Table 6.27 Further research assistance needed by faculty and students

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Evaluating research	**X**				

I am not well prepared to conduct bibliometrics /altmetrics	X				
Training on Reference management tools - Mendeley	X	X			
Publications policy			X		
Remote access improvements			X		
International library collaboration				X	
Exchange services				X	
Social media					X
Undergraduate Information Literacy training					X

6.9 Research support in policy building

Table 6.28 Research output / support contributing to university guidelines or procedures

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
No contribution	X				
Library Committee deals with this	X	X			
Adopt guidelines from library committee	X				
I am not sure		X			
Improve catalogue interface project			X		
NILDE project – Managing Inter-Library Loans			X		
Research evaluation: Scopus /Web of Science				X	
Internal library guides					X

Table 6.29 Research support enhancing teaching and learning

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Information literacy training	X	X	X		
Providing information	X				
Library play an important role to improve teaching			X		X
Effective database use			X		
Improve student learning			X	X	
Independent information seekers: Enhance curiosity				X	

Table 6.30 Research support improving student development and success

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
I don't know: More hope than certainty	X				
Information literacy training	X	X	X	X	
Quality of their work	X				
Students acquire skill to evaluate information sources		X			
Teacher think it is important			X		
Effective database use			X	X	X
Improve student learning			X		
Literature searching – most important component: Search strategies				X	X
Providing reference services					X

Table 6.31 Research support contributing to community engagement

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Not sure	X				
Community engagement initiative – evaluating information sources		X			
Social Awareness: start from student to society		X			
NILDE project: Reach out to community through libraries			X		
Support society functions organised by graduates				X	X
Advice on commercial use of scientific results / Copyright guidance				X	
Applying Information Literacy skills in the workplace					X

6.10 Likert scale statements

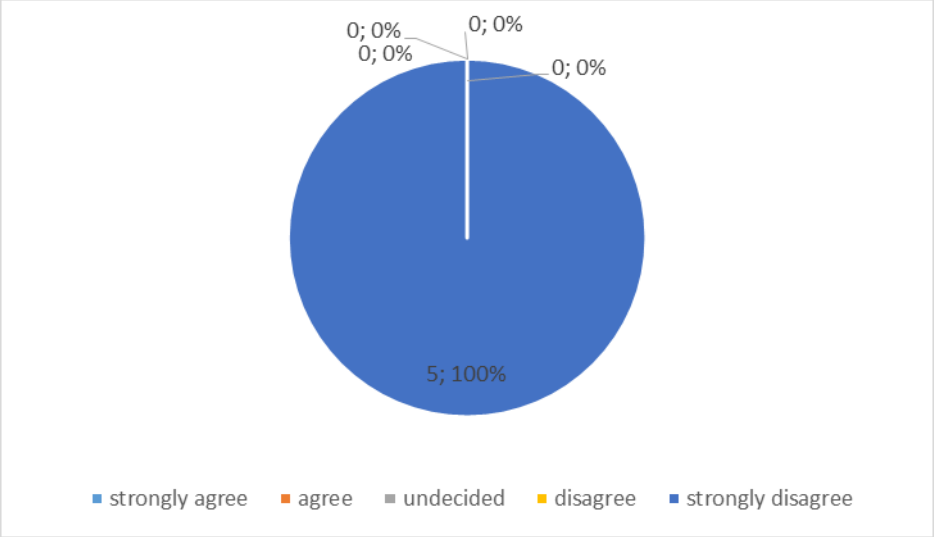

Figure 6.3 "The University's library collection and resources cannot support research"

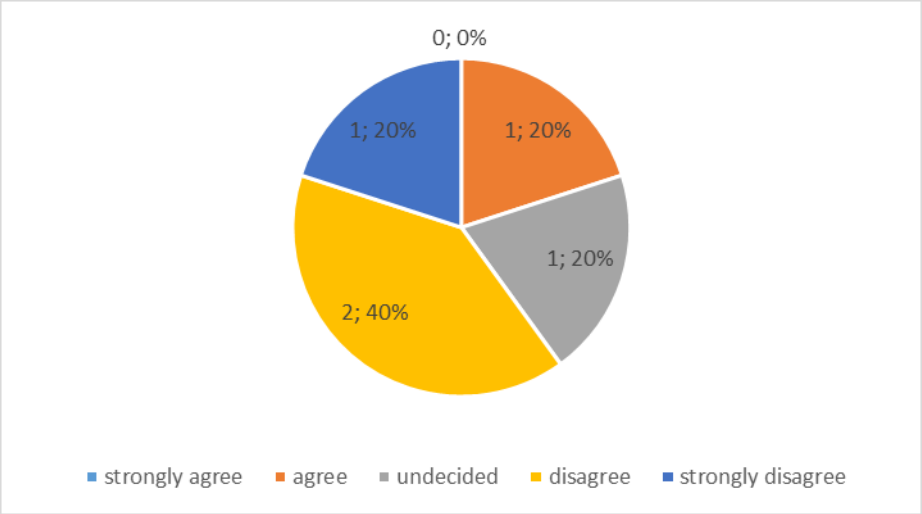

Figure 6.4 "Librarians do not have the subject knowledge to help my research"

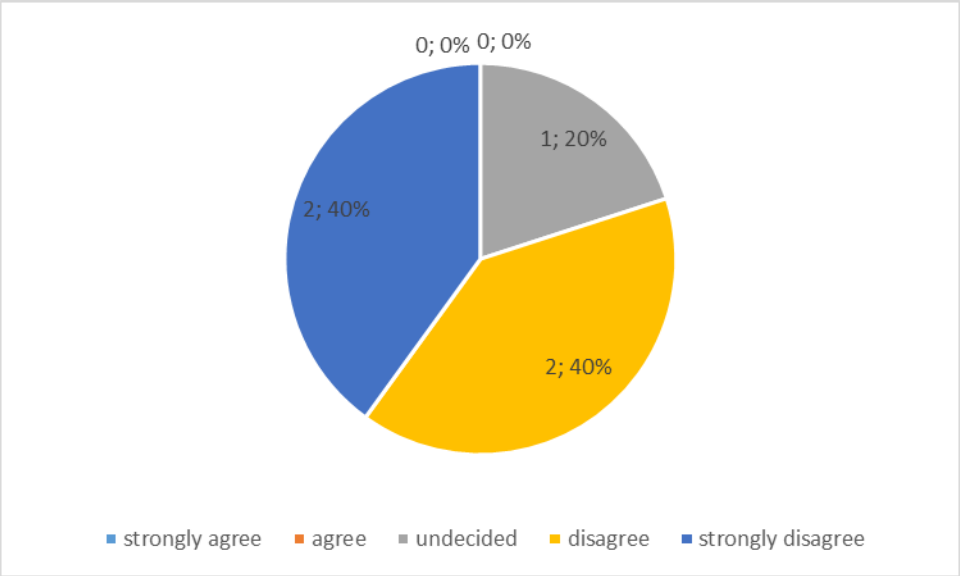

Figure 6.5 "Researchers today no longer need the library"

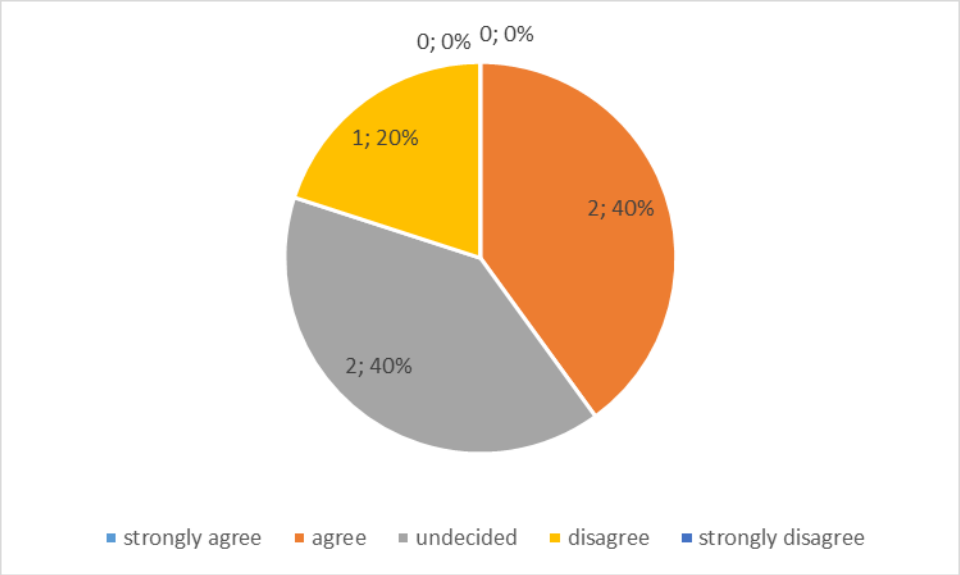

Figure 6.6 "Researchers outside my university provide me with information on my research"

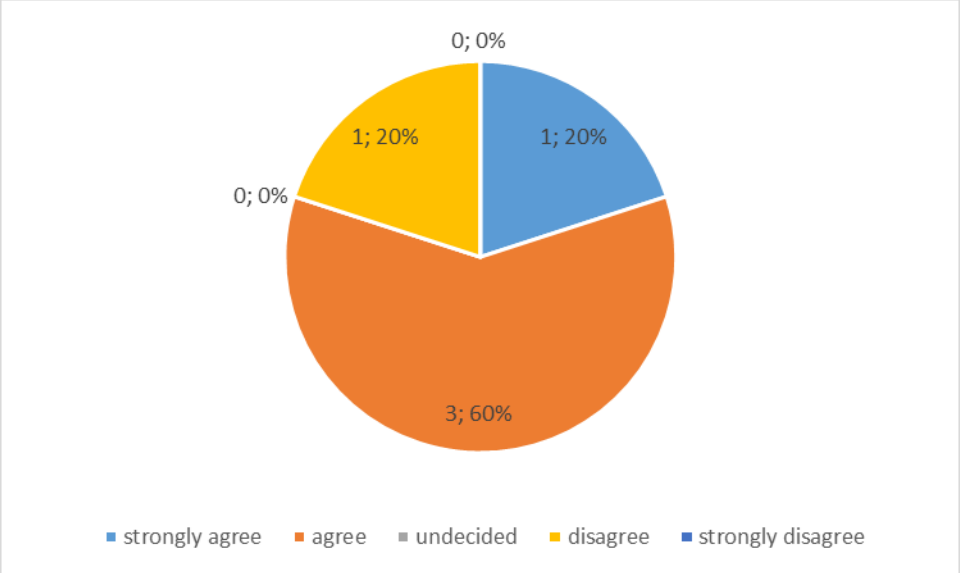

Figure 6.7 "I share knowledge about Chemistry or Chemical Engineering research with researchers"

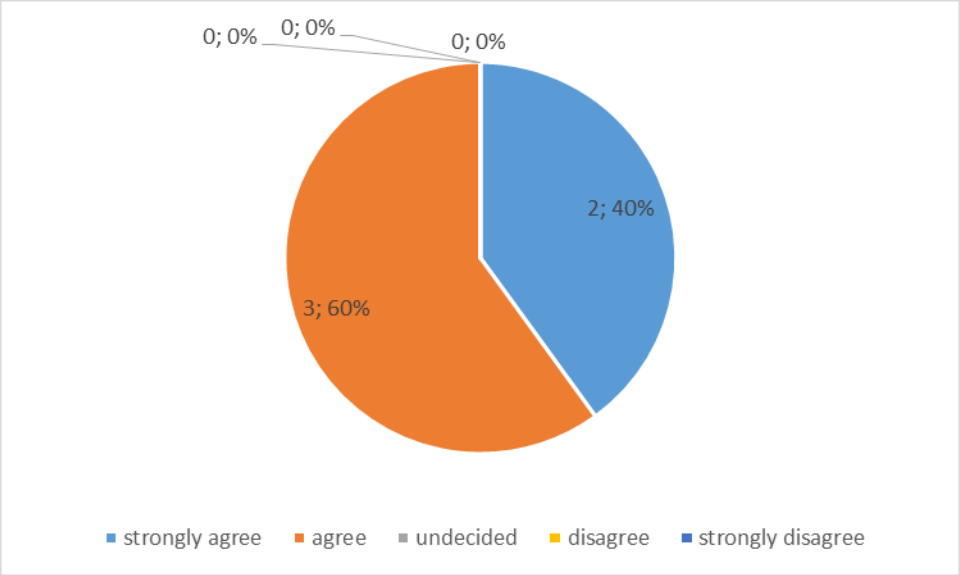

Figure 6.8 "Faculty librarians are updating researchers on the latest information accessible via the library electronic resources for my research"

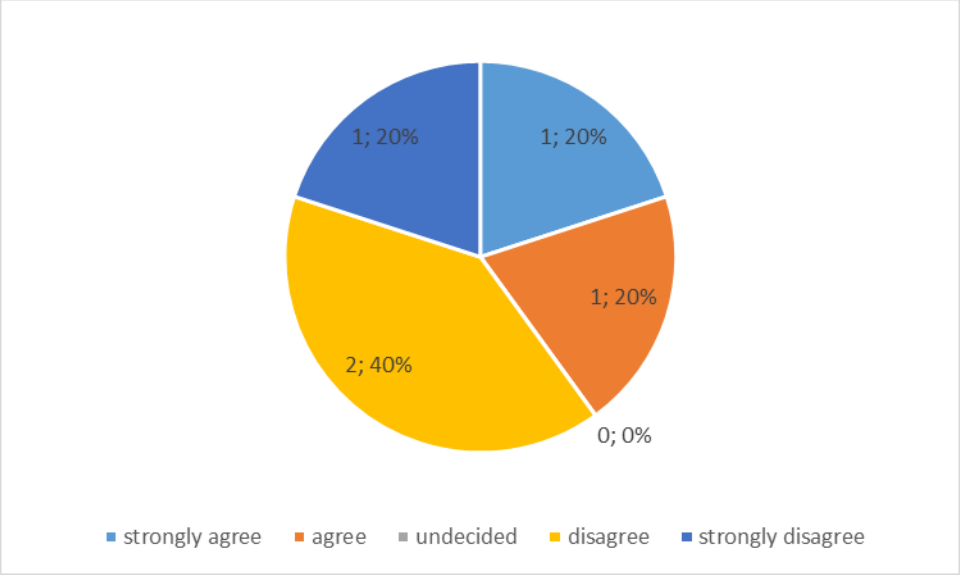

Figure 6.9 "Now that researchers use the library website, they don't need to visit the physical library"

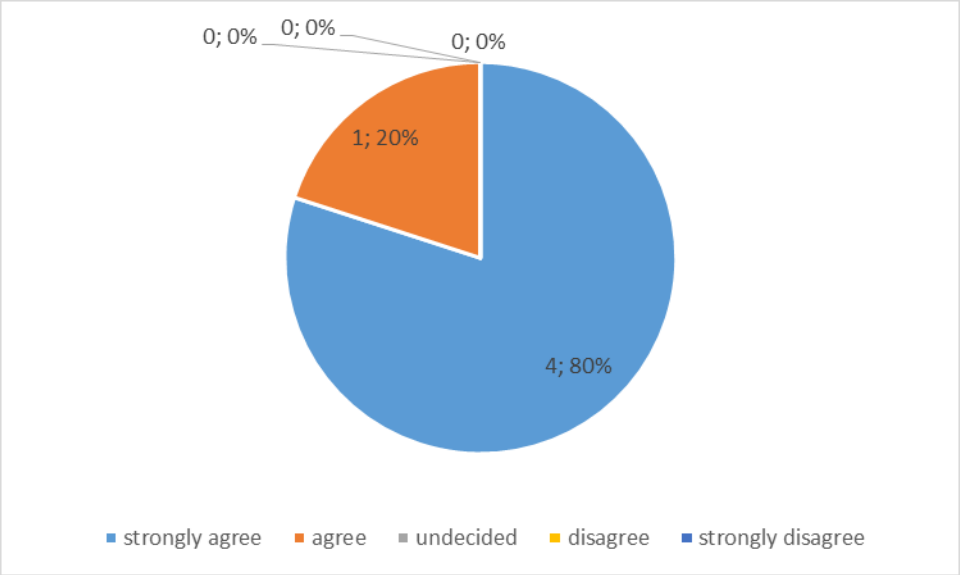

Figure 6.10 "Research is essential to my job"

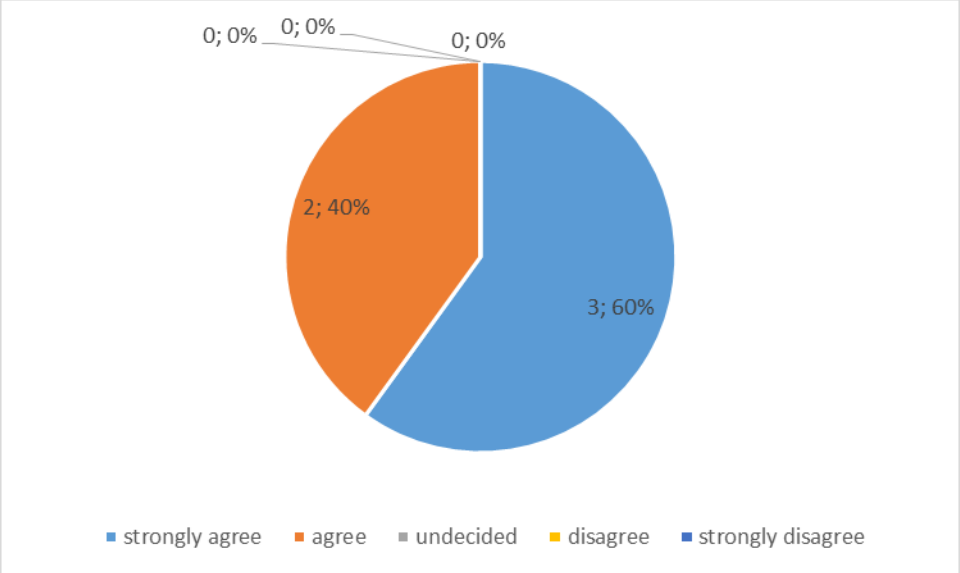

Figure 6.11 "The university needs to build a stronger research culture"

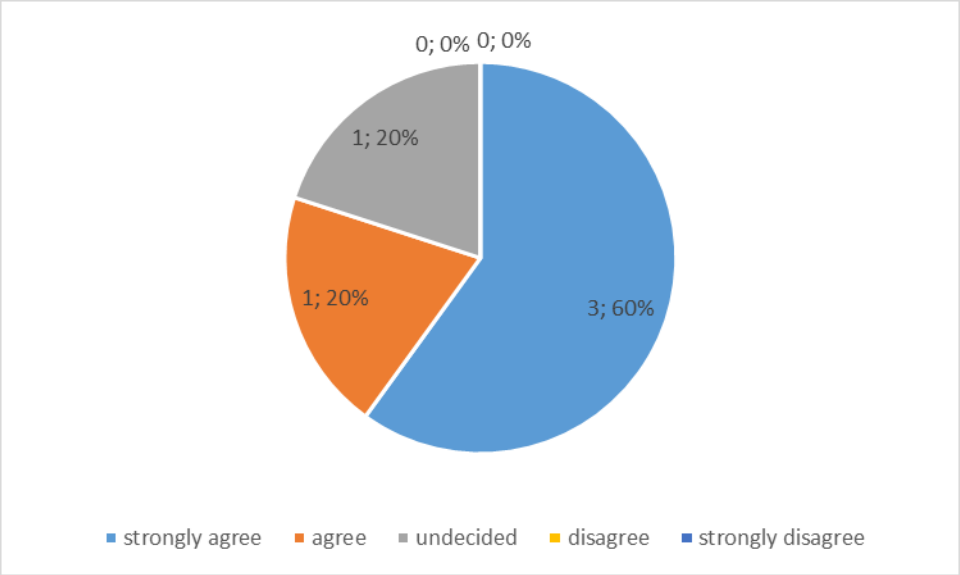

Figure 6.12 "International collaboration builds a stronger knowledge culture in the library"

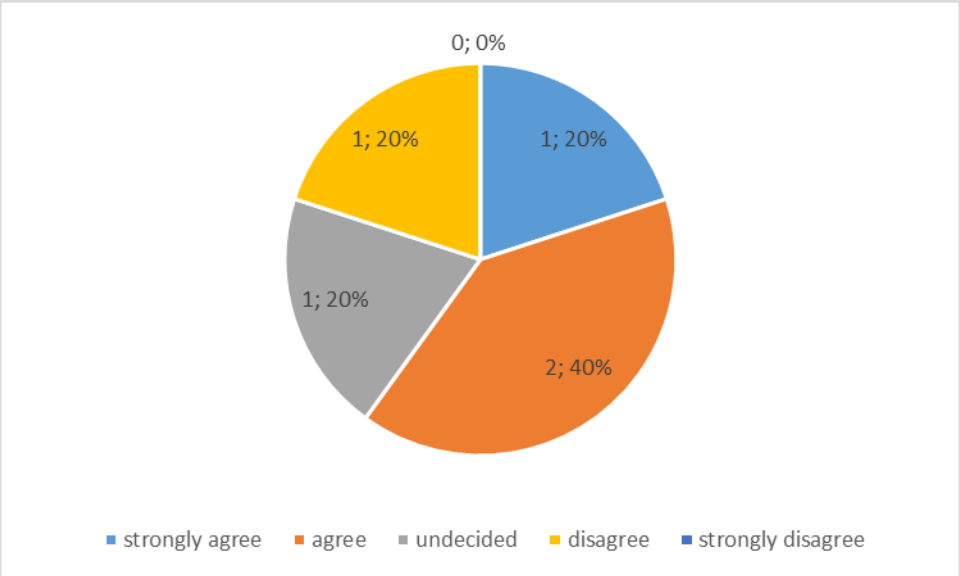

Figure 6.13 "Research Data Management has become an important practice in supporting research"

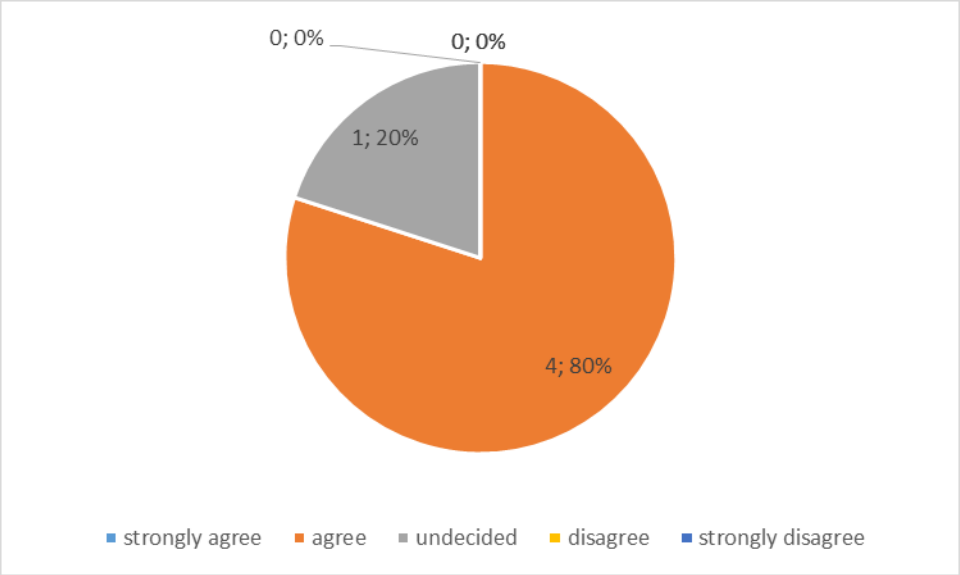

Figure 6.14 "Publishing research in Open Access journals have increased citation counts"

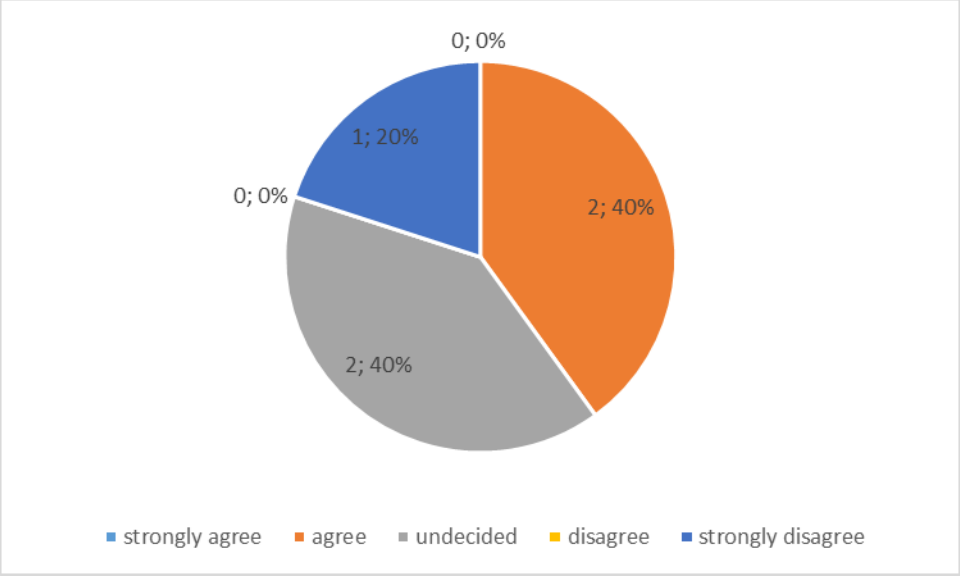

Figure 6.15 "Having a research profile on social networking sites have increased the visibility of my work"

Table 6.32 Additional comments from librarians

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
Currently involved with digitisation project	X				
In need of new techniques to support research		X			
Role clarification of librarian is important			X		

Communication barriers			X		
No OA policy create challenges			X		

6.4 Perception of Chemistry and Chemical Engineering researchers and PhD students at UNIBO

The tables and figures in this section are organised by themes discussed in Chapter 6 in the following sequence: Chemistry researchers, Chemistry PhD students, Chemical Engineering researchers and Chemical Engineering PhD students.

6.4.1 The role of the researcher as prosumer

Table 6.1A The role of the Chemistry researcher

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Devise research programs	X				
Collect experimental data	X				
Make theoretical calculations	X				
Write scientific research papers	X				
PhD co-ordinator		X			
researcher		X			
Development and application research			X		
Very independent				X	
No interaction with other researchers				X	
No support needed				X	
Full professor					X

Table 6.1B The role of the Chemistry PhD student as researcher

Theme	UNICS1	UNICS2	UNICS3
Mainly lab work	X		
Writing up phase of my research project		X	
Literature survey			X
Experiments and treat data			X
Write research articles			X

Table 6.1C The role of the Chemical Engineering researcher

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Researchers are also teachers	X	X	X	X		X
Supervise PhD and post-doc students	X		X			
Heavy teaching load		X	X	X		
Lots of admin work			X			
Part-time worker				X		
I'm a Researcher					X	
Work time: Half research, half teaching						X

Table 6.1D The role of the Chemical Engineering PhD student as researcher

Theme	UNICES1	UNICES2
Work on research projects in the lab	X	
Assist Masters students in the lab	X	
Independent from researchers in the group		X

Conduct Interdisciplinary research in department		**X**

Table 6.2A Current work and changes in research practices of Chemistry researchers

Theme	**UNIC1**	**UNIC2**	**UNIC3**	**UNIC4**	**UNIC5**
Follow two different research areas	**X**				
Manage a research group		**X**			
Focus on writing grant proposals		**X**			
Changes in equipment and techniques		**X**			
Changes: Finding and using information online			**X**		
Data handling is main part of my research practice			**X**		
Research practice: Application to solve real problems				**X**	
Previously conducted a lot of research: Published many papers in the past				**X**	
Currently heavy teaching load: Don't care about publishing anymore				**X**	
Handling analytical technologies and methodologies					**X**
Focus shifted from basic science to industrial research and business applications					**X**

Table 6.2B Current work and changes in research practices of Chemistry PhD students

Theme	**UNICS1**	**UNICS2**	**UNICS3**
Experiments and treat data	**X**		
Write research articles and conference presentations	**X**		
Teaching	**X**		
Literature survey		**X**	

Lab work		X	
Participated in an exchange student program		X	
No change			X

Table 6.2C Current work and changes in research practices of Chemical Engineering researchers

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Depth of research decreased	X					
Methodology changed	X			X		
Now we are forced to produce more publications	X					
Now more collaborative research	X	X				
Manage rather than conducting research	X	X				
Technological developments useful	X	X	X	X	X	X
No more programming knowledge due to new technology	X					
My research practices changed		X	X		X	X
Apparatus commercially available now than in the past		X				
Accessing library resources electronically now			X	X		
Changes beneficial to our research			X	X		X

Table 6.2D Current work and changes in research practices of Chemical Engineering PhD students

Theme	UNICES1	UNICES2
Experimentation work in the lab	X	
Conduct literature searches on my research project	X	
Research practice remained the same since I started	X	

Research practice changed through gaining experience in scientific language		X

Table 6.3A Chemistry Researchers' profile and visibility on the web

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Availability of my research on the web is important	X		X		X
Quality of my research is important	X				
I feel ok		X			
UNIBO website profile		X	X		
Don't like social media		X			
No research profile				X	
I don't care about visibility: My ego is satisfied				X	
Visible because of my business					X

Table 6.3B Chemistry PhD Students' research profile and visibility on the web

Theme	UNICS1	UNICS2	UNICS3
I feel ok	X	X	X
Smart way of connecting people		X	
Local and international collaboration		X	

Table 6.3C Chemical Engineering Researchers' profile and visibility on the web

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
It is quite good: people can access me via Google	X					X
Especially my UNIBO profile	X					

Researcher's responsibility to update research profiles to increase visibility	X		X			
My UNIBO profile low impact: not updated		X	X	X		
Research group webpage improved visibility of lab activities		X		X		
Perhaps useful to Italian companies		X		X		
Feel good and bad			X			
Need time to update			X			
Important					X	
Good viewing/download statistics and citations report						X

Table 6.3D Chemical Engineering PhD Students' research profile and visibility on the web

Theme	UNICES1	UNICES2
I don't know	X	
Departmental website is not so visible	X	
I feel good		X

Table 6.4A Social media / Web 2.0 tools used by Chemistry researchers for research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
I use email only	X				
No need for web 2.0 for scientific research	X				
Indirectly through colleagues: Research group Facebook page		X			
I don't have any		X	X	X	
UNIBO website profile			X		X
Difficult to manage these profiles			X		
Probably I will go with LinkedIn			X		

I don't know what Web 2.0 means				X	
Only use databases				X	
My Business website					X
LinkedIn, Facebook, ResearchGate, LOOP					X

Table 6.4B Social media / Web 2.0 tools used by Chemistry PhD students for research

Theme	UNICS1	UNICS2	UNICS3
No / Not for my research	X	X	X
Only feature on Scopus/Web of Science and my supervisor's website	X		
My research is very specialised	X		
Departmental research group webpage on university website		X	
Not keen on personal research profile: a closed group on Facebook maybe		X	

Table 6.4C Social media / Web 2.0 tools used by Chemical Engineering researchers for research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
I am not active	X	X		X		
ResearchGate	X			X		X
LinkedIn	X	X	X			
UNIBO webpage	X			X	X	
Academia			X			
Facebook page for summer school			X			

Table 6.4D Social media / Web 2.0 tools used by Chemical Engineering PhD students for research

Theme	UNICES1	UNICES2
Not for research	X	

LinkedIn	X	
No, I don't know them		X

Table 6.5A Chemistry researchers' opinion on the use of social media to enhance visibility on the web

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Probably/ it depends	X	X			
No relevance for scientific / established researchers	X	X			
But perhaps help actors and market operators	X				
I already have my visibility without social media		X			
Certainly yes			X		X
I don't use social media			X		
Concerned with reliability of information on Facebook for research			X		
No opinion				X	

Table 6.5B Chemistry students' opinion on the use of social media to enhance visibility on the web

Theme	UNICS1	UNICS2	UNICS3
Yes I think so	X	X	X
But At a later stage	X	X	
Beneficial for collaboration		X	

Table 6.5C Chemical Engineering researchers' opinion on the use of social media to enhance visibility on the web

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Yes	X					X
No		X		X		
It could work for job applications			X			
Repetition of information				X		
Maybe					X	

Table 6.5D Chemical Engineering PhD students' opinion on the use of social media to enhance visibility on the web

Theme	UNICES1	UNICES2
Not much: I don't use it at the moment	X	
It can help		X

Table 6.6A Chemistry researchers' use of social media to enhance research practices

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Social media do not enhance my research practices	X			X	
My publications are visible to people		X			
Publishers think it is important for linking scientists			X		
They support bottom-up contacts					X

Table 6.6B Chemistry PhD students' use of social media to enhance research practices

Theme	UNICS1	UNICS2	UNICS3
Not at the moment	X		X
Minor role	X		
Important for external network building		X	
Link between research and job opportunities		X	
Just introduce researchers' profile			X

Table 6.6C Chemical Engineering researchers' use of social media to enhance research practices

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Only share publications	X					
I have no idea		X				
Not so active on SNS		X				
ResearchGate idea could be interesting		X				
Find useful information or ideas via SNS			X			
No I don't think so				X		
Increase visibility					X	
Not led to collaboration yet on ResearchGate						X

Table 6.6D Chemical Engineering PhD students' use of social media to enhance research practices

Theme	UNICES1	UNICES2
I don't think they do	X	
Through Collaborating or getting in contact with researchers in the same area		X

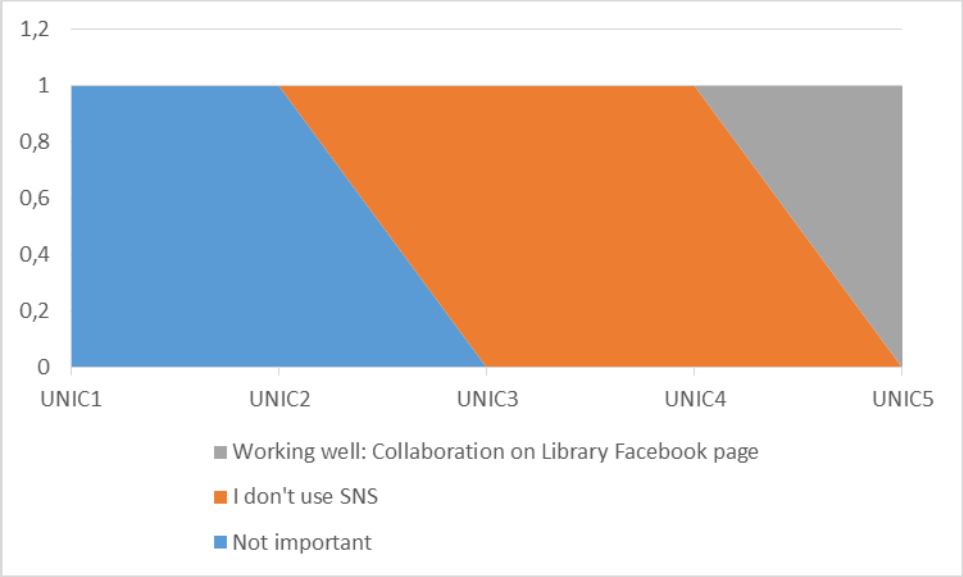

Figure 6.1A Chemistry researchers' opinion on the librarian being a contact on their SNS for research

Table 6.7B Chemistry PhD students' opinion on the librarian being a contact on their SNS for research

Theme	UNICS1	UNICS2	UNICS3
Not applicable	X		X
It would be very smart		X	
Librarian knows what is the latest research in our field		X	

Table 6.7C Chemical Engineering researchers' opinion on the librarian being a contact on their SNS for research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
It would be strange	X					
Librarian not directly involved in my research	X	X				
I don't know		X				
There is no need for another communication tool			X	X	X	
Perhaps for other librarians and academics it is useful			X			
I don't use social media					X	
It is positive: Librarians can endorse my skills						X

Table 6.7D Chemical Engineering PhD Students' opinion on the librarian being a contact on their SNS for research

Theme	UNICES1	UNICES2
I think it would be a good thing	X	
No comment		X

7.4.2 Researchers' perception of the role of the librarian supporting research

Table 6.8A Chemistry researchers' experience of the library supporting research and role of the librarian in research support

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Rarely ask librarians' support for publications	X	X			
Use the electronic library resources		X	X		X
Don't meet librarians anymore		X			
Before the Internet I dedicated a lot of time to spend in the physical library for my research			X		
But I still like to visit the physical library and browse books			X		
Librarian play an important role in supporting research			X	X	
Librarian play a small role					X

Table 6.8B Chemistry PhD students' experience of the library supporting research and role of the librarian in research support

Theme	UNICS1	UNICS2	UNICS3
Very limited interaction with librarian	X		
Providing access to full text articles	X	X	
Positive perception: Very Happy with librarian's support	X	X	
Library is fundamental		X	

But the book is vital for in-depth background knowledge: science behind the work		X	
Save time		X	
Direct contact is good		X	
Only use electronic resources			X
Librarian play no role			X

Table 6.8C Chemical Engineering researchers' experience of the library supporting research and role of the librarian in research support

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
I mainly use library printed books for teaching	X	X				
I always use electronic resources for my research	X	X				
Only communicate with librarian when requesting books	X					
Library /librarian play fundamental role		X	X	X	X	X
NILDE is very useful		X			X	
We are lost without our librarian		X	X	X		X
Library resources are good			X			

Table 6.8D Chemical Engineering PhD students' experience of the library supporting research and role of the librarian in research support

Theme	UNICES1	UNICES2
NILDE is very useful	X	
Librarian play a positive role in my research	X	
I don't use physical libraries		X

Table 6.9A Chemistry researchers' perception of the librarian's role in supporting research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Take care of the library	X				
Facilitate free access: save money		X			
Co-ordinate information resources		X		X	
Librarian role is not to support research		X		X	
Very good role			X		
Information provision				X	
Librarians should be more actively involved in training in online learning environments					X
Share knowledge about research activities on departmental websites					X

Table 6.9B Chemistry PhD students' perception of the librarian's role in supporting research

Theme	UNICS1	UNICS2	UNICS3
Information provision	X	X	
Positive role: collection management		X	
I don't know			X

Table 6.9C Chemical Engineering researchers' perception of the librarian's role in supporting research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
The main role of the librarian is to train me how to retrieve information for my research	X	X			X	
I don't see any other role	X					
Important role		X	X	X		X
We need more librarians to support research beyond information provision		X				
I am an old researcher				X		
For young researchers and PhD students, the librarian role is crucial				X		

Sharing new ideas					X	
Librarian is the interface between libraries outside the university						X
Librarian knows better how to do some practical things						X

Table 6.9D Chemical Engineering PhD students' perception of the librarian's role in supporting research

Theme	UNICES1	UNICES2
Important role	X	
But too much work for librarian to support each PhD student	X	
Current awareness role		X

6.4.3 Faculty-librarian Collaboration and communication

Table 6.10A Chemistry researchers communicating about their research with the faculty librarian

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
No	X	X			
Only NILDE		X			
Not on my research			X		
For books acquisitions			X		
I am the referee of the library: communicate frequently with librarian			X		
Only communicate when I need information on literature				X	
Always positive outcome				X	
Only using electronic resources					X

Table 6.10B Chemistry PhD students communicating with their faculty librarian about their research

Theme	UNICS1	UNICS2	UNICS3
No	X	X	X
Not useful beyond information provision	X		
Only ask for assistance when finding books in the library		X	
May not know my topic			X

Table 6.10C Chemical Engineering researchers communicating about their research with the faculty librarian

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
No	X					
Not on my research		X				X
Only about information resources I need		X	X			X
Yes			X		X	
Search strategies for information retrieval on my research			X		X	
Librarian knows the collection				X		
Research support services are too new for the librarian				X		
Mainly communicate about my teaching and resources						X

Table 6.10D Chemical Engineering PhD students communicating with the faculty librarian about their research

Theme	UNICES1	UNICES2
Seldom	X	
Only when needed, when not sure of something	X	
No		X
I only access online articles		X

Table 6.11A Faculty librarian involvement in assisting Chemistry researchers with their research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Yes	X		X	X	
Good collaboration	X				
No relations with people		X			
Database training			X		
Information provision /book selection			X		
Only communicate when I need information on literature				X	
Always positive outcome				X	
Assist with sharing information on social media					X

Table 6.11C Faculty librarian involvement in assisting Chemical Engineering researchers with their research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
No	X					
Not directly		X				
Yes			X	X	X	X

Table 6.12A Chemistry researchers' preferred mode of communication with faculty librarian

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Face-to-face preferred	X		X	X	
Email		X		X	X
Telephone				X	
Social media					X

Table 6.12B Chemistry PhD students' preferred mode of communication with faculty librarian

Theme	UNICS1	UNICS2	UNICS3
Email	X	X	
Face-to-face		X	
never			X

Table 6.12C Chemical Engineering researchers' preferred mode of communication with faculty librarian

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Face-to-face preferred	X	X	X		X	X
Email		X	X	X	X	X
Telephone		X	X		X	X

Table 6.12D Chemical Engineering PhD students' preferred mode of communication with faculty librarian

Theme	UNICES1	UNICES2
Email	X	
Face-to-face	X	
No comment		X

Table 6.13A Librarians and Chemistry researchers working together to improve library research services

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Librarians know what researchers need	X				
Librarian should be an expert in administration duties and negotiations with publishers		X			
Is fundamental			X		
Never seen a librarian working together with a chemistry researcher: forgive my ignorance				X	
Sharing optimise costs					X

Table 6.13B Librarians and Chemistry PhD students working together to improve library research services

Theme	UNICS1	UNICS2	UNICS3
Could be helpful	X	X	
Room for improvement	X		
Approach for finding information		X	
Not necessary: wide field			X

Table 6.13C Librarians and Chemical Engineering researchers working together to improve library research services

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
It is a good idea	X	X	X	X	X	X
Already happening through meetings	X					
To find out what researchers need is crucial		X				
Current awareness is important		X				
Satisfied with the improved collaboration between librarian and faculty				X		
Librarian is active: stimulates us with new possibilities				X		

Table 6.13D Librarians and Chemical Engineering PhD students working together to improve library research services

Theme	UNICES1	UNICES2
It will be good	X	
Students need to talk more to the librarian about what they need	X	
A PhD student should be independent		X

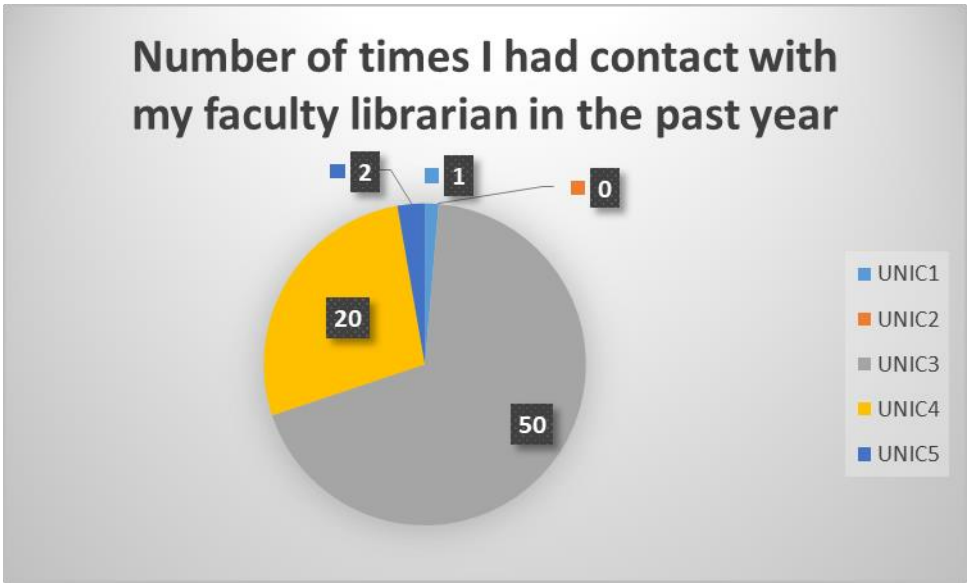

Figure 6.2A Number of times Chemistry researchers had contact with my faculty librarian in the past year

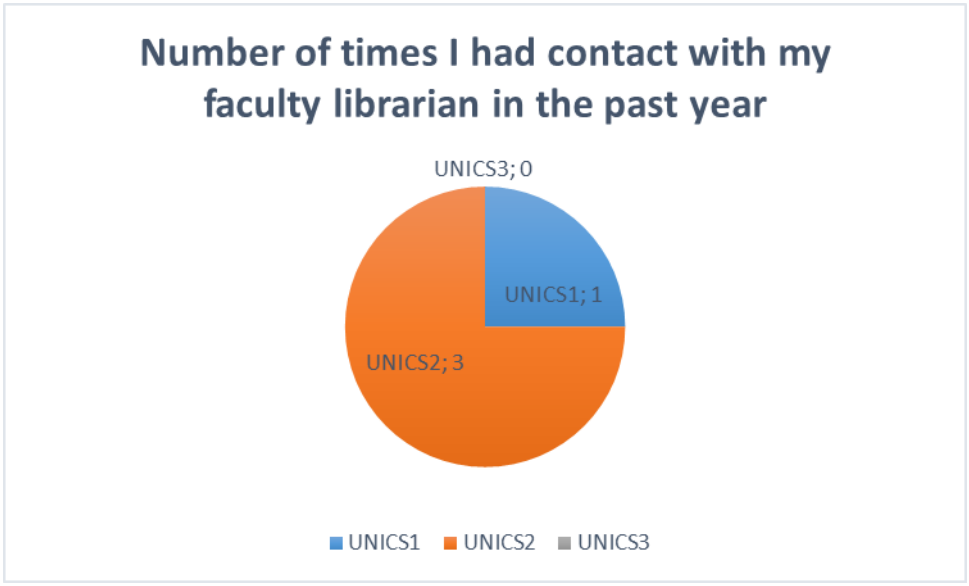

Figure 6.2B Number of times Chemistry PhD students had contact with my faculty librarian in the past year

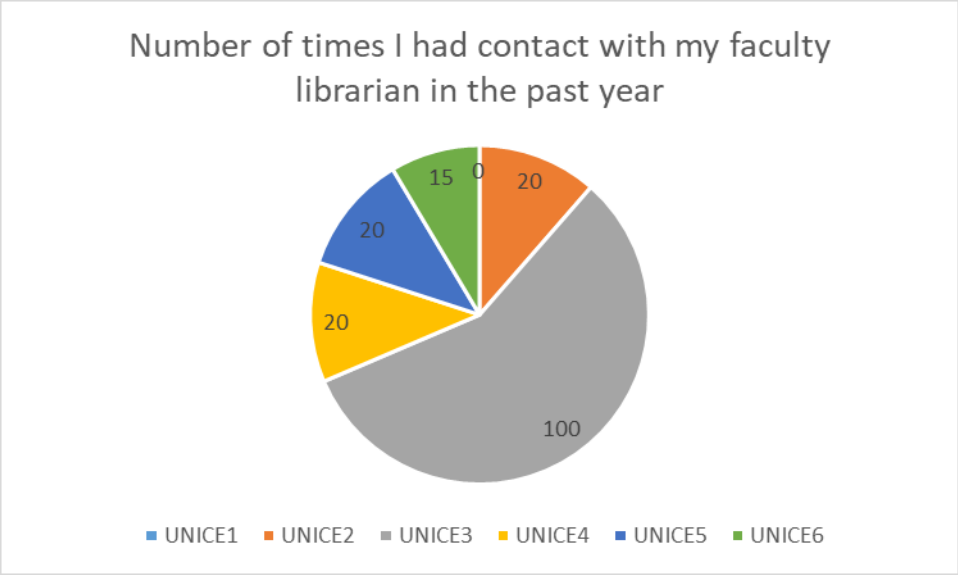

Figure 6.2C Number of times Chemical Engineering researchers had contact with my faculty librarian in the past year

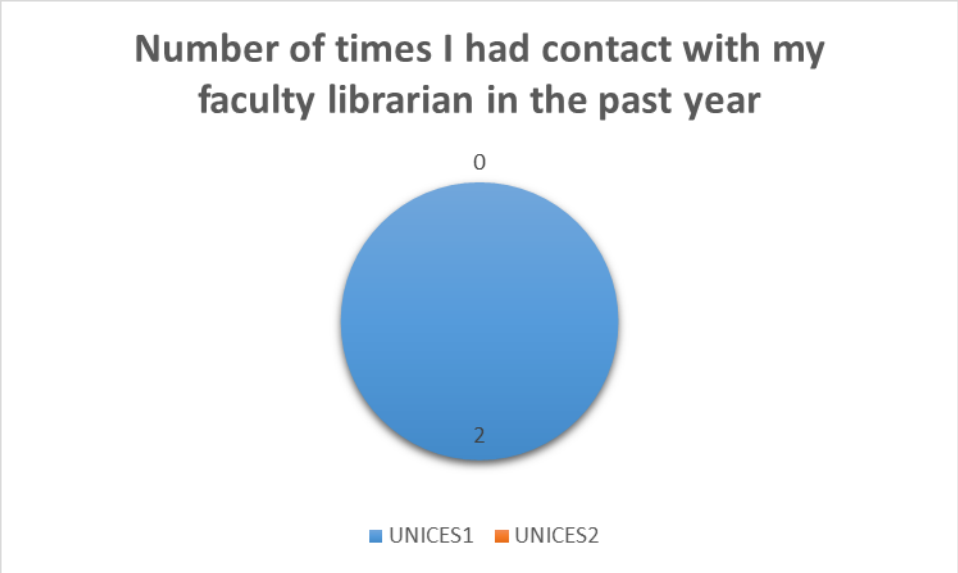

Figure 6.2D Number of times Chemical Engineering PhD students had contact with my faculty librarian in the past year

6.4.4 Chemistry and Chemical Engineering researchers and PhD students' perception of research trends

Table 6.14A Chemistry researchers' opinion on the advantages and disadvantages of Open Access publishing

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Not yet / No	X			X	
OA: Small impact	X	X			X
I have to pay Publication fees: problem	X		X		
It depends on impact factor and cost of OA publishing		X			
OA don't have good reputation: not recognised by scientific community		X			X
H-index and impact factor play a role in promotion		X			X
Public funding force us to publish OA		X	X		
Not our problem at the moment		X			
We publish only in prestigious journals		X			
Yes			X		
Advantage is that scientific research is freely accessible to the entire community			X		
Not regularly					X
We are pushed to look for highest impact factor journals to publish in					X

Table 6.14B Chemistry PhD students' opinion on the advantages and disadvantages of Open Access publishing

Theme	UNICS1	UNICS2	UNICS3
I published a few OA articles	X		
It is the way to go	X	X	
Reputation of the journal matters	X		X
Many options to access full text: ILL, email a friend from another university, email author, or illegal website LIBGEN	X		
Low impact factor of OA journals not good for my reputation	X		X

Very helpful to spread knowledge outside: industry benefit		X	
Author has to pay		X	
Free access to information			X

Table 6.14C Chemical Engineering researchers' opinion on advantages and disadvantages of Open Access publishing

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
A few yes	X		X		X	
I don't like OA publishing	X					
Author has to pay	X	X	X		X	
No strict review process	X					
Low quality: low impact factor	X	X				
Basic principle of OA is good	X					
We need to publish in high impact factor journals	X			X		
Researchers in Chemical Engineering still stick to closed access publishing	X					
No		X		X		
We are forced to through H2020 projects to publish OA		X				
People interested in my research are academics who can afford subscribing to journals		X				
Might be other fields where OA is important		X				
If I had money I could publish OA in the same journal (hybrid journal)			X			
No difference between closed access and OA, everything free through UNIBO				X		
Conducting Funded research: OA publishing useful					X	
Yes						X
Makes my work freely available to all						X

Industry benefit from my OA research						X

Table 6.14D Chemical Engineering PhD students' opinion on the advantages and disadvantages of Open Access publishing

Theme	UNICES1	UNICES2
Very useful	X	
Only tool we have for research	X	
Free access	X	
Save time		X
More responsibility on researchers to publish		X

Table 6.15A The role Open Access publishing play in building a knowledge culture for Chemistry researchers

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Secondary role	X				
In the future maybe		X			X
Economic benefit: high subscription fees			X		X
Information overload			X		
Don't know				X	

Table 6.15B The role of Open Content in Chemistry PhD students' research

Theme	UNICS1	UNICS2	UNICS3
There is no difference: access all information without paying	X		
Play a vital role in my research		X	
Minor contribution			X

Table 6.15C The role Open Access publishing play in building a knowledge culture for Chemical Engineering researchers

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Almost no role	X					
No difference between closed access and OA, everything free through UNIBO	X	X				
Most interesting publications are in conventional journals	X					
Journal administration is not my problem	X					
OA could be useful		X	X			
My research is specialised: target audience		X				
I plan to write OA reviews in the future		X				
Solution to university dealing with high subscription fees: still slow process: OA will eventually be beneficial for the whole university			X			
Research community need to recognise the importance of OA			X			
I don't know				X		
A big role					X	X
OA will benefit industry and community						

Table 6.15D The role of Open Content in Chemical Engineering PhD students' research

Theme	UNICES1	UNICES2
Very important	X	
Firstly journals		X

Table 6.16A Chemistry researchers' knowledge, perception and experience of Open Science

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
No experience	X		X	X	X
I don't like people to see too early		X			

Prefer to publish first		X			
People can steal your work		X			
My students are heading in this direction			X		
European Open Science projects: important and beneficial			X		
Perception is good: easy access, faster publishing				X	

Table 6.16B Chemistry PhD students' perception, knowledge and experience of Open Science

Theme	UNICS1	UNICS2	UNICS3
Not aware of it	X		
It is difficult: Don't think it is worth practicing this	X		
Positive from a scientific viewpoint		X	
Not good if research has commercial value		X	
No experience			X

Table 6.16C Chemical Engineering researchers' knowledge, perception and experience of Open Science

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
If you want to do something with restrictions, register a patent	X					
Science should be open to everybody	X					
No experience		X				X
Sceptical about putting my work out there on the web before publishing: people can steal my work		X				
Better to publish		X		X		X
It depends			X			
Expensive research with industrial money is restricted, cannot be open			X			

To practice open science is fine with public funding			X			
Open Science practice is not necessary				X		
Peer-review publication is sufficient				X	X	
Theoretically it sounds good but practically I'm not sure if it is good						X

Table 6.16D Chemical Engineering PhD students' perception, knowledge and experience of Open Science

Theme	UNICES1	UNICES2
No experience	X	X

Table 6.17B Role of Open Science for Chemistry PhD students

Theme	UNICS1	UNICS2	UNICS3
Not practiced in department at the moment	X		X
Useful in applied science: crowdfunding is a form of Open Science		X	
Not explored it: working with confidential information		X	

Table 6.17D Role of Open Science for Chemical Engineering PhD students

Theme	UNICES1	UNICES2
Could be useful	X	
No comment		X

Table 6.18A Chemistry researchers' experience of Research Data Management and its role in research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Play No role	X	X			
No experience			X		X
If you know what you are doing then you don't have to manage anything				X	
My opinion on RDM is baloney				X	

Table 6.18B Chemistry PhD students' experience of Research Data Management and its role in research

Theme	UNICS1	UNICS2	UNICS3
Could be useful in other fields	X		
For reuse or verifying	X		
Extremely rare for researchers to want to access my dataset	X		
My data is stored on a cloud: possibility to share		X	
When collaborating with companies we cannot share data		X	
Data needs to be accurate		X	
We do not use it			X

Table 6.18C Chemical Engineering researchers' experience of Research Data Management and its role in research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Good idea to share	X					
Upload data as supplementary is important	X					X
Data reuse: new research	X					X
Data verification	X					X

No experience yet, but in future yes		X				X
Important			X			
Need for standardisation of RDM			X			
Different formats make it difficult to read data			X			
Having data means having power				X		
Producing data is expensive: One needs to pay for access to data				X		
Something new to me					X	

Table 6.18D Chemical Engineering PhD students' experience of Research Data Management and its role in research

Theme	UNICES1	UNICES2
I didn't know it existed	X	
Could be useful	X	
No comment		X

Table 6.19A Chemistry researchers' opinion on the library assisting with Research Data Management

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
I don't see how	X	X			
Library could assist in online bibliographic searching	X				X
Library has no background to do this		X			
I don't have any experience			X		
Most probably the library have competencies, but will need more staff			X		
Doubt that scientists would want the library to handle their data			X		
Library don't assist me in RDM				X	
I may be wrong				X	

Digitalisation reduced the role of the librarian					X

Table 6.19B Chemistry PhD students' opinion on the library assisting with Research Data Management

Theme	UNICS1	UNICS2	UNICS3
I don't think the library should	X		X
It would be difficult to handle data	X		
It would be very good		X	
Upload thesis together with data in the institutional repository		X	
It should be a library function		X	

Table 6.19C Chemical Engineering researchers' opinion on library assisting with Research Data Management

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Absolutely yes	X					
Service already available through institutional repository	X					
Not sure about the library handling data: complex	X	X			X	X
I don't have experience		X				X
Maybe it could be useful		X	X		X	X
An expert is required for RDM, more library staff needed			X			
Not necessary				X		
Don't know how much work it entails: Should the researcher be doing it themselves?						X

Table 6.19D Chemical Engineering PhD students' opinion on library assisting with Research Data Management

Theme	UNICES1	UNICES2
I think it would be a good thing	X	
Students could access my data in the future	X	

Not in my field		X

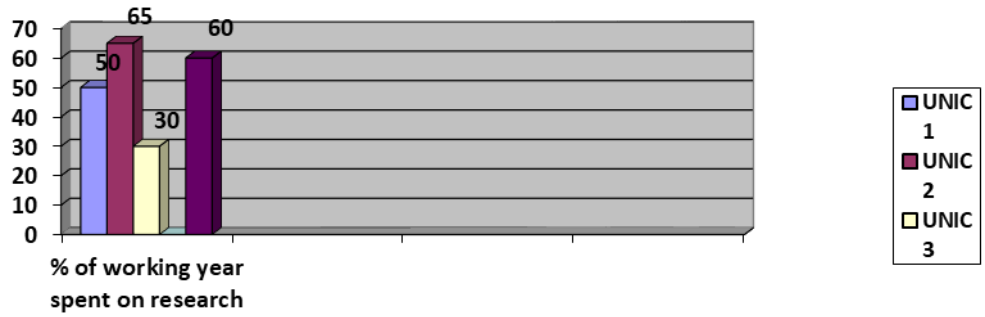

Figure6.3A Percentage of working year spent on research by Chemistry researchers

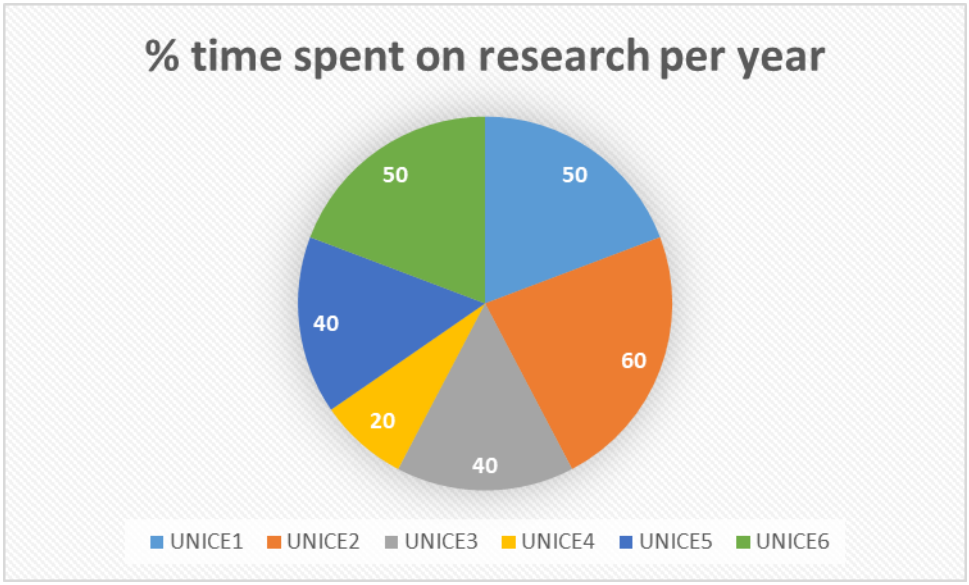

Figure6.3C Percentage of working year spent on research by Chemical Engineering researchers

6.4.5 Faculty research informing policy or procedures

Table 6.20A Research output of Chemistry researchers' contributing to university guidelines or procedures

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
No contributions	X			X	
During internal meetings		X			
I am not directly involved		X			
Important to contribute by increasing knowledge acquired by scientists			X		
Works the other way: guidelines are set and researchers need to follow them			X		
My spinoffs contribute to academia					X

Table 6.20B Research output of Chemistry PhD students contributing to university guidelines or procedures

Theme	UNICS1	UNICS2	UNICS3
Not at the moment	X		
My research independent	X		
Only a small contribution		X	
Pioneer in creating collaboration during my exchange programme		X	
Joint publications and open channels		X	
I don't know			X
I just publish			X

Table 6.20C Research output of Chemical Engineering researchers contributing to university guidelines or procedures

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Uncommon in my research	X					
Previously building apparatus and establishing procedures useful to the lab.		X				

Basic theory introduced through modelling activity		X				
No it has not			X			
Technical procedures				X		
No influence on university procedures				X		
My research made a huge contribution to industry and Italian Law				X		
By adding new research					X	
Not yet: Young researcher						X

Table 6.20D Research output of Chemical Engineering PhD students contributing to university guidelines or procedures

Theme	UNICES1	UNICES2
Not yet, hopefully in the future	X	
Use a simple approach to solving a research problem		X

Table 6.21A Chemistry Research enhancing teaching and learning

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Of course it is important	X			X	X
Only long-term	X				
At university level: very important		X			
A good teacher conducts research		X	X	X	
Stay updated in the field to teach new concepts		X	X	X	X

Table 6.21C Chemical Engineering research enhancing teaching and learning

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Yes for sure	X	X	X	X	X	X
Explain better	X				X	X
Easily give examples in teaching	X	X	X	X	X	X
Research is fundamental for teaching and vice versa		X	X	X		X
Keep up to date		X	X			
Important when teaching masters level			X	X		
Young research field: conference discussions			X			
My research different from what I teach		X				X

Table 6.22A Chemistry research output improving student development and success

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
It did not	X				
Graduates get good positions based on research conducted in my lab		X		X	X
My Scientific methods is critical in data			X		
Companies ask me for young chemists due to my reputation				X	
Students started spin-off				X	

Table 6.22C Chemical Engineering research output improving student development and success

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
By teaching students to apply the fundamentals to improve their research	X				X	X
Students doing research in my lab is good for their development and success		X	X		X	
Students get good positions all over the world through my research networks			X	X		

Table 6.23A Chemistry research output contributing to community engagement

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
No / No opinion	X			X	
Sometimes		X			
Methodology can be appealing to community: Eg NASA		X			
I hope so			X		X

Table 6.23C Chemical Engineering research output contributing to community engagement

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Yes definitely	X			X		X
Teaching programmes for firefighters	X					
Not much		X	X			
Basic research		X				
Industry related			X			
My ultimate research goal is protect community				X		X
Maybe					X	

6.4.6 Competencies for conducting research

Table 6.24A Additional research assistance needed from the library or faculty librarian by Chemistry researchers

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
None	X			X	
Real-time free ILL services		X			

Mendeley training			X		
Open Access publishing guidance			X		
Database training			X		
Librarians in other departments for information provision on financial /business science					X

Table 6.24B Additional research assistance needed from the library or faculty librarian by Chemistry PhD students

Theme	UNICS1	UNICS2	UNICS3
Public dissemination	X		
IL training for PhD students		X	
Discovering databases through my supervisor		X	
Now No need			X

Table 6.24C Additional research assistance needed from the library or faculty librarian by Chemical Engineering researchers

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Referencing: Mendeley training	X					
My research is too technical	X					
I can't expect the library/librarian to assist in other stages of my research	X	X				
Librarian staff capacity is limited		X				
Aware of librarians running workshops for PhD students and young researchers		X				
IL training for my students			X			
No				X		
Librarian could assist academics in teaching with technology					X	
Proofreading perhaps						X

Table 6.24D Additional research assistance needed from the library or faculty librarian by Chemical Engineering PhD students

Theme	UNICES1	UNICES2
Access to Chemistry information resources	X	
Researchers should be independent of librarians		X

Table 6.25A Local and international collaboration between Chemistry researchers in the Chemistry field

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Yes	X				
Meetings/ Conferences	X	X	X		
Email	X	X			
Through the literature	X		X		
Collaborative research publications		X			X
University websites			X		
No				X	
Shared knowledge					X

Table 6.25B Local and international collaboration between researchers and Chemistry PhD students in the Chemistry field

Theme	UNICS1	UNICS2	UNICS3
Through my supervisor	X	X	X
International Exchange student group		X	
Through conferences			X

Table 6.25C Local and international collaboration between researchers in the Chemical Engineering field

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Locally	X		X	X		
Conferences	X	X	X		X	X
Email	X		X			
Club dropbox	X					
Through colleagues	X	X		X	X	X
Locally and International		X			X	X
CNR		X				
Visiting professors presenting seminars in Bologna		X				
Telephone			X			
Personal meetings			X			
Through my supervisor						X

Table 6.25D Local and international collaboration between researchers and Chemical Engineering PhD students in the Chemical Engineering field

Theme	UNICES1	UNICES2
Yes	X	X
Through my supervisor	X	
Conference		X

Table 6.26A Information provision on Chemistry researchers' research

Theme	UNIL1	UNIL2	UNIL3	UNIL4	UNIL5
By myself: accessing scientific publications	X	X	X	X	

ARIC		X			
Scientists working on the project: collaborators			X		X
Sometimes I ask the librarian				X	

Table 6.26B Information provision on Chemistry PhD students' research

Theme	UNICS1	UNICS2	UNICS3
By myself through journals	X		X
Co-workers / PhD peers	X	X	
My supervisor		X	
Librarian		X	
Information resources		X	

Table 6.26C Information provision on the Chemical Engineering researchers' research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Do it myself	X	X		X		X
Ask colleagues /researchers	X		X		X	
Ask librarian for information resources	X	X	X			

Table 6.26D Information provision on the Chemical Engineering PhD students' research

Theme	UNICES1	UNICES2
My professor	X	
PhD students	X	
Librarian	X	

No comment		X

6.4.7 Rating library research support services

Table 6.27A How Chemistry researchers benefit from the library in their research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Rarely ask librarians' support for publications	X				
Electronic resources only		X			X
If I had more time, I would enjoy browsing journal issues /books			X	X	
Using keywords to retrieve online journal articles are both an advantage and disadvantage			X		
Each discipline has a different opinion and experience			X		
Use the library as support to retrieve documents				X	

Table 6.27B How Chemistry PhD students benefit from the library in their research

Theme	UNICS1	UNICS2	UNICS3
Virtual library is very important	X		X
I don't visit the physical library that often	X		
I use the library to consult printed books		X	

Table 6.27C How Chemical Engineering researchers benefit from the library in their research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Electronic resources	X	X	X	X	X	X
Books		X		X		
Library resources support my writing		X				
Rely heavily on the library		X	X			

Old papers			X			
NILDE					X	
Library website					X	
Visit the physical library to browse Print collection						X

Table 6.27D How Chemical Engineering PhD students benefit from the library in their research

Theme	UNICES1	UNICES2
Books	X	
ILL	X	
Electronic resources	X	X

Table 6.28A Library resources used by Chemistry researchers for research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Scientific journals	X				X
Chemistry databases		X			X
Electronic resources			X		
Books			X	X	
Standards			X		
Librarian				X	

Table 6.28B Library resources used by Chemistry PhD students for research

Theme	UNICS1	UNICS2	UNICS3
Electronic resources	X	X	X
Books		X	

ScienceDirect, ACS, RSC very important		X	
Other university resources too: exchange student		X	

Table 6.28C Library resources used by Chemical Engineering researchers for research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Subject specific databases	X			X		
Standards	X				X	
ScienceDirect	X			X		
Scopus	X				X	
Books		X	X			X
Electronic resources		X	X			X
Engineering Village				X		

Table 6.28D Library resources used by Chemical Engineering PhD students for research

Theme	UNICES1	UNICES2
Books	X	
NILDE	X	
Electronic resources	X	
Scopus		X
ScienceDirect		X

Table 6.29A Resources mainly accessed from the library website by Chemistry researchers for research

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
None	X				
Articles		X			
Books		X			
Free downloads/ Databases/ e-journals/ e-books		X	X		
Scopus			X		X
Bibliometric queries			X		
Browsing printed journal issues /books				X	
Use the library as support to retrieve documents				X	
SciFinder					X

Table 6.29B Resources mainly accessed from the library by Chemistry PhD students for research

Theme	UNICS1	UNICS2	UNICS3
Articles mainly	X	X	
Old documents	X		
Books / e-books		X	
Electronic resources			X

Table 6.29C Resources mainly accessed from the library website by Chemical Engineering researchers for research

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
ScienceDirect	X			X		
Scopus	X	X			X	X
Web of Science	X	X				
Standards	X			X	X	

Catalogue	X	X				
Google Scholar		X				
Engineering Village		X		X		X
Elsevier		X				
ACS		X				
Wiley		X				
Electronic resources			X	X		
Dictionaries			X			
books			X			

Table 6.29D Resources mainly accessed from the library by Chemical Engineering PhD students for research

Theme	UNICES1	UNICES2
Electronic resources	X	
Attend database and referencing training	X	
Search engines		X

Table 6.30A Library services and facilities used for research in the past year by Chemistry researchers

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
Used library's e-resources (e-books, online journals, databases etc.)	X	X	X	X	X
Library's Inter-Library Loan & document delivery services	X		X	X	
Borrowed library's print resources			X	X	X
Faculty librarian's reference / information services			X		X
Used the library's quiet study area or Research Commons or computer lab			X		
Attended a training workshop on e-resources or databases	0	0	0	0	0

Table 6.30B Library services and facilities used for research in the past year by Chemistry PhD students

Theme	UNICS1	UNICS2	UNICS3
Used library's e-resources (e-books, online journals, databases etc.)	**X**	**X**	**X**
Borrowed library's print resources	**X**	**X**	
Used the library's quiet study area or Research Commons or computer lab		**X**	
Faculty librarian's reference / information services		**X**	
Library's Inter-Library Loan & document delivery services	**0**	**0**	**0**
Attended a training workshop on e-resources or databases	**0**	**0**	**0**

Table 6.30C Library services and facilities used for research in the past year by Chemical Engineering researchers

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Used library's e-resources (e-books, online journals, databases etc.)	**X**	**X**	**X**	**X**	**X**	**X**
Library's Inter-Library Loan & document delivery services		**X**	**X**	**X**	**X**	**X**
Borrowed library's print resources	**X**	**X**	**X**	**X**	**X**	**X**
Faculty librarian's reference / information services	**X**	**X**	**X**	**X**		**X**
Used the library's quiet study area or Research Commons or computer lab					**X**	
Attended a training workshop on e-resources or databases	**0**	**0**	**0**	**0**	**0**	**0**

Table 6.30D Library services and facilities used for research in the past year by Chemical Engineering PhD students

Theme	UNICES1	UNICES2
Used library's e-resources (e-books, online journals, databases etc.)	**X**	**X**
Borrowed library's print resources	**X**	
Library's Inter-Library Loan & document delivery services	**X**	
Attended a training workshop on e-resources or databases	**X**	
Used the library's quiet study area or Research Commons or computer lab	**0**	**0**

Faculty librarian's reference / information services	**X**	**0**

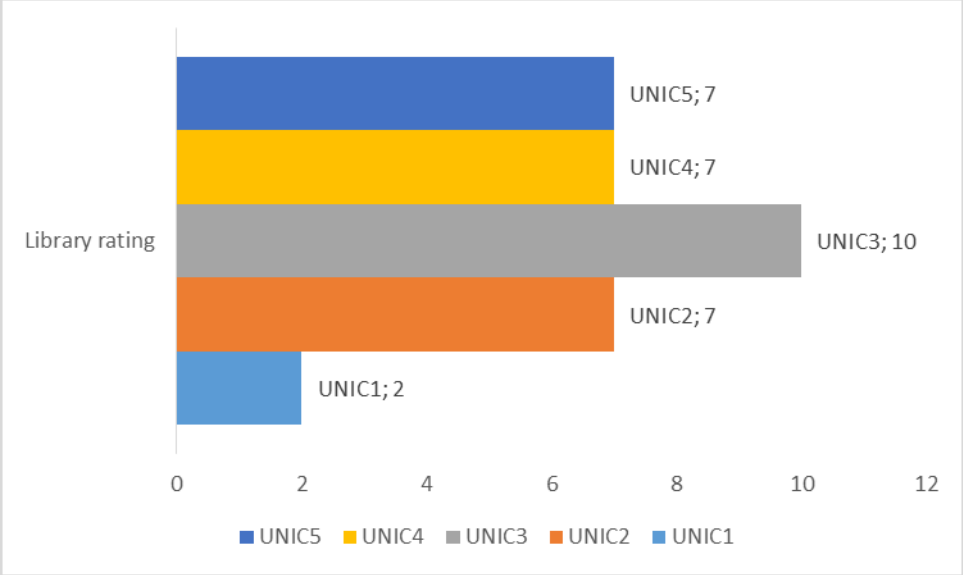

Figure 6.4A Library rating for research by Chemistry researchers

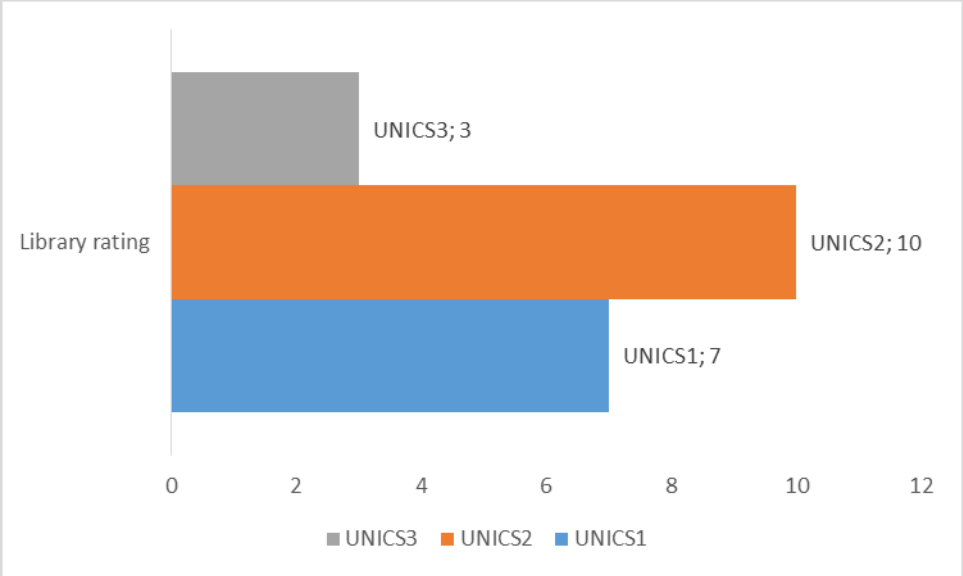

Figure 6.4B Library rating for research by Chemistry PhD students

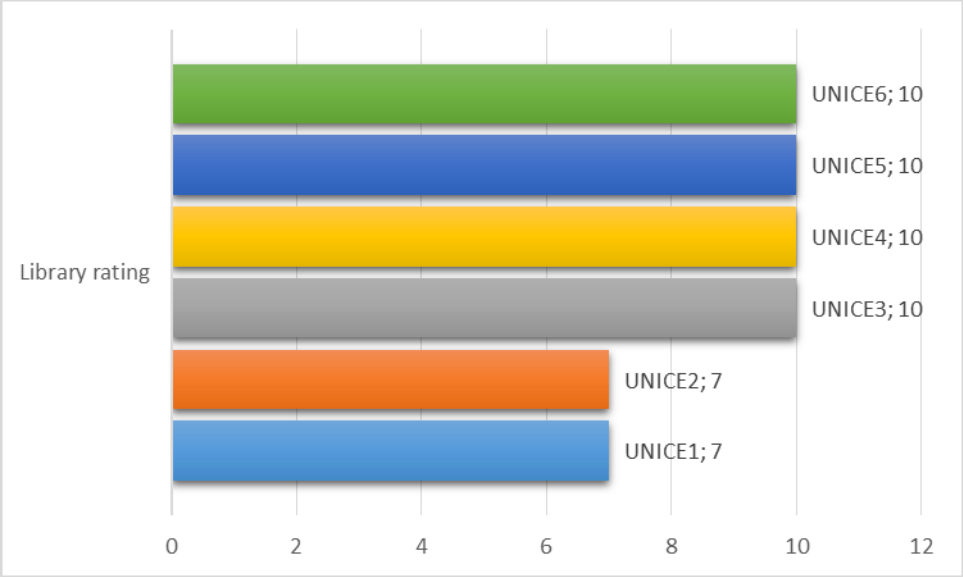

Figure 6.4C Library rating for research by Chemical Engineering researchers

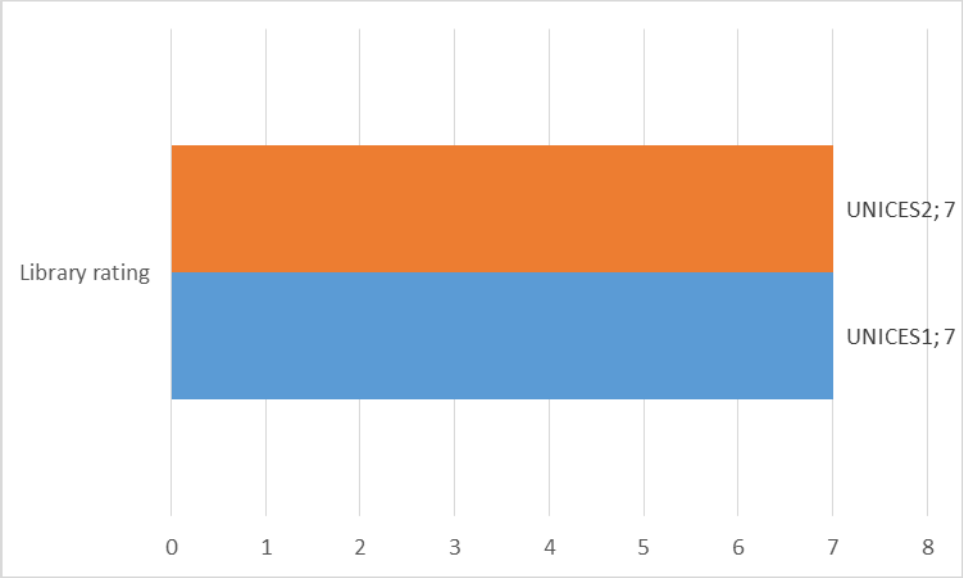

Figure 6.4D Library rating for research by Chemical Engineering PhD students

Table 6.31A Possible research support services prioritised by Chemistry researchers

Possible Research Support Services	**Score**
Ongoing updates on new information resources	10
Database training	10

Providing a reading list on faculty and students' research topic and providing advice on their literature review	11
Maintaining of research repositories	12
Training on mobile apps for research	12
Advice on Open Access publishing	12
Advice on research proposal writing	13
Advice on bibliographic referencing	13
Advice on Research Data Management	13
Advice on my research topic	14
Training on social media use for research	14
TOTAL	**134**

Table 6.31B Possible research support services prioritised by Chemistry PhD students

Possible Research Support Services	**Score**
Other: "Access to the highest possible number of bibliographic resources" (UNICS1)	1
Advice on research proposal writing	5
Database training	5
Maintaining of research repositories	5
Advice on Research Data Management	5
Ongoing updates on new information resources	6
Advice on bibliographic referencing	6
Providing a reading list on faculty and students' research topic and providing advice on their literature review	7
Training on social media use for research	7
Advice on Open Access publishing	7
Advice on my research topic	8

Training on mobile apps for research	8
TOTAL	**70**

Table 6.31C Possible research support services prioritised by Chemical Engineering researchers

Possible Research Support Services	**Score**
Ongoing updates on new information resources	7
Advice on bibliographic referencing	9
Database training	10
Maintaining of research repositories	10
Advice on Open Access publishing	10
Providing a reading list on faculty and students' research topic and providing advice on their literature review	11
Advice on research proposal writing	11
Advice on Research Data Management	11
Advice on my research topic	13
Training on social media use for research	14
Training on mobile apps for research	15
TOTAL	**121**

Table 6.31D Possible research support services prioritised by Chemical Engineering PhD students

Possible Research Support Services	**Score**
Providing a reading list on faculty and students' research topic and providing advice on their literature review	3
Ongoing updates on new information resources	3
Advice on bibliographic referencing	4
Database training	4

Advice on Research Data Management	4
Maintaining of research repositories	5
Advice on research proposal writing	6
Training on social media use for research	6
Advice on Open Access publishing	6
Advice on my research topic	6
Training on mobile apps for research	6
TOTAL	**53**

6.4.8 Question 40: Likert Scale Statements

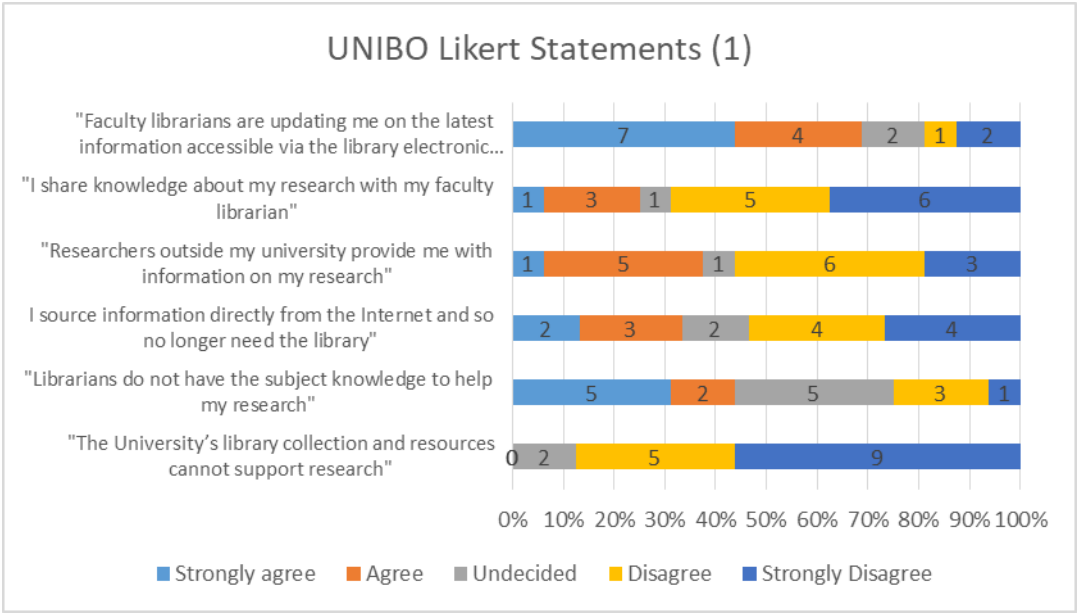

Figure 6.5A Likert statement 1-6

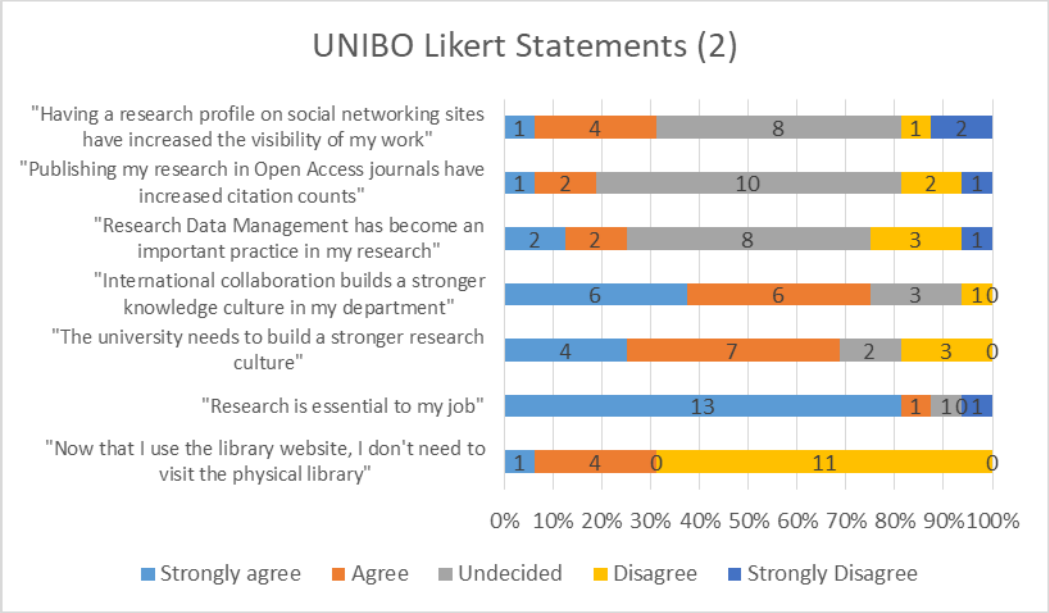

Figure 6.5B Likert statement 7-13

6.4.9 Additional comments by Chemistry and Chemical Engineering researchers and PhD Students

Table 6.32A Additional comments by Chemistry researchers

Theme	UNIC1	UNIC2	UNIC3	UNIC4	UNIC5
None	X				X
Physical library was very important 20 years ago		X			
Difficult to ask a librarian for support: not a qualified chemist		X			
I prefer to ask research office		X			
Library is too general		X			
Difficult times now with electronic resources			X		
I am still attached to the printed book and physical library			X		
Physical library is the best environment to think and gain scientific knowledge			X		
Contact with a librarian is key in research: Library saves time			X		
Lost enthusiasm of research				X	

Not updated with research trends				X	

Table 6.32B Additional comments from Chemistry PhD students

Theme	UNICS1	UNICS2	UNICS3
None	X		X
Positive aspect of the library: providing information resources on academic and personal		X	

Table 6.32C Additional comments by Chemical Engineering researchers

Theme	UNICE1	UNICE2	UNICE3	UNICE4	UNICE5	UNICE6
Evaluation for promotion should be on teaching and other extra activities, not only research	X					
Library services must be promoted more		X				
Need for close contact with postgraduate students		X				X
Need for a better communication tool for the whole university community to share information and best practices		X				
The library and librarian's role cannot be disregarded because of electronic resources			X			
Satisfied with the library services				X		
Library can assist in the beginning stages through workshops and training					X	X
ILL logistics needs improving						X
Support with bibliometric reports						

Table 6.32D Additional comments from PhD students

Theme	UNICES1	UNICES2
Opened my mind to possible collaboration with the librarian	X	
No comment		X

11 Appendix B: Data analysis of CPUT (Chapter 7)

7.3 CPUT Librarians

7.3.1 Librarians' perception of their role in conducting LIS research and supporting research

Table 7.1 The role of the librarian supporting research in chemistry and chemical engineering

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Handling queries	X	X			
Database training	X				
Institutional repository – upload theses assistance	X		X		X
Our research function became more important		X			
Reactive-to-proactive Information provision		X			
Young university- developing researchers		X			
Bibliometrics /altmetrics reports: Evaluating research output: lecturer promotion process assistance		X		X	X
Ensuring researcher visibility through ORCID IDs /Scopus promotion		X	X	X	X
Proactive research support		X			
Librarians in a learning process – new practices		X			
Engaging with all stakeholders		X			
Branch librarian		X			
Big role				X	X
Grant proposal assistance				X	
Current awareness				X	
Information literacy training				X	X
Collection development					X
Publishing assistance: Open Access guidance					X
Copyright guidance					X

Provide Individual training					**X**

Table 7.2 Current work and changes in research support practices

Theme	**CPUL1**	**CPUL2**	**CPUL3**	**CPUL4**	**CPUL5**
Current awareness sessions on library resources for research	**X**				
More interactive than before	**X**				
Promotion of services increased	**X**				
Individual training increased : in researchers' space/office	**X**			**X**	
Providing a more proactive service		**X**			
Recently introduced postgraduate studies in the department		**X**			
Most recent research support services are Bibliometric and Altmetric		**X**			
Evaluating research output		**X**	**X**	**X**	
Ensure Research visibility on the web- ORCID, Scopus, PoP, ResearchGate		**X**	**X**	**X**	
Work strategically		**X**			
Assist with lecturer promotion processes			**X**		
Institutional repository – upload theses assistance			**X**	**X**	
Importance of librarians supporting research realised			**X**	**X**	
Drastic change in how we support research			**X**	**X**	**X**
Workshops on new developments in research				**X**	
Return on Investment				**X**	
Open Access policy in place				**X**	
Keep up to date with new trends					**X**

Information literacy training					X
Disseminating information					X
Advocacy					X

7.3.2 Researchers' perception of the librarians' role in supporting research: from the librarians' point of view

Table 7.3 Librarians' experience of supporting faculty and PhD students' research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Working relationship improved	X				
How librarians promote themselves and services makes the difference	X	X		X	X
Faculty open to librarian supporting research		X	X		
Clarify librarian role- research partner		X			X
Information specialist		X			
Students are lazy-my perception			X		
Faculty recognise librarians' support: Faculty have positive attitude			X	X	X
Personal gratification expressed by students after graduation				X	
IL training lead to quality work from students				X	
Librarians speak their 'research language'					X

Table 7.4 Librarians' support benefitting research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
The knowledge that they can come to us for help	X				
Pivotal role – save them time	X	X			
Provide guidance / support	X	X			

User appreciation		X			
Receive positive feedback from faculty			X		
Information Literacy training: Students' work improved- referencing / search strategies			X	X	
Librarian support reflected in research report- updating researcher profiles					X

7.3.3 Technology trends in communication and supporting research

Table 7.5 Librarian profile and visibility on the web

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Physical visibility more effective at this small campus	X	X			
No feedback on visibility on library website	X				
Visibility on Libguide more prominent	X				
Challenging		X			
Librarian role not understood		X			
Market ourselves properly to faculty		X			
Faculty not interested if something takes up their time		X			
Value of librarians supporting research needs to be realised		X	X		
It is actually nice: feel great			X	X	
Librarians' profession recognised through web profile			X		
Faculty take my work seriously			X		
Market ourselves properly to faculty			X		
I try my best					X

Table 7.6 Social media / Web 2.0 tools used to support research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
None	X				
Academia.edu		X		X	
ResearchGate		X	X		X
Mendeley		X	X	X	X
Facebook			X	X	X
LinkedIn			X	X	X
Twitter			X		
Google+ / Calendar / Drive			X		X
WhatsApp			X	X	
LOOP: Similar to ResearchGate ["the first research network available for integration into all journals and academic websites" (LOOP, 2017)]					X
Libguides					X

Table 7.7 The use of social media to enhance research practices

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Not sure about social media for research purposes	X				
Mendeley is a good tool for researchers	X				X
Collaboration		X	X	X	X
Accessibility of information		X	X	X	X
Improves visibility of researchers		X	X	X	X
Increased consultation: handling online queries through ResearchGate			X	X	

Improves services				X	
Build networks with experts					X

Table 7.8 Librarians communicating with faculty about research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Literature searches	X		X	X	
Aware of researcher niche areas	X				
Current awareness		X	X		
Setting up alerts – research updates		X	X		
Staff capacity challenges		X			
Evaluating research- research profiles, Bibliometrics /altmetrics / ORCID					X

Table 7.9 Mode of communication between librarians, faculty and students

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Email	X		X	X	X
Face-to-face	X	X	X		X
Telephone			X	X	
Departmental listservs / meetings /faculty board		X			X
Blackboard		X			X
WhatsApp		X	X		
Libguides		X			
Academia.edu				X	
Department's Facebook page					X

Table 7.10 Librarian being a contact on researchers' social networking sites

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
I don't have a problem	X	X			X
Broadens my knowledge	X		X		
It is fine/ a good thing			X	X	
Quicker way of contacting me			X		
As long as it is work/research-related				X	
I should be visible to support wherever					X

7.3.4 Librarian-faculty collaboration in research

Table 7.11 Librarians and researchers working together to improve library research services

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Good idea	X		X	X	
Library embedded in research	X				
Very important		X			
Library core business – support university		X	X		
Authoritative partner		X			
Good to collaborate-work together			X		X
We need to listen to their needs				X	
Important to know my clients				X	X

Table 7.12 Librarian-faculty-student collaboration to improve library research support services

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Library matters /Resources	X			X	
In the process of doing that		X			
Liaison with faculty on thesis submission process		X			
Not currently: Work overload			X		
Previous collaboration was very successful			X		
IL-team teaching					X
Run research workshops with postgraduates					X

Table 7.13 Librarians discussing library matters and ideas with faculty and students

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Departmental meetings	X			X	
Advice on databases			X		
Shared Chemistry free titles with faculty					X

7.3.5 Librarian collaboration in LIS research and Library Association

Table 7.14 The role of the library association in research support

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
At the moment I can't say	X		X		
An active role in librarian profession: HELIG (Higher Education Libraries Interest Group)		X		X	X
Create awareness		X		X	X
Webinars/Workshops		X		X	X

Research Academy		X			
Research support modules added to curriculum in library schools		X			
I need to be informed about LIASA: I have no interest			X		
Lots of support				X	X
Share best practices					X

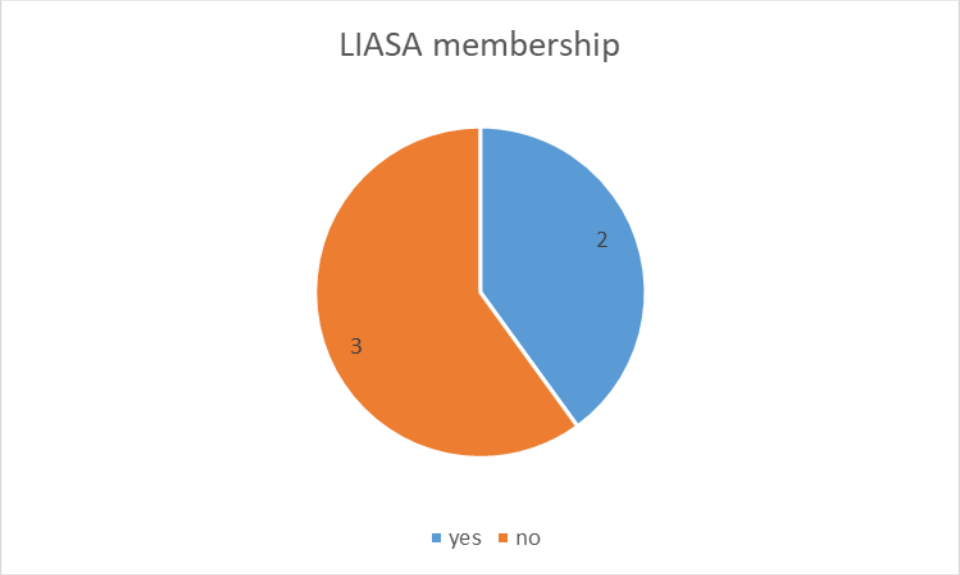

Figure 7.1 LIASA Library Association membership

Table 7.15 Librarians conducting research to improve research support services

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Understand research process	X	X	X	X	X
Stay up to date	X	X	X	X	X
Become research partner in faculty		X			

Find time to do research		X		X	
We are information specialists				X	

Table 7.16 Librarian -librarian collaboration to support research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
collaborating with colleagues internally	X				
we are thinking about it				X	
None			X	X	
through social media: share best practices					X

7.3.6 Academic library trends in supporting research (OA, OS, RDM)

Table 7.17 Advantages and disadvantages of Open Access publishing

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Good for the researcher	X	X			
Increase researcher visibility	X	X	X	X	X
Free access to information	X	X	X	X	X
I Only see the benefits	X		X		
I advise lecturers on OA journals	X				
Having your work out there	X				
OA publishing stigma: Researchers concerned about reputability of OA journals and work being stolen		X			
Author fees - expensive			X	X	X
Some don't want their work to be reproduced			X		

Hybrid journals –author and library pay high costs					X
Constant debate on handling OA publishing					X
Definitely more advantages than disadvantages		X	X		
Open Access publishing saves subscription costs		X			
Measures in place to protect work		X			
Higher citations, higher ratings, High impact journals part of OA movement		X	X	X	
Library encourage publishing in institutional repository				X	
Benefit to society					X
Solution: Open Journal System					X

Table 7.18 Promoting Open Access to university community

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
I'm not sure	X				
When researchers request assistance	X				X
Still new, we are still learning		X			
Open Access projects: Recommend Open Content		X			
Open Access Movement is a mind-shift		X			
Promote the institutional repository: At faculty board /departmental meetings			X	X	X
Libguides					X
Individual meetings					X

Table 7.19 Knowledge, perception and experience of Open Science

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Good to know what is happening in the world	X				
Risk of work being stolen before publishing	X				
SciVal / Scopus-good collaborative research practice		X			
Avoid re-inventing the wheel		X			
Competition – competitive advantage		X			
I am not familiar with this practice			X	X	
Protected work					X

Table 7.20 Library's role in promoting Open Science

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
I am really not sure	X		X	X	X
Linking researchers with collaborators		X			
Step one in opening up the world		X			
Librarians are on the web all the time		X			

Table 7.21 Research Data Management and the role in research support

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Topic for further discussion	X				
The library busy with a RDM project	X	X	X		
RDM is a hot topic for librarians at the moment		X			
A buzzword		X			
A policy in place- RDM plan to be included in proposal		X			
Not actively engaged at the moment – work in progress		X			

Librarians expected to be involved in RDM from January 2017		X			
Librarians play a Pivotal role in RDM		X			
Researchers are concerned about data security			X	X	X
Librarians are attending workshops			X	X	
It is still new				X	
Good research practice				X	X
Data protection mechanisms					X
Increase research production					X

Table 7.22 Library assisting with managing research data

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Not a bad idea	X				
Other stakeholders-Postgraduate support unit /research directorate	X	X	X	X	
Library Not to take full responsibility		X	X	X	
Clarify role- assist RDM		X			
Not really / certain			X	X	
Collaborate				X	
We need to, but is still new					X
Library need to step up					X

7.3.7 Rating of academic library research support services

Table 7.23 Librarians' satisfaction with the library function

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Huge improvement	X				
Librarian and faculty collaboration improved	X			X	
When compared with other units: yes		X			
Room for improvement		X		X	X
Still more reactive than proactive		X			
No management support to implement new activities			X		
Heavy workload: Few librarians					X

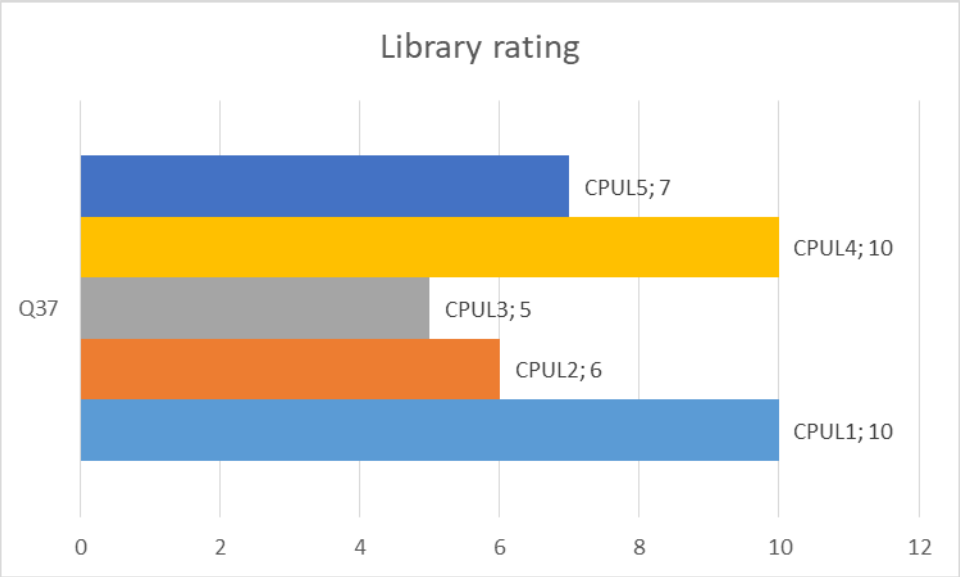

Figure 7.2 Library rating for research

Table 7.24 Library resources mainly used by faculty and students for research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Still Rely on Print books	X	X			
Electronic resources	X				X
Online Maritime Journals	X				
Google scholar		X	X		
LibGuides		X			
ScienceDirect		X			
Scopus		X			
Sage Research Methods		X		X	
EBSCO			X		
IEEE Explorer				X	
Books 24x7				X	
CHEM SPIDER					X
RSC [Royal Society of Chemistry]					X

Table 7.25 Research support services offered in the past year

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Information Literacy Training	X		X	X	
Bibliometrics /Altmetrics		X			
Advanced Information Literacy		X			X
Mendeley		X		X	X
Searching originality of research			X		
Assistance with Turnitin and SafeAssign			X		
Academic writing support.			X		

Institutional repository- create researcher profiles /self-archiving				X	X
Copyright guidance					X
Licenses for protecting work					X
Databases / e-journal subscriptions					X

Table 7.26 Library resources promoted for research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
ScienceDirect	X				
EBSCO	X				
Libguides	X	X			
Accredited journal list		X			
Sage Research Methods database		X		X	
institutional repository: DK [Digital Knowledge]			X		X
Electronic resources		X	X	X	
Mendeley			X	X	
Credo Reference database			X	X	
Research methodology books				X	
ORCID/research output/h-index					X

Table 7.27 Possible research support services

Possible Research Support Services	Score
Other	3
Ongoing updates on new information resources	5

Advice on bibliographic referencing	5
Database training	5
Advice on Research Data Management	5
Advice on research proposal writing	6
Maintaining of research repositories	6
Advice on Open Access publishing	6
Providing a reading list on faculty and students' research topic and providing advice on their literature review	7
Advice on their research topic	7
Training on mobile apps for research	8
Training on social media use for research	9
TOTAL	**72**

7.3.8 Competencies for conducting and supporting research

Table 7.28 Further research assistance needed by faculty and students

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Information Literacy training	**X**				
Librarian and faculty collaboration in research process	**X**				
Thesis writing	**X**				
First phase of research assistance		**X**	**X**		
RDM plans		**X**			
Originality of research assistance		**X**			
Publishing research assistance		**X**			

Design research topics			X		
Information Literacy training				X	
Library should assist / train throughout research process					X

Table 7.29 Librarian training needs to support research

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
We can always learn something new	X		X		
Depend on individual	X				
RDM		X		X	X
Publishing processes		X			
Understanding research methods		X	X		
I am still new in this position			X		
The A-Z of research				X	
Librarians have a heavy teaching workload				X	X
Publishing data training					X

7.3.9 Research support in policy building

Table 7.30 Research output / support contributing to university guidelines or procedures

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Current awareness	X			X	
Evaluating research output-increased visibility		X			
Promoting institutional repository- Contribute to research image of university		X	X		
Librarians supporting research drive university research in the right direction		X			
Faculty consult librarians for assistance beyond traditional library services		X			

Librarians discussing a solution to link researchers' profiles: Researchers don't want duplicate activities			X		
Presentations at faculty board /departmental meetings – increased database usage statistics				X	
Influences library colleagues- conducting research/ conference presentations					X

Table 7.31 Research support enhancing teaching and learning

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Improves knowledge	X	X			
Knowledge transfer: academic to student	X			X	
Information Literacy training			X	X	
Librarians keeping up to date			X		X
Improves researchers' bibliographic referencing			X		
Saves time			X		
Update researchers on new research trends: Bibliometrics, Altmetrics, RDM			X		X

Table 7.32 Research support improving student development and success

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Current awareness	X			X	
Information Literacy training	X			X	
Update researchers on new research trends: Bibliometrics, Altmetrics, RDM		X			
Motivated students- Higher throughput rate		X	X	X	X
Increase their research visibility			X		X
Student publications					X

Table 7.33 Research support contributing to community engagement

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Not sure / I hope so	X				
Agriculture: extension services provided		X			
Information provision beyond academic, to broader community		X			
Faculty publications uploaded in various platforms / institutional repository: reaches community			X		X
Knowledge gained through librarian easily reach the outside community: Student community engagement projects				X	

7.3.10 Likert scale statements

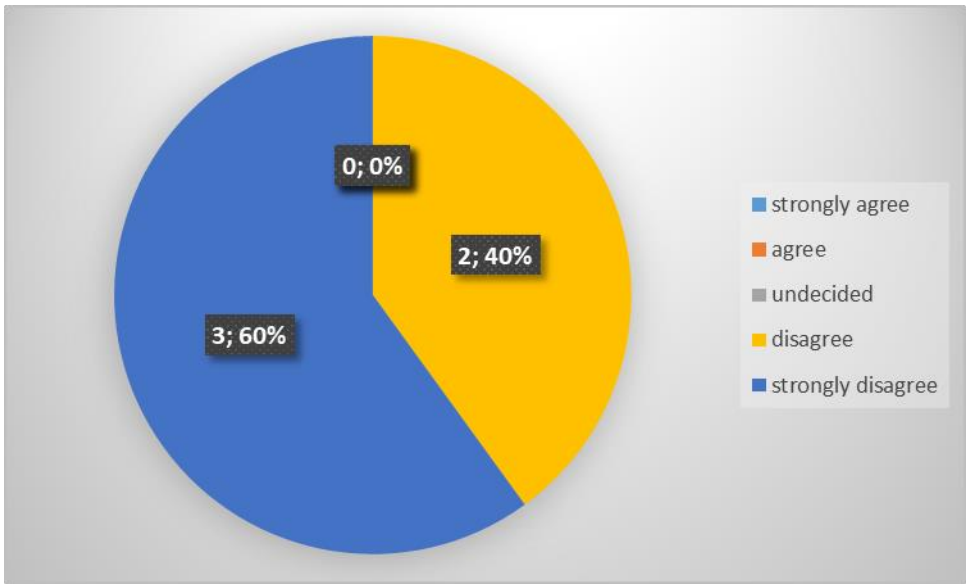

Figure 7.3 "The University's library collection and resources cannot support research"

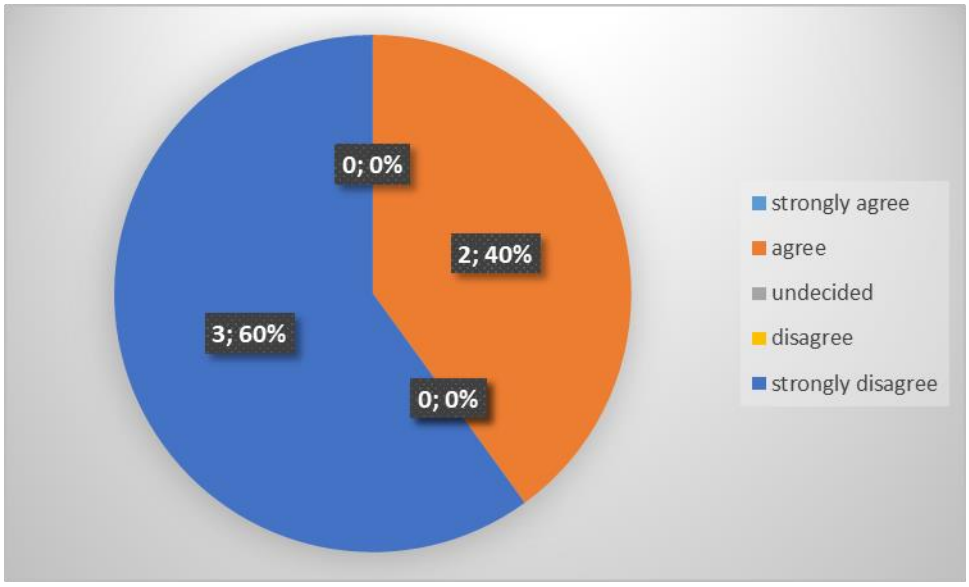

Figure 7.4 "Librarians do not have the subject knowledge to help my research"

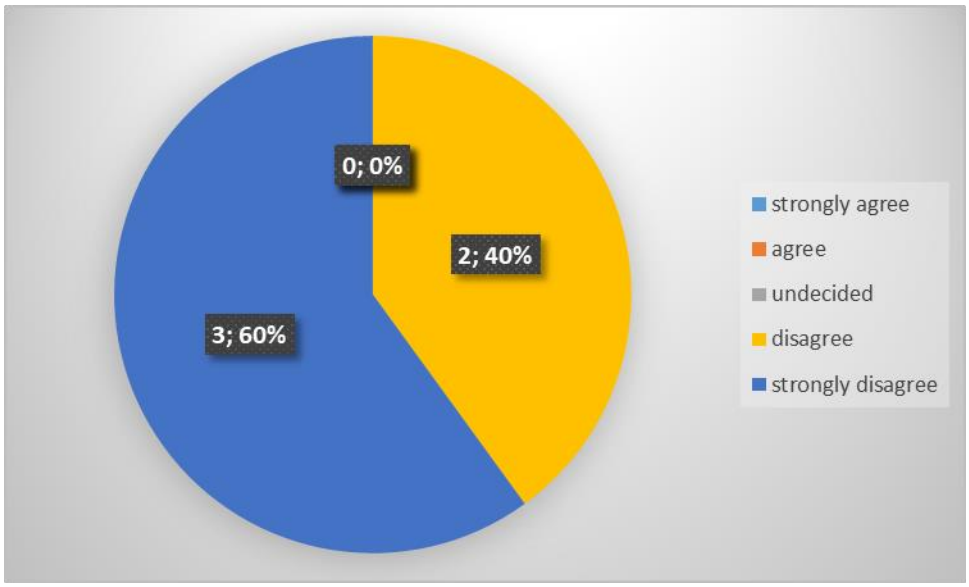

Figure 7.5 "Researchers today no longer need the library"

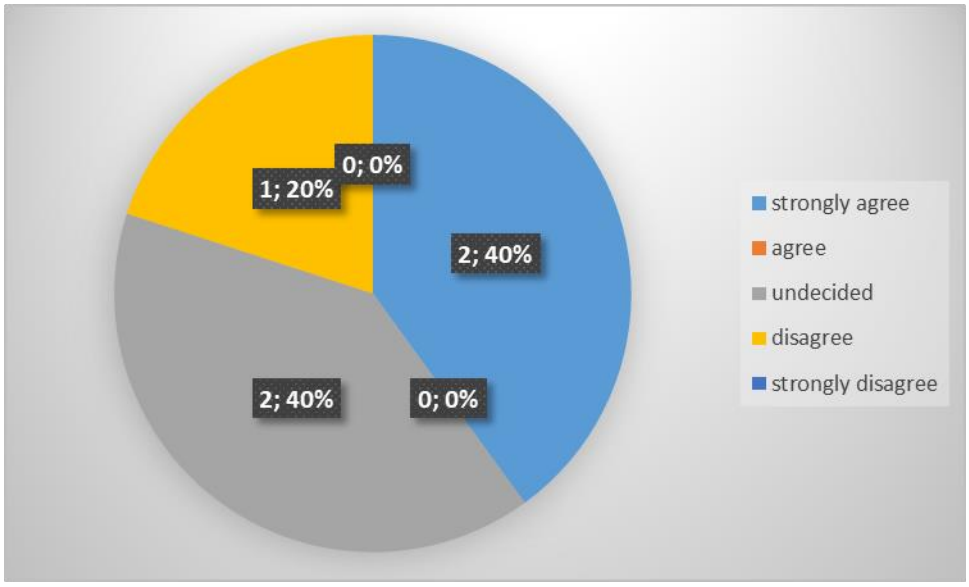

Figure 7.6 "Researchers outside my university provide me with information on my research"

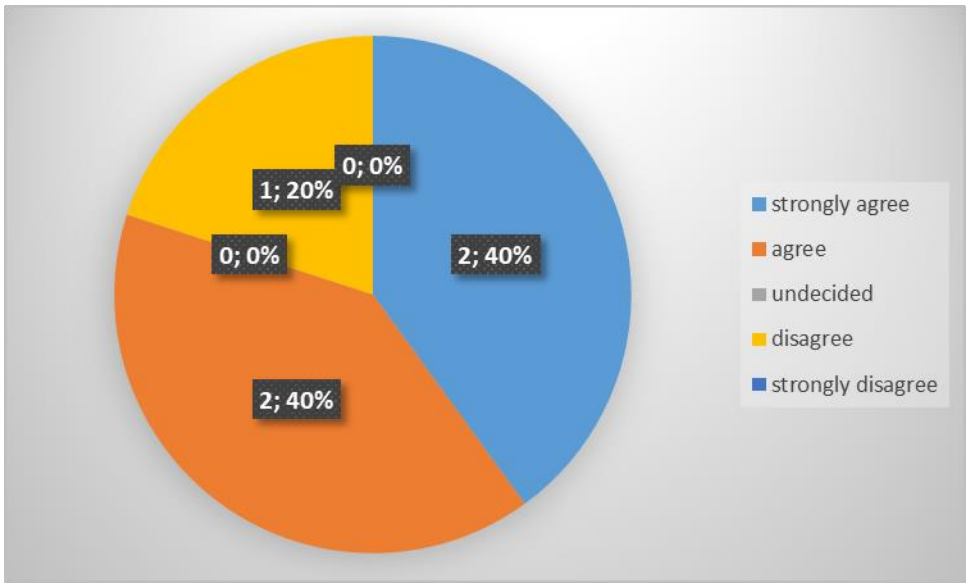

Figure 7.7 "I share knowledge about Chemistry or Chemical Engineering research with researchers"

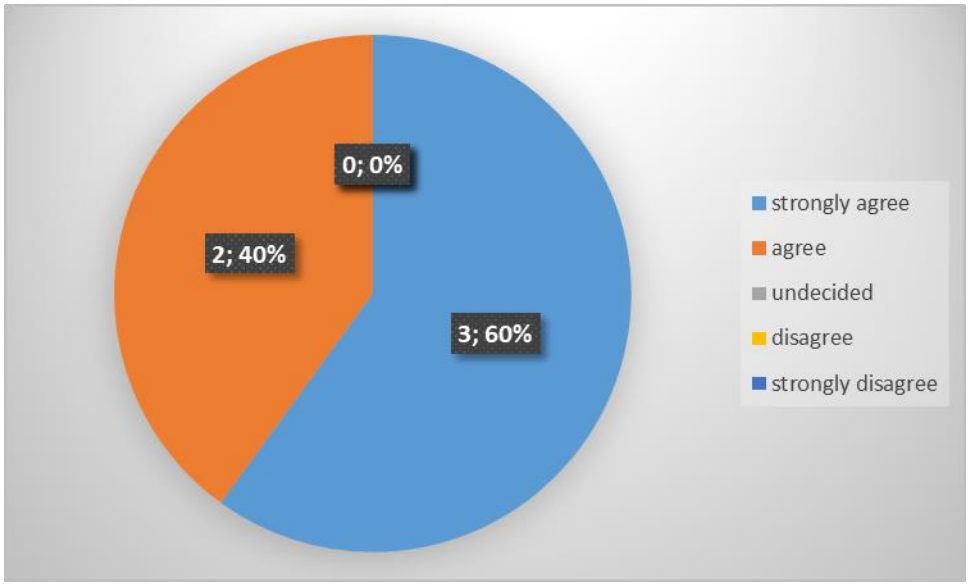

Figure 7.8 "Faculty librarians are updating researchers on the latest information accessible via the library electronic resources for my research"

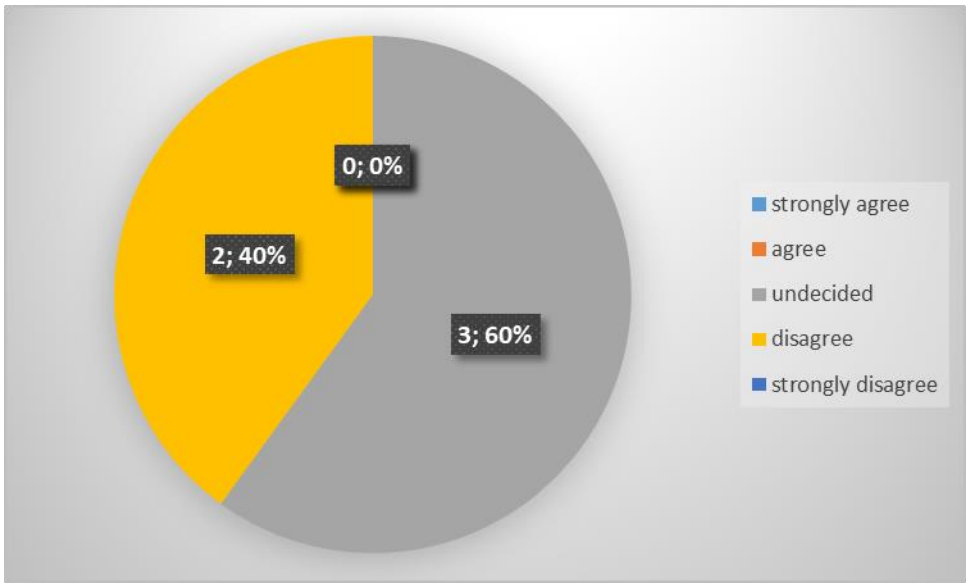

Figure 7.9 "Now that researchers use the library website, they don't need to visit the physical library"

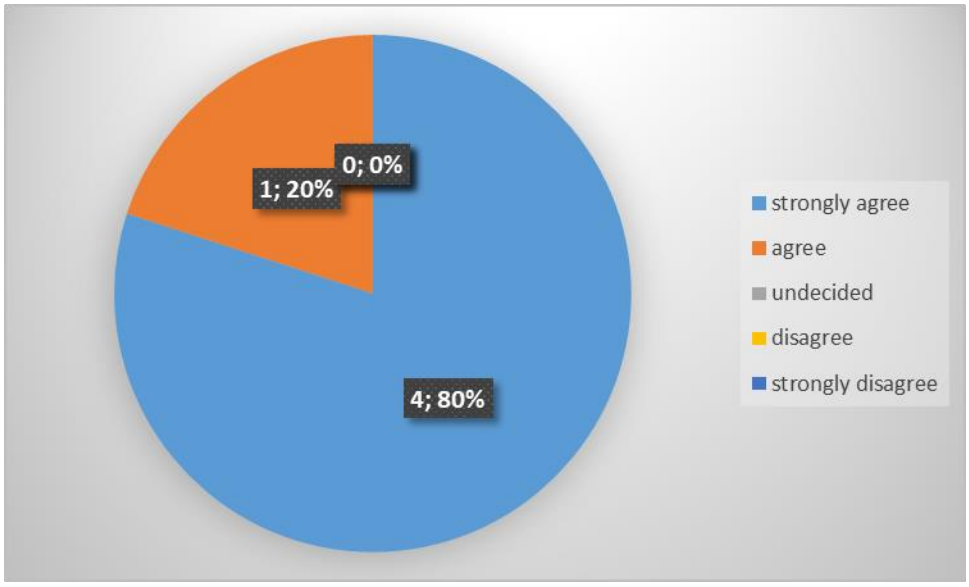

Figure 7.10 "Research is essential to my job"

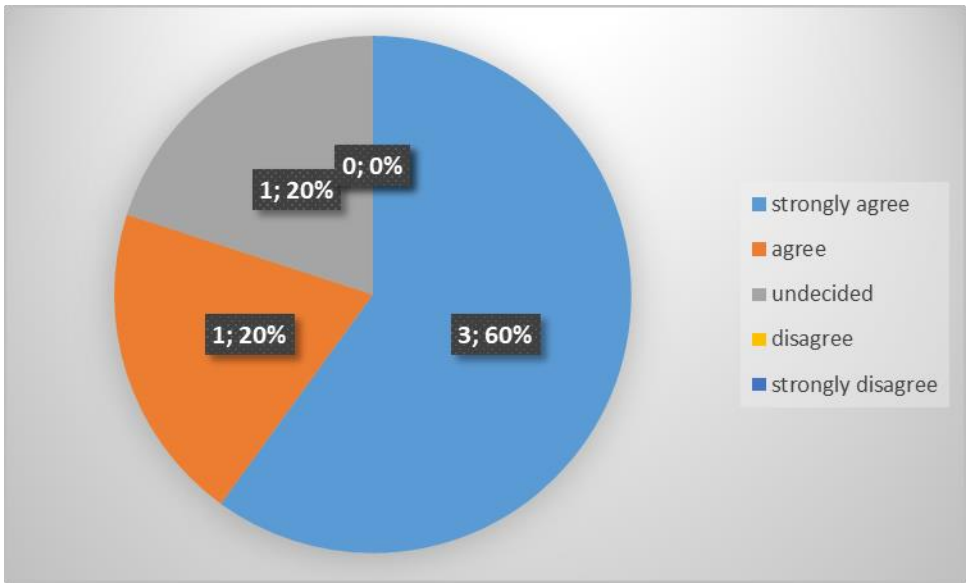

Figure 7.11 "The university needs to build a stronger research culture"

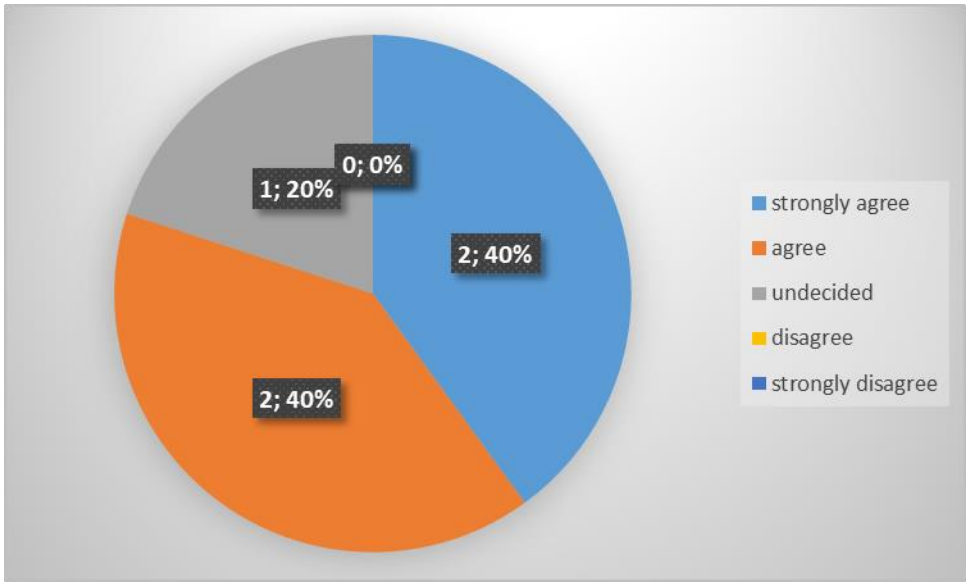

Figure 7.12 "International collaboration builds a stronger knowledge culture in the library"

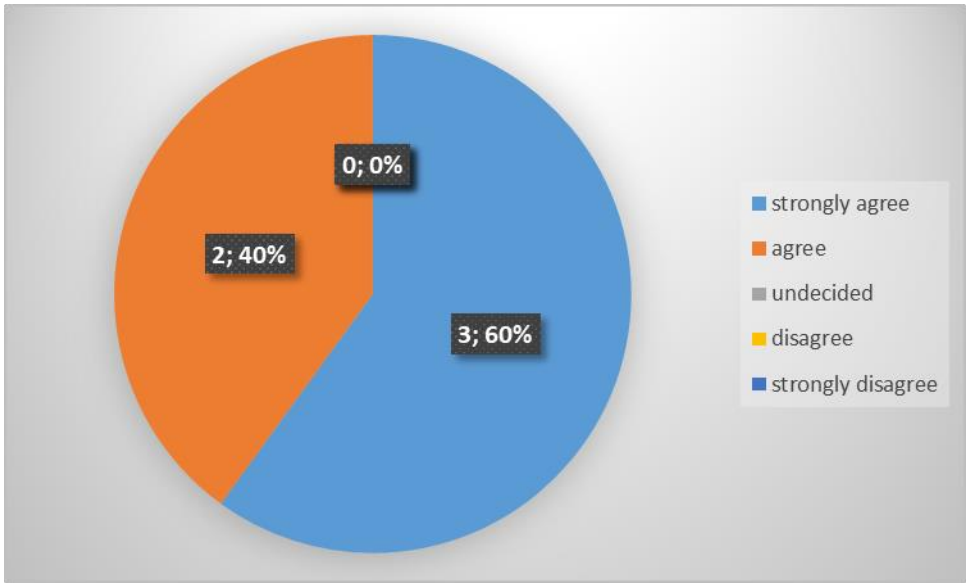

Figure 7.13 "Research Data Management has become an important practice in supporting research"

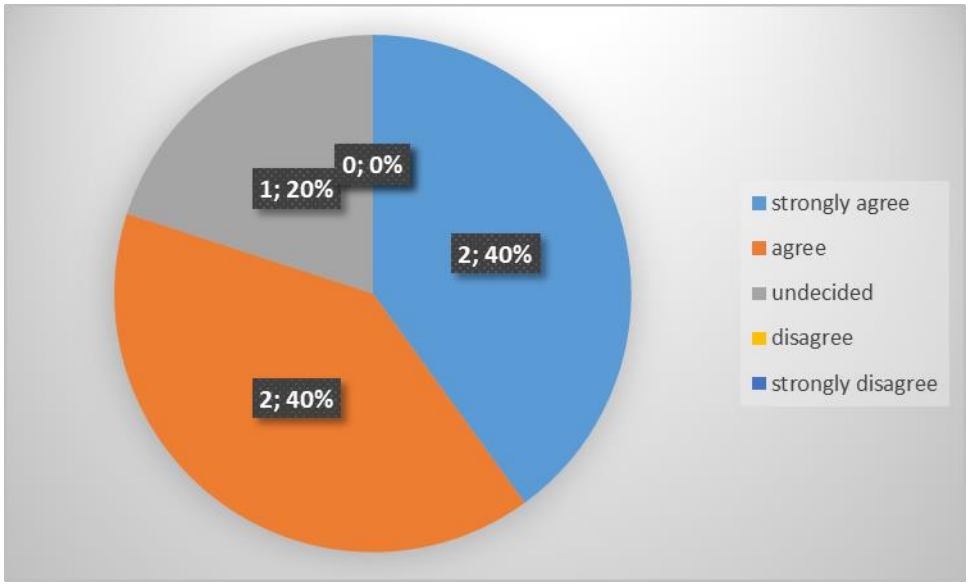

Figure 7.14 "Publishing research in Open Access journals have increased citation counts"

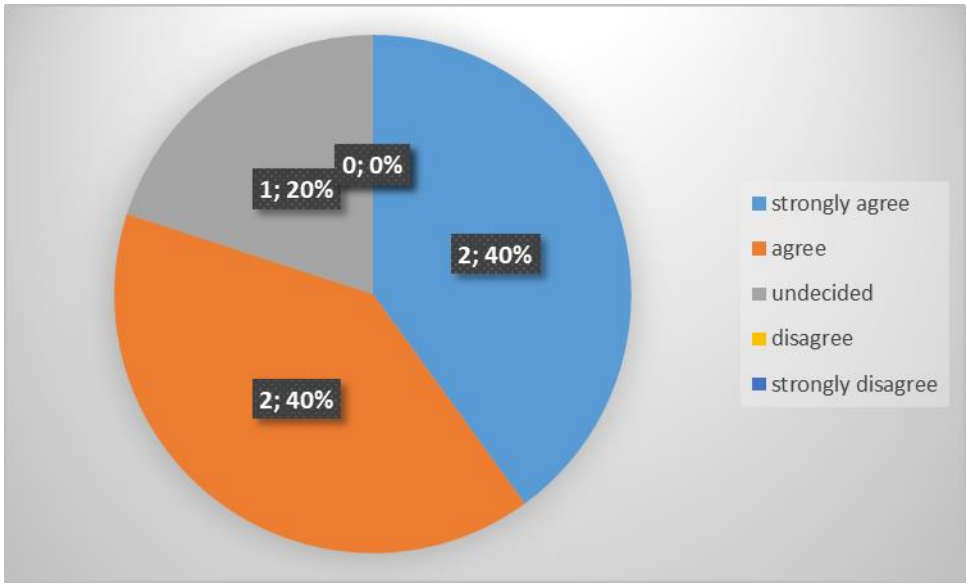

Figure 7.15 "Having a research profile on social networking sites have increased the visibility of my work"

7.3.11 Additional Comments by faculty librarians

Table 7.34 Additional comments from librarians

Theme	CPUL1	CPUL2	CPUL3	CPUL4	CPUL5
Library should be embedded in departments	X				
Important to show the value libraries have	X				
Timing is good [of this interview]		X			
Role clarification of librarian is important		X			
On track with research support		X			
Looking at RDM platform		X			
Library taking the initiative in research- supporting and partnership in university community		X			
Librarians have too much admin work			X		
Overstepping boundaries is supporting research			X		
Librarian heavy workloads			X		
No management support			X		
No rotation / exposure in library- so much to learn from different library sections			X		
No additional comment				X	
Open Access publishing Open Journal System is the way to go					X

7.4 Perception of Chemistry and Chemical Engineering researchers and PhD students

The tables and figures in this section are organised by themes discussed in Chapter 7 in the following sequence: Chemistry researchers, Chemistry PhD students, Chemical Engineering researchers and Chemical Engineering PhD students.

7.4.1 The role of the researcher as prosumer

Table 7.1A The role of the Chemistry researcher

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Part-time lecturer	X						
PhD studies	X			X		X	
Assist students in lab and research projects	X					X	X
Initially an ordinary researcher		X					
Currently managing a research group: Manage research		X					
Mentor undergraduate and postgraduate students		X				X	
Basically a student			X				
Supervise Btech and Mtech students				X		X	X
Role misunderstood: Two jobs: teach and research					X		
Researcher position					X		
Heavy teaching load					X		
Design and implement research projects							X
Proposal writing guidance							X

Table 7.1B The role of the Chemistry PhD student as researcher

Theme	CPUCS1	CPUCS2
Acquire scientific knowledge	X	
Solve problems	X	
Working with industry	X	
Apply knowledge to real-life situation	X	
Review proposals for Btech and Masters students		X
Train and assist students in lab		X

Table 7.1C The role of the Chemical Engineering researcher

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Recently completed PhD	X				
Co-ordinating research workshops for PhD students	X				
Currently busy with PhD studies		X		X	
Also conduct Research on Teaching with Technology		X			
Supervising student research role			X	X	
Conduct collaborative research with young researchers in the department			X		
Write funding proposals			X		
All staff required to conduct research in the department					X

Table 7.1D The role of the Chemical Engineering PhD student as researcher

Theme	CPUCES1	CPUCES2
Conduct research and contribute to the work within the department	X	
My role is to learn, write reports and present research	X	
My role is focus on my research project		X

Currently in the experimentation phase		X

Table 7.2A Current work and changes in research support practices of Chemistry researchers

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Writing up phase of PhD	X						
Not much has changed	X						
Struggled in the beginning: Now adapted	X						
Tedious previously		X	X				
Spent lots of time in the physical library before		X	X				
Things have changed: Huge technological changes: Everything is readymade		X	X	X	X	X	X
Stay in my office now and access library's electronic resources		X	X				
Different research area now				X			
Try to link lab work with computer programmes				X			
Previously no research funds					X		
Collaborated with other researchers					X		
After becoming a rated researcher I received research funds					X		
Manage research now					X		
Rarely go to the lab anymore					X		
Previously I didn't understand the field, different research area						X	
I developed over the years: I became a critical thinker						X	
Publish high quality work						X	
Draw up a memorandum of understanding with students: Agree on timeframe							X
Monthly student research presentations							X
Heavy teaching load							X

Days assigned for my research							X

Table 7.2B Current work and changes in research support practices of Chemistry PhD students

Theme	CPUCS1	CPUCS2
Lab work	X	
Try to solve problems	X	
Not much changed	X	
Spend time to familiarise myself in my research	X	
Built confidence to put my work out there	X	
My project changed drastically		X
Using different methods: more advanced techniques		X

Table 7.2C Current work and changes in research support practices of Chemical Engineering researchers

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Previously conducted research for the community	X				
After PhD, different view, understand the research process better	X				
More collaborative than individual research	X				
Things are easier now: access to information		X			X
Library played a role in supporting my research		X			X
More independent researcher now		X			
At the start I had limited resources			X		
Now I am established, we can advance in research			X		
Level and content of my research evolved				X	
Previously exploratory				X	

Practice changed in terms of depth in content				X	
Expand my skills				X	

Table 7.2D Current work and changes in research support practices of Chemical Engineering PhD students

Theme	CPUCES1	CPUCES2
Experimentation work in the lab	X	X
Through my exploring and discovery, helped the department grow	X	X

Table 7.3A Chemistry Researchers' profile and visibility on the web

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Not active	X	X					
A good thing	X	X				X	
Helped me get in contact with international researchers		X		X			
I need to update my profile		X					
No web visibility			X	X	X		
Initially against it				X			
High quality work on my profile						X	
Increased citations						X	
Feel authoritative in my field						X	
Very little visibility at the moment: don't want to expose all my work yet							X

Table 7.3B Chemistry PhD students' research profile and visibility on the web

Theme	CPUCS1	CPUCS2
I feel ok / good	X	X
Not doing much updating	X	
My profile viewed many times based on my research		X
Receive local and international collaboration requests		X

Table 7.3C Chemical Engineering Researchers' profile and visibility on the web

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
I am quite happy	X	X		X	X
Give an idea of who is reading my work		X			
Your work is given value		X			
Researchers' visibility poor on the university website			X		
ResearchGate has increased visibility			X		X
Received more contacts for collaboration			X		X
I am quite happy				X	
My visibility is not much				X	
Web of Science visibility				X	

Table 7.3D Chemical Engineering PhD Students' research profile and visibility on the web

Theme	CPUCES1	CPUCES2
An area for improvement: postgraduate student visibility on university website	X	
Good for communication and building networks		X

Table 7.4A Social media / Web 2.0 tools used by Chemistry researchers for research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
LinkedIn	X	X		X	X		X
YouTube	X						
ResearchGate		X		X	X	X	X
None			X				
ORCID ID in process					X		
Google Scholar						X	X

Table 7.4B Social media / Web 2.0 tools used by Chemistry PhD students for research

Theme	CPUCS1	CPUCS2
ResearchGate	X	X
LinkedIn	X	X
Google Scholar	X	
Academia.edu		X

Table 7.4C Social media / Web 2.0 tools used by Chemical Engineering researchers for research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
ResearchGate	X	X	X	X	X
Academia	X		X	X	
PLoS1	X				
LinkedIn			X	X	X

Table 7.4D Social media / Web 2.0 tools used by Chemical Engineering PhD students for research

Theme	CPUCES1	CPUCES2
Not for research	X	
ResearchGate		X
LinkedIn	X	X

Table 7.5A Chemistry researchers' opinion on the use of social media to enhance visibility on the web

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Yes	X	X	X		X	X	
Connect with researchers	X	X			X	X	X
See who is publishing what	X	X			X	X	
See the benefits	X						
Important		X			X	X	
Easy communication: Saves time		X			X	X	
Not a young researcher: Not bothered			X				
To some extent				X			X
Depends on who you are				X			
A bit wary about using social networking sites				X			
Make a contribution by people citing my work: authoritative						X	
Follow research trends						X	
My students refer people there							X

Table 7.5B Chemistry PhD students' opinion on the use of social media to enhance visibility on the web

Theme	CPUCS1	CPUCS2
Yes	X	X
Ability to exchange knowledge		X
Increase post-doc possibility through networks built		X

Table 7.5C Chemical Engineering researchers' opinion on the use of social media to enhance visibility on the web

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Yes	X	X	X	X	X
Good statistics		X			
Receive comments from researchers				X	
Community that helps each other					X

Table 7.5D Chemical Engineering PhD students' opinion on the use of social media to enhance visibility on the web

Theme	CPUCES1	CPUCES2
Yes	X	X
Increase citations		X

Table 7.6A Chemistry researchers' use of social media to enhance research practices

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Not for research purposes	X				X		
Browse platforms once in a while	X						
Mainly use ScienceDirect	X						
Through peer-learning: I can ask advice from others on these platforms		X				X	
Collaborating with researchers			X	X			

Being connected is beneficial			X	X	X		
Discovering publications in my research area				X	X		X
Easy access to information					X		
By following trends						X	
I try to solve my own problems						X	
Compelled to publish							X

Table 7.6B Chemistry PhD students' use of social media to enhance research practices

Theme	CPUCS1	CPUCS2
Marketing tool	X	
Share information and gain information	X	X
Rate myself against other researchers	X	

Table 7.6C Chemical Engineering researchers' use of social media to enhance research practices

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
I wouldn't say improve research practices	X				
Good for visibility of research	X		X		
Direct communication with authors	X		X	X	X
It does through new publication matching		X		X	
Alerts to new developments in my field		X		X	
Advances my research			X		X
Researchers contact me for my publications			X		X
Influences direction of research				X	

Table 7.6D Chemical Engineering PhD students' use of social media to enhance research practices

Theme	CPUCES1	CPUCES2
Through Collaborating or getting in contact with researchers in the same area	X	
Learn from what other researchers are doing	X	X
Improves through people accessing your publications		X

Table7.7A Chemistry researchers' opinion on the librarian being a contact on their SNS for research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Very good idea	X	X					
Easy access to librarian	X						
Not applicable			X	X			
Very important					X		
Librarian already on my profile					X		
That is too much work for the librarian						X	X

Table 7.7B Chemistry PhD students' opinion on the librarian being a contact on their SNS for research

Theme	CPUCS1	CPUCS2
Very important	X	X
Good for sharing and collaboration between librarian and student	X	X

Table7.7C Chemical Engineering researchers' opinion on the librarian being a contact on their SNS for research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
I strongly support that	X	X	X		
It is about visibility		X	X		
Librarian can manage our publications this way			X		
A redundant role				X	

Not practical for librarian to be interested in all our research niche areas					X
Librarian providing information could be useful					X

Table 7.7D Chemical Engineering Students' opinion on the librarian being a contact on their SNS for research

Theme	CPUCES1	CPUCES2
It depends	X	
It could be useful	X	X

7.4.2 Researchers' perception of the role of the librarian supporting research

Table 7.8A Chemistry researchers' experience of the library supporting research and role of the librarian in research support

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Library is trying, providing access to information	X						
I was not aware there was a librarian for support	X						
We cannot function without the library: from print to electronic resources		X					
Faculty librarian's intervention is crucial		X					
Inter-library loans very useful in the past			X				
RISC staff helped me implement Mendeley			X				
Librarian has always been helpful			X	X			
Not used this library much for my research				X			
I use the academic library where I am doing my PhD research and very pleased				X			
Very impressed with the library and librarian support					X		X
Time is the problem in spending the collection budget					X		

Fantastic to access information off campus					X		
I'm not a library person: I prefer owning printed books						X	
But the librarian really helpful in accessing full text articles						X	
Library as space to escape for peaceful writing is good						X	
Library will soon lose its value due to illegal websites like Sci-Hub						X	
Library has supported me well							X
IL training for students							X
Monthly updates on new resources							X

Table 7.8B Chemistry PhD students' experience of the library supporting research and role of the librarian in research support

Theme	CPUCS1	CPUCS2
Library supported me very well with my research	X	
RISC section is fundamental	X	
No interaction with faculty librarian, but with RISC librarian	X	
I had a bad experience with ILL		X
Don't go to the library		X
Institution not equipped to handle postgraduate students		X
No consultation with faculty librarian yet		X

Table 7.8C Chemical Engineering researchers' experience of the library supporting research and role of the librarian in research support

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Library resources are very useful: excellent actually	X			X	
ILL and OA are fundamental	X		X	X	X
Librarian is part of our departmental family	X				X

Good working relationship with the librarian	X		X	X	X
I'm an independent researcher		X			
Only need assistance with new services like ORCID ID registration /bibliometrics report		X	X		
Librarian role is still more for teaching support, not research		X			
Suggest the library website have a space for academics to post their wish list for collection development				X	

Table 7.8D Chemical Engineering PhD students' experience of the library supporting research and role of the librarian in research support

Theme	CPUCES1	CPUCES2
Virtual library is fundamental	X	
Physical space for postgraduate students (RISC) is small	X	
Good library/librarian support	X	
RISC is so important and a great support for postgraduate students		X
ILL services		X

Table 7.9A Chemistry researchers' perception of the librarian's role in supporting research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
I am not sure about research support in terms of data	X						
Sometimes we need support	X						
Librarian should be the link to the world		X					
Librarians have the expertise to access information			X	X		X	X
Librarian is ultimate support					X		
Librarian visibility is crucial					X		
Providing information in due time						X	

Table 7.9B Chemistry PhD students' perception of the librarian's role in supporting research

Theme	CPUCS1	CPUCS2
Librarian presence is critical	X	
Scientific publishing advice	X	
Positive role: collection management		X
Book acquisitions should be based on research output		X

Table 7.9C Chemical Engineering researchers' perception of the librarian's role in supporting research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Librarian play a huge role	X				
We only access the library for information sources	X	X			
Librarian provide us with knowledge about current research developments, beyond information provision	X				X
I already acquired the skill from the librarian		X			
Librarian need to explore new models for electronic books, collection budget should operate on a needs-based model		X			
Librarian is the link between stakeholders, collaborators and access to material outside our subscriptions			X	X	
IL and Quality Assurance is very useful for our students					X

Table 7.9D Chemical Engineering PhD students' perception of the librarian's role in supporting research

Theme	CPUCES1	CPUCES2
Important role	X	
Regular communication and engaging researchers	X	X

Table 7.10A Chemistry researchers communicating about their research with the faculty librarian

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
No	X		X	X	X	X	X
yes		X					

Current awareness		X			X		
Do it myself			X	X			
But my students yes							X
ILL and literature review							X

Table 7.10B Chemistry PhD students communicating with their faculty librarian about their research

Theme	CPUCS1	CPUCS2
Yes	X	
Information provision	X	
Uploading my documents into the institutional repository	X	
No consultation with faculty librarian		X
I think my supervisor is doing that on our behalf		X

Table 7.10C Chemical Engineering researchers communicating about their research with the faculty librarian

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
No				X	
yes	X	X	X		
Open communication	X				
Mainly for teaching		X		X	
Bibliometrics and IL training for students			X		
Book acquisitions				X	
Not on my research					X
Information resources					X

Table 7.10D Chemical Engineering PhD students communicating with the faculty librarian about their research

Theme	CPUCES1	CPUCES2
Seldom	X	
Independent researcher	X	
Yes		X
When needed, for information resources		X

Table 7.11A Faculty librarian involvement in assisting Chemistry researchers with their research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
No	X				X		
In the past yes		X	X	X		X	
My masters students yes				X			X

Table 7.11C Faculty librarian involvement in assisting Chemical Engineering researchers with their research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
No		X			
Yes	X		X	X	X
IL workshops for postgraduate students	X				
Independent researcher		X			
ILL/information resources				X	X
Now I recommend titles to my librarian more than before				X	

Table 7.12A Chemistry researchers' preferred mode of communication with faculty librarian

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
No communication	X						
Email		X		X	X		X
Telephone		X					X
Face-to-face			X	X		X	

Table 7.12B Chemistry PhD students' preferred mode of communication with faculty librarian

Theme	CPUCS1	CPUCS2
Telephone	X	
Email	X	
Face-to-face occasionally	X	
never		X

Table 7.12C Chemical Engineering researchers' preferred mode of communication with faculty librarian

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Email	X		X		X
Face-to-face	X	X		X	X
Departmental meetings	X	X			
Telephone					X

Table 7.12D Chemical Engineering PhD students' preferred mode of communication with faculty librarian

Theme	CPUCES1	CPUCES2
Email	X	X
Face-to-face	X	X

Table 7.13A Librarians and Chemistry researchers working together to improve library research services

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Very important	X	X	X	X	X	X	X
Librarian has the skills	X	X					
Researchers can say what they need	X						
We should work together					X		X
IL training is crucial: add datamining training					X		

Table 7.13B Librarians and Chemistry PhD students working together to improve library research services

Theme	CPUCS1	CPUCS2
Very good idea	X	X
Will lead to librarian knowing what students need	X	X
Important for planning training for students	X	X
Increase RISC space in library will be beneficial		X

Table 7.13C Librarians and Chemical Engineering researchers working together to improve library research services

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
I strongly support that	X	X	X	X	X
It should be happening	X	X			X
Librarian needs to know what the researcher needs and want		X			
Still a communication gap		X			
Especially in RDM				X	
Librarian participating in departmental meeting is crucial					X

Table 7.13D Librarians and Chemical Engineering PhD students working together to improve library research services

Theme	CPUCES1	CPUCES2
Students need to be reminded of the important role the librarian plays in research	X	
Workshops improve communication between students and librarians	X	X

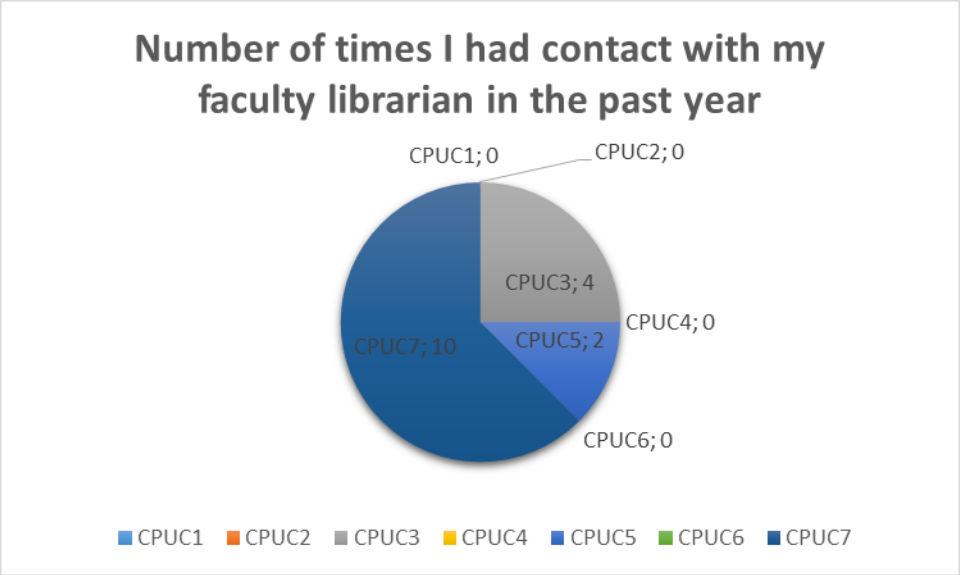

Figure 7.1A Number of times Chemistry researchers had contact with my faculty librarian in the past year

Figure 7.1B Number of times Chemistry PhD students had contact with my faculty librarian in the past year

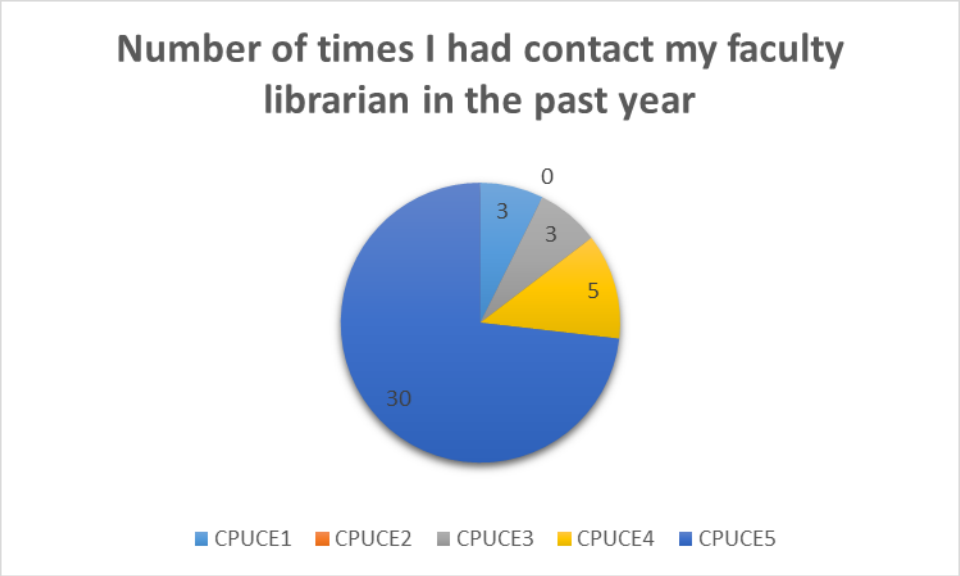

Figure 7.1C Number of times Chemical Engineering researchers had contact with my faculty librarian in the past year

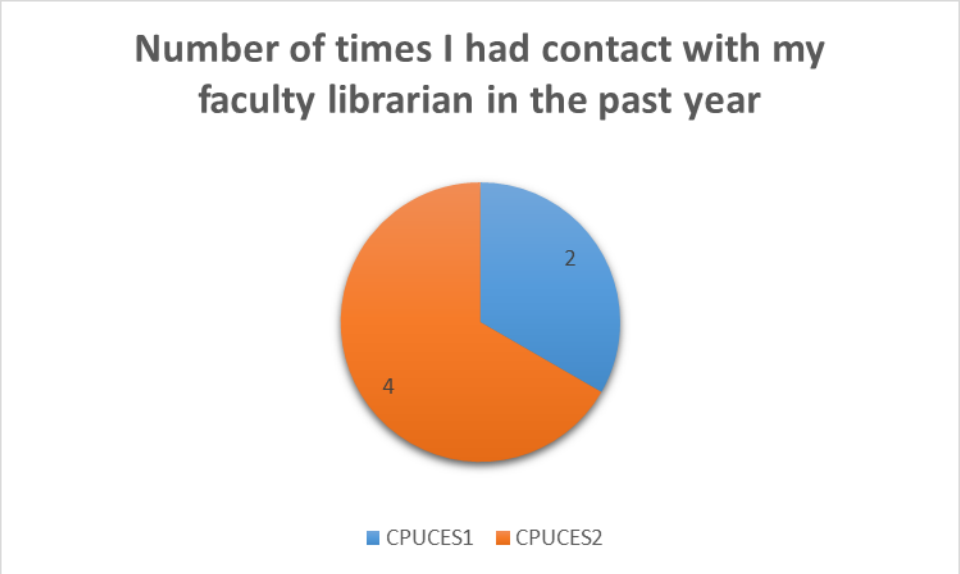

Figure 7.1D Number of times Chemical Engineering PhD students had contact with my faculty librarian in the past year

7.4.4 Chemistry and Chemical Engineering researchers and PhD students' perception of research trends

Table 7.14A Chemistry researchers' opinion on the advantages and disadvantages of Open Access publishing

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Yes	X	X	X			X	X
Free access and reach a wider audience	X	X	X			X	X
OA is the way to go for a researcher	X						
Benefit those who don't have facilities or subscriptions		X				X	X
Science should serve the public: improve quality of life		X					
Danger of plagiarism		X					
Disadvantage is high author fees			X	X	X		
No				X	X		
Don't know enough about OA				X			
OA have a lower quality				X			
Need a better solution or model to deal with author fees				X			
No rigorous reviewing because the author pays					X	X	
My research must be published in high quality journals: I don't settle for anything less					X		
OA publishing a betrayal to science due to low quality journals						X	
OA increase citations						X	X
Publishing in closed access is a problem when there is no subscription							X

Table 7.14B Chemistry PhD students' opinion on the advantages and disadvantages of Open Access publishing

Theme	CPUCS1	CPUCS2
A good thing: ideal for young researchers	X	
Increase citations	X	X

Disadvantage: possibility of plagiarism	X	
If it is free, less valuable to research community	X	
It is the way to go: the future		X
Researchers realise the benefit of OA for visibility of research		X

Table 7.14C Chemical Engineering researchers' opinion on advantages and disadvantages of Open Access publishing

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
I prefer OA actually	X				
Free access to publications	X			X	
Low status: but I disagree	X				
Traditional publishing houses adopted OA	X				
Not yet, considering it		X		X	
As long as OA journals are DHET accredited: subsidy purposes		X			
Yes			X		
OA publications increase citations			X		
Low quality			X		
Accredited list includes OA journals			X		
High author fees				X	
No					X
I did not identify OA journals on the accredited list I can publish in					X

Table 7.14D Chemical Engineering PhD students' opinion on the advantages and disadvantages of Open Access publishing

Theme	CPUCES1	CPUCES2
Not much experience	X	
Students benefit from easy access	X	
Free access to content		X
One way of access		X

Table 7.15A The role Open Access publishing in building a knowledge culture for Chemistry researchers

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Free access to information	X	X	X				
Learn more through access		X					
Makes science open		X					
Researchers at a university have access to many resources				X			
Inter-library loans is the option				X			
OA don't make a huge difference				X			
Not building a knowledge culture: damaging the field					X		
Measuring quality versus quantity is problematic					X		
Negative about OA publishing					X		
Important to publish case studies OA						X	
Benefit those who don't have facilities or subscriptions						X	X
OA teach students to read and write reviews							X

Table 7.15B The role of Open Content in Chemistry PhD students' research

Theme	CPUCS1	CPUCS2
Play a vital role in my research	X	X
Easy access	X	X

Table 7.15C The role Open Access publishing in building a knowledge culture for Chemical Engineering researchers

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Big role	X				
My OA publication received reviews immediately compared to my closed access publications	X				
OA is essentially what knowledge sharing should be about	X	X			
Not much yet		X			
Easy access to scientific research			X		
University cannot subscribe to all the journals in the world			X		
Advance your research this way			X		
OA play important role for students to access and absorb open content from home				X	
Researchers outside SA can benefit from OA publications from SA				X	
Funding is an important, but selfish approach					X
Contact authors through ResearchGate to access full text					X

Table 7.15D The role of Open Content in Chemical Engineering PhD students' research

Theme	CPUCES1	CPUCES2
Make my research work easier	X	
Speeds up the learning process	X	
Major role		X
We rely on open content for research		X

Table 7.16A Chemistry researchers' knowledge, perception and experience of Open Science

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Good to learn from one another	X						
Ownership of research: publish first to avoid people stealing your work	X		X		X	X	
Researchers keep their work to themselves	X		X		X		
Problem is patenting	X						
Important: science should be open		X				X	
Reproduce research		X					
Grow the communal knowledge		X					
If people are honest, Open Science practice will be fine			X				
I don't know about it				X			
An idea is key: big competition					X		
Measured by the number of research output					X		
Not much experience							X
Through conferences and collaboration							X

Table 7.16B Chemistry PhD students' perception, knowledge and experience of Open Science

Theme	CPUCS1	CPUCS2
A major role	X	X
Open to advice, criticism, share ideas	X	X
ResearchGate facilitate Open Science		X
Disadvantage: people can steal your work before you publish		X

Table 7.16C Chemical Engineering researchers' knowledge, perception and experience of Open Science

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Not yet, considering it	X				
It is what science is all about: better advance by being open	X				
Collaboration is important	X				
Disclaimer is important though	X				
It is happening in ResearchGate		X			
Competition don't allow us to put our ideas out there in the open		X	X		
Tricky situation		X	X		
Good for discussing research methods		X			
Only share with my collaborator			X		
I benefitted from exchanging information at conferences				X	
It would be fantastic if information exchange could be facilitated online				X	
Restricted: research has commercial value					X
Received negative feedback when posting my idea: so I stopped					X

Table 7.16D Chemical Engineering PhD students' perception, knowledge and experience of Open Science

Theme	CPUCES1	CPUCES2
A good idea	X	X
Make a contribution to research	X	
Research ethics important: consult supervisor first	X	
Practice takes place at conferences	X	
Happening internally only		X

A blog can help us		**X**

Table 7.17A The role of Open Science for Chemistry researchers

Theme	**CPUC1**	**CPUC2**	**CPUC3**	**CPUC4**	**CPUC5**	**CPUC6**	**CPUC7**
Help people starting out	**X**		**X**				
Avoid duplication of trial and error	**X**		**X**				
A give and take		**X**					
Sharing techniques and knowledge			**X**				
Not at all				**X**			
Important to have a research profile					**X**		
Scientists are secretive: they will hardly discuss future research						**X**	
No comment							**X**

Table 7.17B Role of Open Science for Chemistry PhD students

Theme	**CPUCS1**	**CPUCS2**
Advice go a long way	**X**	
We can learn: increase quality	**X**	**X**
Science is practical: department could benefit		**X**

Table 7.17C The role of Open Science for Chemical Engineering researchers

Theme	**CPUCE1**	**CPUCE2**	**CPUCE3**	**CPUCE4**	**CPUCE5**
Not yet been exposed	**X**				
Open discussion with researchers around the world to solve a problem is good		**X**			

Not being acknowledged for sharing my idea is a problem		X			
Better to publish first		X			
For teaching and learning it is fine			X		
Only share with research collaborators			X		
Important for young researchers to get expert advice				X	
A virtual room to exchange knowledge is useful				X	X

Table 7.17D Role of Open Science for Chemical Engineering PhD students

Theme	CPUCES1	CPUCES2
Important role	X	X
Sense of learning	X	
Building working relationships with researchers	X	X

Table 7.18A Chemistry researchers' experience of Research Data Management and its role in research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Good for quality control: verify data	X	X				X	X
Re-use data: interpret data different to create new research	X						X
Data should belong to the scientific community		X					
It could be good			X				
I have not considered it			X				
All our datasets accessible in the Cambridge database				X			
Through funded research, all output needs to be publicly available					X		
Very important to share					X	X	X
Avoid duplication of experiments							X

Save time							**X**
Very important when supervising students' research to have a good data management plan							**X**

Table 7.18B Chemistry PhD students' experience of Research Data Management and its role in research

Theme	**CPUCS1**	**CPUCS2**
Play a major role	**X**	**X**
Important in collecting data to analyse in research project	**X**	**X**
Data re-use: create new research	**X**	**X**
Managing data is crucial: can publish data these days without the article		**X**

Table 7.18C Chemical Engineering researchers' experience of Research Data Management and its role in research

Theme	**CPUCE1**	**CPUCE2**	**CPUCE3**	**CPUCE4**	**CPUCE5**
Depends on what one wants to do with the data	**X**				
I support the idea of OA, OS for the advancement of science	**X**				
Data must be managed properly	**X**				
The author should have the authority to make decisions about the data	**X**				
Not in favour of being forced to upload datasets by publishing houses and university institutional repositories	**X**				
It is good		**X**	**X**		
Data reuse		**X**			
Verify data		**X**	**X**		
Credible: share data		**X**			
I don't think we have RDM services at our university				**X**	
I manage my own data				**X**	
I will support the practice of RDM in my department				**X**	

I have experience					X
Useful for researchers to access data from a repository					X

Table 7.18D Chemical Engineering PhD students' experience of Research Data Management and its role in research

Theme	CPUCES1	CPUCES2
Area where I had to learn to manage data	X	
I had to upload my data into the institutional repository [at university in Europe where I was an exchange student]	X	
Informed about it late: should have worked on DM plan from the start of my research	X	
Had a workshop on RDM		X
Plays a major role in research		X

Table 7.19A Chemistry researchers' opinion on the library assisting with Research Data Management

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
I think the library should	X		X				X
The only unit on campus that could do this	X						
If it is in the scope, yes		X					
Unnecessary if RDM is an extra burden		X					
Thesis /articles already being uploaded into repository, so also the data			X				X
No the library should not				X	X		
It is my research, my decision				X			
Publishing houses already manage the data					X		
Library will do well in teaching RDM plans: incorporate in Advanced IL training						X	
IL Certificate should be a requirement for approving research proposals						X	

Table 7.19B Chemistry PhD students' opinion on the library assisting with Research Data Management

Theme	CPUCS1	CPUCS2
I think the library should	X	X
Data analysis software is challenging	X	
Keep up with international standards		X
People don't take their research data seriously		X

Table 7.19C Chemical Engineering researchers' opinion on library assisting with Research Data Management

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Researcher should take responsibility for RDM	X		X	X	X
Librarian is pushing academics to upload publications in the IR	X				
My PhD data had commercial value and so completely disagree with making it openly available	X				
We don't know much about it		X			
Format of data: complex		X			
Maybe it could be useful		X			
Library could assist to some extent			X	X	
It doesn't matter who does it, as long as it is done properly				X	
I don't think the library should					X
It is not practical for a librarian to handle our research data					X

Table 7.19D Chemical Engineering PhD students' opinion on library assisting with Research Data Management

Theme	CPUCES1	CPUCES2
I think it would be a good thing	X	X
Students could access my data in the future	X	
Assist in future research	X	X

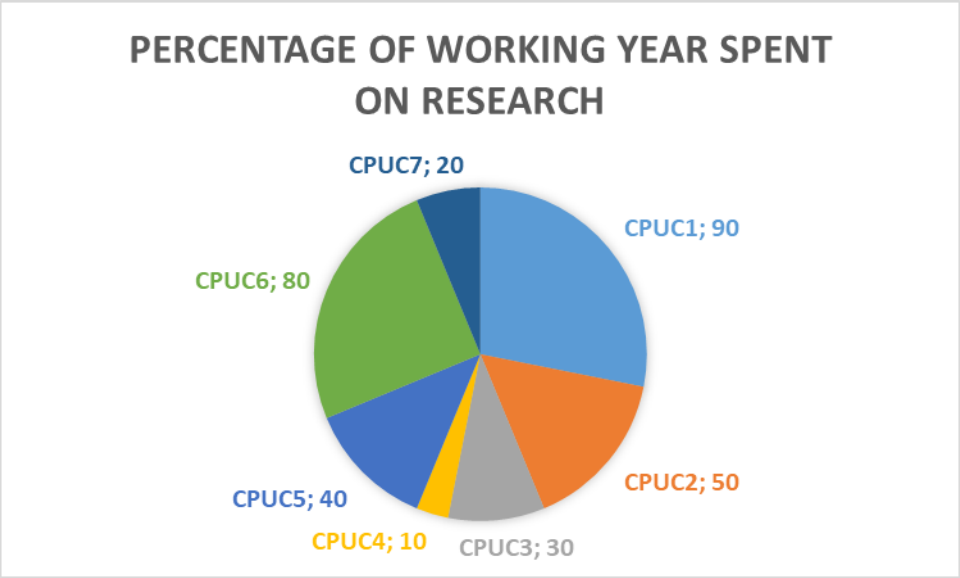

Figure 7.2A Percentage of working year spent on research by Chemistry researchers

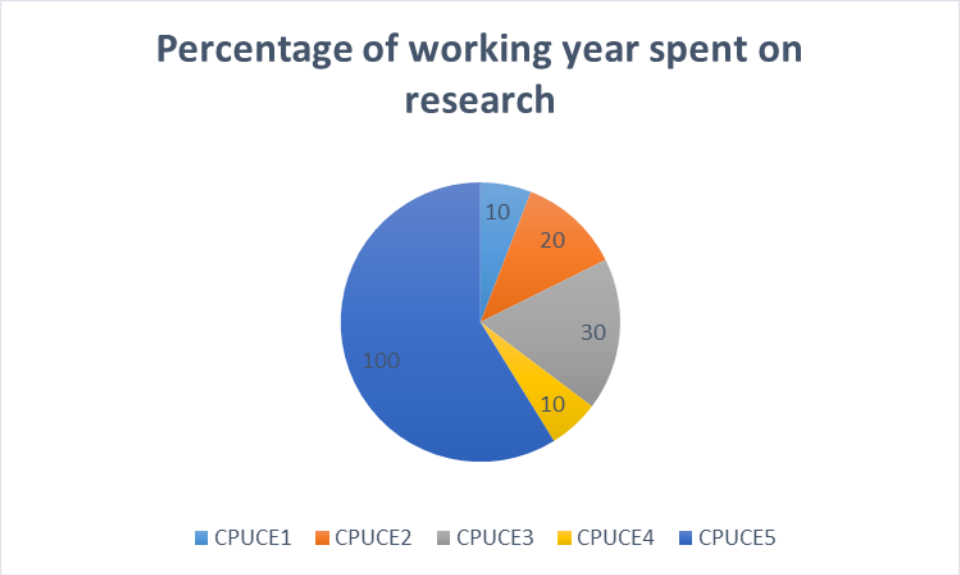

Figure 7.2C Percentage of working year spent on research by Chemical Engineering researchers

7.4.5 Faculty research informing policy or procedures

Table 7.20A Research output of Chemistry researchers' contributing to university guidelines or procedures

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Not yet	X		X	X		X	
By mentoring and graduating students		X					
Huge contribution: graduating PhD students		X			X		
Qualification more important than the research at the moment				X			
Through my new marking scheme					X		
Publish research mainly – not patented					X		
Raised quality of students' work						X	
A number of ways							X
PhD student can't graduate without a publication							X
Forced by the library to upload theses							X

Table 7.20B Research output of Chemistry PhD students contributing to university guidelines or procedures

Theme	CPUCS1	CPUCS2
Conferences and international exposure attract interest	X	
I used a new technique, led to departmental implementation		X

Table 7.20C Research output of Chemical Engineering researchers contributing to university guidelines or procedures

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
My research has not had that kind of impact in the university yet	X		X		
Department is moving in that direction where research has impact	X				

Sharing best practices is important	X				
Through my research on teaching with technology my department can learn		X			
Sharing best practices is important		X			
Created visibility for myself in the department: obtained 2013 teaching excellence award		X			
On environmental side my research makes a contribution: national level			X		
My research opened a new area to explore patenting				X	
My research interest is in patenting and commercial value				X	
My research contribute to library matters: subscriptions and evaluating databases					X

Table 7.20D Research output of Chemical Engineering PhD students contributing to university guidelines or procedures

Theme	CPUCES1	CPUCES2
My research led to registering a patent	X	
Not yet, hopefully in the future		X

Table 7.21A Chemistry Research enhancing teaching and learning

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Minimum	X						
Conducting Research can help explain a topic better	X	X		X	X	X	X
Things work different: research different from what I teach	X						
Yes, a lot!		X	X	X		X	X
Bringing science closer		X					
Student succeed using my formats			X				
I learn so much and can pass on to students				X			

On the other hand, good researcher is not necessarily a good lecturer					X		
Constantly update my knowledge							X

Table 7.21C Chemical Engineering research enhancing teaching and learning

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Yes	X	X	X	X	X
My research added interesting developments /aspects/ examples for students	X		X	X	X
Research is important for improving teaching	X	X	X		X
Strong correlation between research interest and teaching practice				X	

Table 7.22A Chemistry research output improving student development and success

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Students benefit by learning from what I am doing	X		X			X	X
I supervise students	X					X	
By graduating students		X					
Placing students in industry		X					
Lab / research techniques			X				X
Still early days for me				X			
I believe so					X		
I push students to work hard – not in favour of students taking long to complete Masters /PhD					X		
I make sure students work on something that can be published						X	
Important that students can think critically, apply and evaluate							X
I provide in-service training in my lab for students							X

Table 7.22C Chemical Engineering research output improving student development and success

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Engage students, motivate them to conduct research	X		X		
Through student evaluation I improve student development		X			
Some graduates have top positions			X		
Through my research I improved my writing skills which led to transfer to student development				X	
My research funding lead to developing postgraduate students					X

Table 7.23A Chemistry research output contributing to community engagement

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Yes	X	X	X				X
My research results can assist policy makers	X						
Community service: taking science to the village people		X				X	
Science is not abstract, it's about life		X					
Outcome focused on solving problems in rural communities			X				
Not yet				X		X	
Important for community schools: crystallography				X			X
Increase student interest through growing crystals in my lab					X		X

Table 7.23C Chemical Engineering research output contributing to community engagement

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5

Not directly	X				X
Currently conducting research which will impact the community	X	X		X	
Shift from abstract to practical research	X				
Previously yes			X		

7.4.6 Competencies for conducting research

Table 7.24A Further research assistance needed from the library or faculty librarian by Chemistry researchers

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Not at the moment	X			X		X	
Improve communication with postgraduate students	X						
Train PhD students as well	X				X	X	X
Librarian to support in all areas of the research process is crucial		X					
Need Mendeley and database training			X				
Need to wean myself from working with print materials			X				
Plagiarism software access					X		
Online IL course is the future					X		
Embargo option needed for uploading theses for publishing purposes					X		
Train students to Read, interpret and analyse scientific articles							X
Train students on Constructing a research topic, writing abstracts							X
Librarian could provide podcasts							X

Table 7.24B Further research assistance needed from the library or faculty librarian by Chemistry PhD students

Theme	CPUCS1	CPUCS2
Data analysis/data management	X	
Courses on scientific writing		X

Table 7.24C Further research assistance needed from the library or faculty librarian by Chemical Engineering researchers

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Need for the library to be more actively involved in research process through workshops	X				
Library could play a vital role in analysis of data	X				
I know where to go when needed		X			
Job description of the librarian should be known to faculty		X			
Funding assistance needed			X		
Research specific books in my field			X		
Need assistance with data archiving				X	
Improve ILL logistics					X

Table 7.24D Further research assistance needed from the library or faculty librarian by Chemical Engineering PhD students

Theme	CPUCES1	CPUCES2
Access to other resources such as photographic equipment and video recording equipment	X	
Improve communication through an internal blog, live chat facility		X

Table 7.25A Local and international collaboration between Chemistry researchers in the Chemistry field

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
No	X						
Yes		X	X	X	X	X	X
Old contacts from previous job		X				X	X
Introduced many years ago			X				
Through my supervisor				X			
Within my research/study circle				X			
Conferences					X	X	X
Funding							X

Table7.25B Local and international collaboration between researchers and Chemistry PhD students in the Chemistry field

Theme	CPUCS1	CPUCS2
Through conferences /seminars	X	
Research exchange at other university labs	X	
Through my supervisor		X
Internationally through publications		X

Table 7.25C Local and international collaboration between researchers in the Chemical Engineering field

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Not at the moment, but in the future yes	X				
Locally and internationally		X	X	X	X
Through my supervisor		X		X	

Through publications			X		X
Conferences			X	X	
Changing jobs			X		

Table7.25D Local and international collaboration between researchers and Chemical Engineering PhD students in the Chemical Engineering field

Theme	CPUCES1	CPUCES2
Not at the moment	X	
In contact with PhD students in the department	X	
Yes		X
Through my supervisor		X
Conferences		X

Table 7.26A Information provision on Chemistry researchers' research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
By myself: electronic resources	X				X		X
My collaborators		X					
Consult professor in the department			X				
My supervisor and co-supervisor				X			
Email researchers					X		
Internet						X	
Consult colleagues							X

Table 7.26B Information provision on Chemistry PhD students' research

Theme	CPUCS1	CPUCS2
Through my supervisor	X	
Information resources	X	X

Table 7.26C Information provision on the Chemical Engineering researchers' research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Mainly publications	X			X	
The library	X				
Attending conferences	X				
Interaction with other researchers	X		X		
Search engines		X	X		
My supervisor's advice		X			
The research group					X

Table 7.26D Information provision on the Chemical Engineering PhD students' research

Theme	CPUCES1	CPUCES2
My supervisor	X	X
Myself	X	X
Other researchers	X	
Library		X

7.4.7 Rating library research support services

Table 7.27A How Chemistry researchers benefit from the library in their research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Quiet study area	X						
Internet access / electronic resources	X	X	X	X	X	X	X
Books	X			X			
Books acquisitions			X				
Remote access					X		
Library is first point of call						X	
IL training for my students							X

Table 7.27B How Chemistry PhD students benefit from the library in their research

Theme	CPUCS1	CPUCS2
Electronic resources	X	
Publishing advice	X	
Current technology in my field	X	
RDM project		X
IL training		X

Table 7.27C How Chemical Engineering researchers benefit from the library in their research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Electronic resources	X	X	X	X	X
Remote access		X			

ILL			X		X
Bibliometrics			X		
Books and theses					X
IL training					X
University library resources where I am studying my PhD					X

Table 7.27D How Chemical Engineering PhD students benefit from the library in their research

Theme	CPUCES1	CPUCES2
Books	X	
Electronic resources	X	X
RISC		X
ILL		X

Table 7.28A Library resources used by Chemistry researchers for research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Quiet study area	X						
Internet	X						
Books	X						
Remote access to electronic resources	X			X		X	X
Everything in the library		X					
ScienceDirect			X				
ACS			X		X		
RSC					X		
Encourage my students to use library resources: especially referencing tools					X		

ILL							X
Printing and archives							X
Receive amazing support							X

Table 7.28B Library resources used by Chemistry PhD students for research

Theme	CPUCS1	CPUCS2
Libguides	X	
Electronic resources	X	X
Mendeley	X	X
ScienceDirect		X

Table 7.28C Library resources used by Chemical Engineering researchers for research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
ScienceDirect extensively	X		X	X	X
Electronic resources		X	X	X	
e-theses: IR		X			
Springer			X		
Remote access			X		
ACS extensively				X	
Wiley extensively				X	

Table 7.28D Library resources used by Chemical Engineering PhD students for research

Theme	CPUCES1	CPUCES2
ScienceDirect	X	
RSC	X	
Computers		X
Books		X
ILL		X
Electronic resources		X
Google Scholar		X

Table 7.29A Resources mainly accessed from the library website by Chemistry researchers for research

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Articles	X			X	X	X	X
Books	X						
None: not active in research at the moment		X					
Databases			X		X		X
ACS			X				
Archives							X
Theses							X

Table 7.29B Resources mainly accessed from the library by Chemistry PhD students for research

Theme	CPUCS1	CPUCS2
Wi-Fi is very important	X	
Journals /databases	X	X

Printing / scanning facilities	X	
Mendeley		X
Theses		X

Table 7.29C Resources mainly accessed from the library website by Chemical Engineering researchers for research

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Electronic resources	X	X	X	X	
ScienceDirect	X				X
e-books			X		X
Mendeley				X	

Table 7.29D Resources mainly accessed from the library by Chemical Engineering PhD students for research

Theme	CPUCES1	CPUCES2
Electronic resources	X	X
Internet access	X	
Books	X	X
Physical space		X

Table 7.30A Library services and facilities used for research in the past year by Chemistry researchers

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Used library's e-resources (e-books, online journals, databases etc.)	X	X	X	X	X	X	X
Borrowed library's print resources	X		X	X		X	X
Library's Inter-Library Loan & document delivery services				X		X	X
Faculty librarian's reference / information services					X	X	X
Used the library's quiet study area or Research Commons or computer lab	X					X	

Attended a training workshop on e-resources or databases							X

Table 7.30B Library services and facilities used for research in the past year by Chemistry PhD students

Theme	CPUCS1	CPUCS2
Used library's e-resources (e-books, online journals, databases etc.)	X	X
Used the library's quiet study area or Research Commons or computer lab	X	X
Attended a training workshop on e-resources or databases	X	X
Borrowed library's print resources		X
Library's Inter-Library Loan & document delivery services		X
Faculty librarian's reference / information services	X	
Other: Thesis access		X

Table 7.30C Library services and facilities used for research in the past year by Chemical Engineering researchers

Theme	CPUCE1	CPUCE2	CPUCE3	CPUCE4	CPUCE5
Used library's e-resources (e-books, online journals, databases etc.)	X	X	X	X	X
Borrowed library's print resources	X			X	X
Library's Inter-Library Loan & document delivery services	X	X	X	X	X
Faculty librarian's reference / information services	X			X	X
Used the library's quiet study area or Research Commons or computer lab		X		X	
Attended a training workshop on e-resources or databases		X	X		X

Table 7.30D Library services and facilities used for research in the past year by Chemical Engineering PhD students

Theme	CPUCES1	CPUCES2
Used library's e-resources (e-books, online journals, databases etc.)	X	X
Used the library's quiet study area or Research Commons or computer lab	X	

Attended a training workshop on e-resources or databases	**X**	**X**
Borrowed library's print resources		**X**
Library's Inter-Library Loan & document delivery services		**X**
Faculty librarian's reference / information services	**X**	
Other: Used the department's collection	**X**	

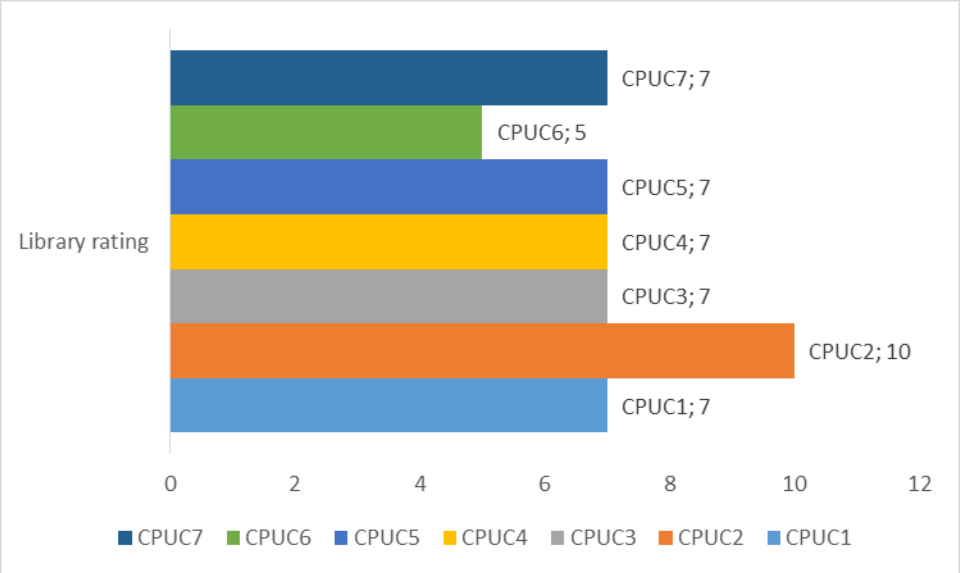

Figure 7.3A Library rating for research by Chemistry researchers

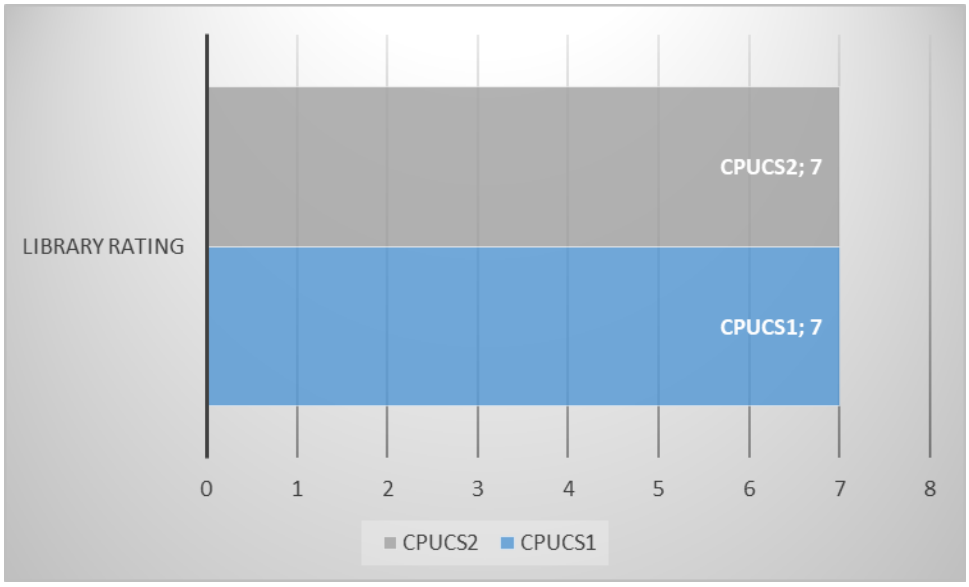

Figure 7.3B Library rating for research by Chemistry PhD students

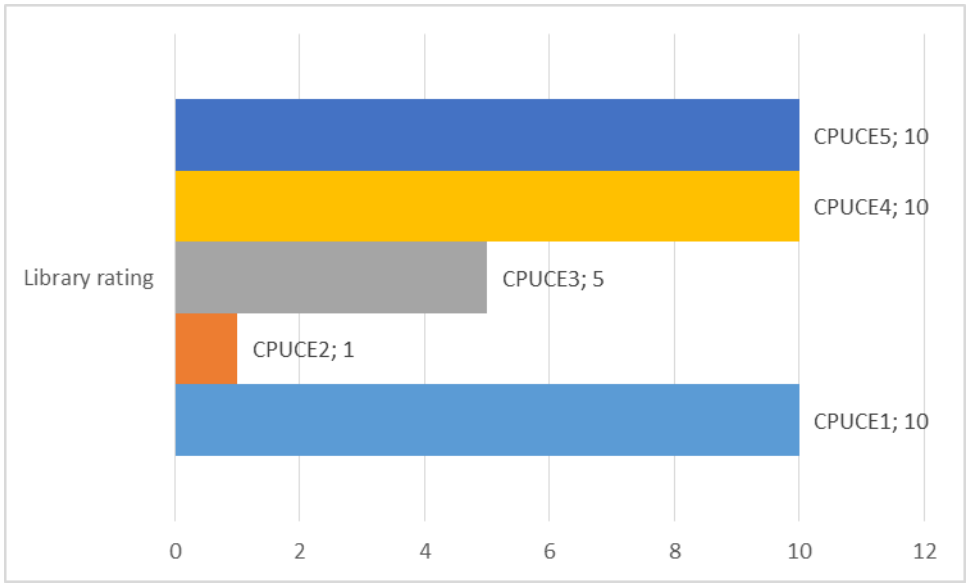

Figure 7.3C Library rating for research by Chemical Engineering researchers

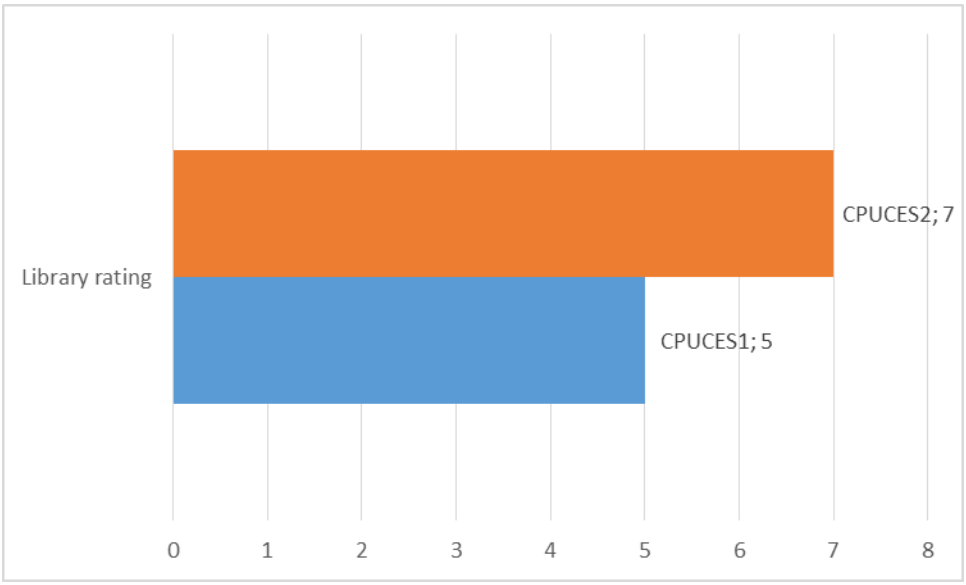

Figure 7.3D Library rating for research by Chemical Engineering PhD students

Table 7.31A Possible research support services prioritised by Chemistry researchers

Possible Research Support Services	**Score**
Ongoing updates on new information resources	8
Advice on bibliographic referencing	10
Maintaining of research repositories	10
Database training	11
Advice on Open Access publishing	11
Training on social media use for research	13
Training on mobile apps for research	13
Advice on Research Data Management	14
Advice on research proposal writing	14
Providing a reading list on faculty and students' research topic and providing advice on their literature review	16
Advice on my research topic	18
TOTAL	**138**

Table 7.31B Possible research support services prioritised by Chemistry PhD students

Possible Research Support Services	Score
Other: "Scientific software support (SAS /Origin)" (CPUCS1) and "Scientific writing and proposal writing workshops" (CPUCS2)	2
Ongoing updates on new information resources	2
Advice on research proposal writing	2
Advice on bibliographic referencing	2
Database training	2
Maintaining of research repositories	2
Training on social media use for research	2
Advice on Research Data Management	2
Training on mobile apps for research	3
Advice on Open Access publishing	3
Providing a reading list on faculty and students' research topic and providing advice on their literature review	4
Advice on their research topic	4
TOTAL	**30**

Table 7.31C Possible research support services prioritised by Chemical Engineering researchers

Possible Research Support Services	Score
Maintaining of research repositories	5
Advice on Research Data Management	5
Ongoing updates on new information resources	6
Advice on bibliographic referencing	6
Training on social media use for research	6
Advice on Open Access publishing	6

Database training	7
Training on mobile apps for research	7
Advice on research proposal writing	8
Providing a reading list on faculty and students' research topic and providing advice on their literature review	11
Advice on my research topic	11
TOTAL	**78**

Table 7.31D Possible research support services prioritised by Chemical Engineering PhD students

Possible Research Support Services	**Score**
Other: "Open Science workshops" (CPUCES1)	1
Providing a reading list on faculty and students' research topic and providing advice on their literature review	2
Ongoing updates on new information resources	2
Database training	2
Maintaining of research repositories	2
Training on social media use for research	2
Advice on Research Data Management	2
Advice on research proposal writing	3
Advice on bibliographic referencing	3
Training on mobile apps for research	3
Advice on Open Access publishing	3
Advice on their research topic	4
TOTAL	**29**

7.4.8 Question 40: Likert Scale Statements

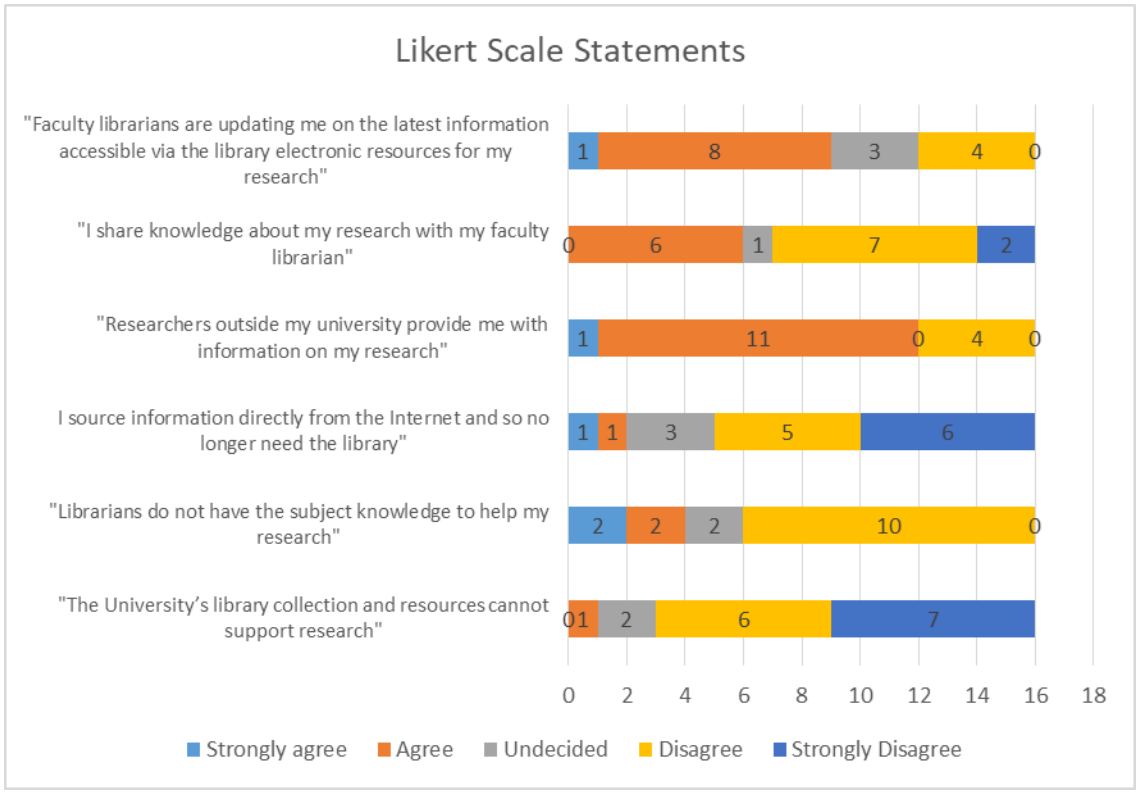

Figure 7.4A Likert statement 1-6

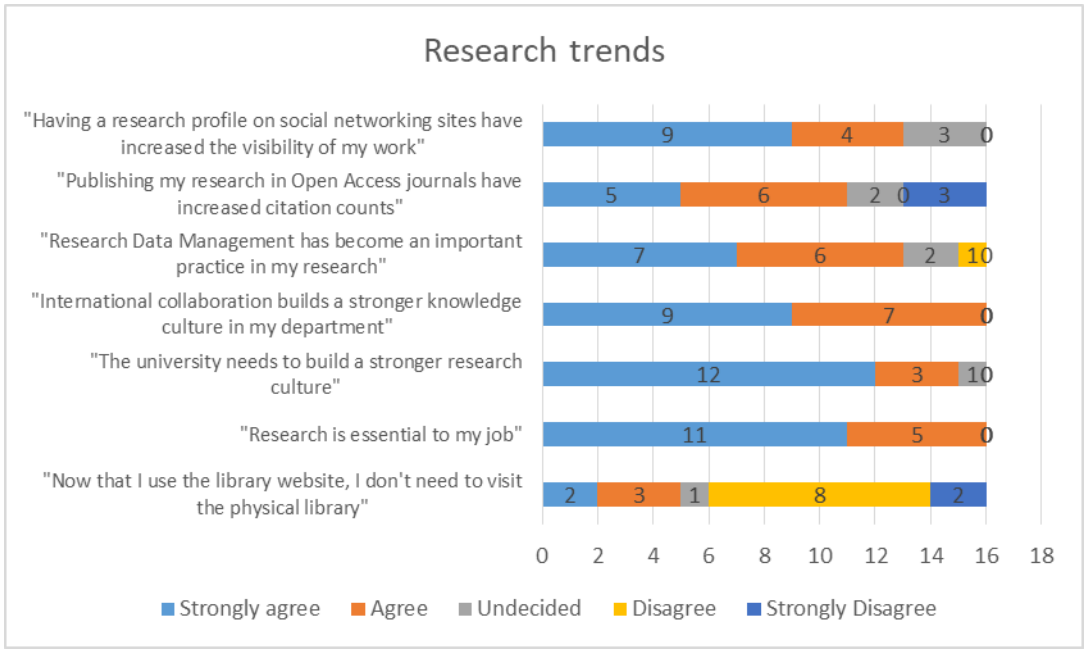

Figure 7.4B Likert statement 7-13

7.4.9 Additional comments by Chemistry and Chemical Engineering researchers and PhD Students

Table 7.32A Additional comments by Chemistry researchers

Theme	CPUC1	CPUC2	CPUC3	CPUC4	CPUC5	CPUC6	CPUC7
Librarian should get mailing list of postgraduate students	X						
Research in Africa not adequately funded		X					
Limiting infrastructure		X					
Africa-centric is crucial		X					
We find what others are doing through the librarian, then we must adapt to our context		X					
Librarians are proactive			X				
I suggest librarian do more presentations on what the library has to offer			X				
Easy access to electronic resources through the library				X			
Communication is crucial					X		
Re-allocate subsidy money received from publishing to the library to increase subscriptions					X		
IL training is crucial for quality of research						X	
Promotion of academics in the institution: for research and teaching							X
Leave it up to the people who are passionate about teaching or research to choose their path							X

Table 7.32B Additional comments from Chemistry PhD students

Theme	CPUCS1	CPUCS2
Increase visibility of the institutional repository	X	
Binding of theses should be a library service	X	
Wi-Fi still weak	X	

I have issues at institutional level with regards to research		**X**
Unfortunate that the library is the victim		**X**
Still lots that needs to be done to increase research output in the institution		**X**
Funding for research is constantly reduced		**X**

Table 7.32C Additional comments by Chemical Engineering researchers

Theme	**CPUCE1**	**CPUCE2**	**CPUCE3**	**CPUCE4**	**CPUCE5**
Library should become a publishing house	**X**				
There is a need for an interdisciplinary journal especially for young researchers	**X**				
Library need to provide regular research workshops	**X**	**X**		**X**	
The role of the library and librarian must be clear		**X**		**X**	
We need to learn to communicate		**X**			
We need more PhDs in our department			**X**		
IT is poor			**X**		
Library must do all IR processes			**X**		
We have a good setup here					**X**
A need for a 24-hour physical space					**X**

Table 7.32D Additional comments from PhD students

Theme	**CPUCES1**	**CPUCES2**
Need for more research seminars to bring researchers closer to the library	**X**	**X**
We need to know at the start who is our librarian	**X**	**X**
Library is a very good support unit for researchers	**X**	

12 Appendix C: LETTER OF INTRODUCTION

31 May 2016

Dear Academic Staff / PhD student / Faculty Librarian

I hereby wish to ask you kindly for a few minutes of your time to participate in my research interview session. I am a faculty librarian in Applied Sciences at CPUT and am currently studying towards a PhD in Philosophy, Science, Cognition and Semiotics at the University of Bologna, Italy. As part of my course, I am required to produce a thesis which involves conducting an investigation. My investigation is facilitated by means of a structured interview to be conducted with Chemistry and Chemical Engineering researchers (including PhD students) and faculty librarians at the Cape Peninsula University of Technology and the University of Bologna. As a faculty librarian in the Applied Sciences Faculty at the Cape Peninsula University of Technology (CPUT) Libraries, I wish to investigate the changing mode of communication as well as to what extent the academic library is used in research, the gap between what researchers need and want from the library to support research and what research support they are currently receiving, and how faculty librarians perceive their role in supporting research. My research project is titled: **Exploring the position of communication and science academic libraries in research: with special reference to Chemistry and Chemical Engineering Researchers at the Cape Peninsula University of Technology and the University of Bologna.**

Professor Giuliano Pancaldi, the programme co-ordinator in the Department of Philosophy and Communication at the University of Bologna, approved the project and have given permission for the study to be conducted. I also obtained permission from Dr Elisha Chiware, (Director of CPUT Libraries), Dr Wewers (HOD of Chemistry Department) and Prof Ikhu-Omoregbe (HOD of Chemical Engineering) to conduct interviews in their departments.

The success of this study relies on the information that will be gathered by means of the interview session. Please be assured that the information gathered will be used strictly for the purposes of the study and confidentiality and anonymity are assured. Participation is voluntary, and participants are free to withdraw from participation in the research at any time without suffering any consequences.

The study is done under the supervision of Dr Anna Guagnini from the Department of Philosophy and Communication, at the University of Bologna. Her email address is anna.guagnini@unibo.it

Your co-operation in this regard is greatly appreciated.

Yours Sincerely

Lynn Kleinveldt

PhD student: Philosophy, Science, Cognition and Semiotics: University of Bologna, Italy

Lynntatum.kleinveld2@unibo.it / lynn.kleinveldt@gmail.com

Faculty Librarian: Applied Sciences and Health & Wellness Sciences: CPUT Libraries: Cape Town Campus; kleinveldtl@cput.ac.za

13 Appendix D: Data collection instruments

This section presents the three sets of interview questions to be conducted with Chemistry and Chemical Engineering researchers, PhD students, and librarians.

13.1 Interview schedule with Chemistry and Chemical Engineering Researchers

This section looks at the interview questions that was covered with Chemical Engineering researchers at UNIBO and CPUT that will be selected based on the bibliometric analysis.

Section A: aimed at answering the research sub question 2.

Sub-question 2: What is the role of the researcher as a prosumer in the contemporary university?

1. Could you describe your role as a researcher in your department?

2. Briefly describe your current research practice, what does it entail and how it has changed since you started conducting research?

3. How do you feel about your research profile and visibility on the web?

4. Are you using social media or Web 2.0 tools for your research? (If so, please name them and explain how you are using it in research? And if not, explain why you are not using it?)

5. Do you think that social media enhances your visibility on the web?

6. Can you describe how social media enhances your research practices?

7. In what way has your research output contributed to procedures and guidelines in the university?

8. In your opinion, does research output enhance teaching and learning? (If yes, how does research output enhance teaching and learning? If no, please explain)

9. How has your research output improved student development and success?

10. In your opinion, does your research output contribute to community engagement?

11. Do you publish in Open Access journals? (If yes, what, in your opinion, are the advantages and disadvantages of publishing in Open Access Journals? If no, please explain?)

12. What role does Open Access publishing play in building a knowledge culture in your field?

13. What are your perceptions, knowledge and experience of Open Science?

14. What role does Open Science play in your field?

15. What are your perception, knowledge and experience of Research Data Management and what role does it play in your research?

16. An academic's job comprises teaching, administration and research. What percentage of your working year do you estimate that you spend on research?

Section B: aimed at answering research sub-question 3.

Sub- question 3: How do the researchers perceive the role of the library in supporting research?

17. Could you please describe your experience of the library in supporting your research?

What is your perception of the faculty librarian's role in supporting your research?

18. Are you currently communicating with your faculty librarian about your research? (If yes, what are you communicating on? (Literature, methodologies?) If no, can you explain why?)

19. How do you use the library to benefit your own research?

20. Is your faculty librarian involved in assisting you with your research? And how?

21. How do you normally communicate with your faculty librarian? (Telephone, email or other?)

22. Describe the library resources you are using particularly for your research?

23. What is your opinion on the library assisting with managing your research data? Do you think it is a function the library should be managing and why?

24. What is your opinion on the faculty librarian being a contact on your social networking sites that are specifically used for your research?

Section D: **The following questions aim to answer the research question which is to explore what chemistry and chemical engineering researchers need and want from the library in supporting their research, and how the librarians perceive their role in supporting these researchers:**

25. What are your thoughts on librarians and researchers working together to enhance Library services for research?

26. What do you perceive the librarian's role to be in supporting research?

27. Are you currently collaborating with your faculty librarian to enhance Library Services specifically for research? (If so, what do you collaborate on? If not, what are the reasons for not collaborating?

28. Are you satisfied with the functionality of the Library? (If not, how can the Library be improved to support research?)

29. What resources are you accessing from the Library website specifically for your research?

30. Do you discuss any Library issues or share new ideas or discoveries with the librarian? (If yes, could you please give one example? If no, what are your reasons for not sharing?)

31. What other areas in your research process do you need assistance with, and would you like the library or faculty librarian to assist with these?

32. Are you engaged in a research project at the moment?

33. Are you currently collaborating with researchers (locally and internationally) in your field? (If yes, how did you get in contact with the researchers?)

34. Who provides you with information on your research?

35. Which of the following library services & facilities have you used for **your research** in the past year? More than one may be ticked.

1	Borrowed Library's print resources	
2	Used Library's E- resources (e-books, online journal databases etc.)	
3	Library's Inter-Library Loan & document delivery services	
4	Used the Library's quiet study area or Research Commons or computer lab	
5	Faculty librarian's reference/information services	
6	Attended a training workshop on E-resources or databases	
7	Other (Please specify)	

36. How many times in the past year have you had contact (in person, by phone or email) with your faculty librarian **in connection with your research**?

37. How would you rate the library in supporting your research? Tick as appropriate from 1 for non-existent to 10 for indispensable.

Non existent 1 ……	Weak 3……	Adequate 5……	Good 7……..	Indispensable ……..10

38. If you rated it as lower than 5, please tick the following possible reasons as appropriate. More than one may be ticked.

Collection in my area is not adequate		1
Network / databases too slow		2
The Library website is not user-friendly		3
I do not know how to search for information on the Library website		4
Other (Please specify)		5

39. Please rate the importance to you of the following possible Library research support services

A	Providing a reading list on my topic and providing advice on my literature review	Very important 1	Useful 2	Not important 3
B	Advice on my research topic	Very important	Useful	Not important
C	Ongoing updates on new information resources	Very important	Useful	Not important
D	Advice on research proposal writing	Very important	Useful	Not important
E	Advice on bibliographic referencing	Very important	Useful	Not important
F	Database training	Very important	Useful	Not important
G	Maintaining of research repositories	Very important	Useful	Not important
H	Training on Social Media use for research	Very important	Useful	Not important
I	Training on mobile apps for research	Very	Useful	Not

		important		important
J	Advice on Open Access publishing	Very important	Useful	Not important
K	Advice on Research Data Management	Very important	Useful	Not important
L	Any other? (Please specify)	Very important	Useful	Not important

40. Please rate the following by ticking your views in the relevant box below.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. The University's Library collection and resources cannot support research	①	②	③	④	⑤
2. Librarians do not have the subject knowledge to help my research	①	②	③	④	⑤
3. I source information directly from the Internet and so no longer need the Library	①	②	③	④	⑤
4. Researchers outside my university provide me with information on my research	①	②	③	④	⑤
5. I share Knowledge about my research with my faculty librarian	①	②	③	④	⑤
6. Faculty librarians are updating me on the latest information accessible via the Library electronic resources for my research	①	②	③	④	⑤
7. Now that I use the Library website, I don't need to visit the physical library	①	②	③	④	⑤
8. Research is essential to my job	①	②	③	④	⑤
9. The university needs to build a stronger research culture	①	②	③	④	⑤
10. International collaboration builds a stronger knowledge culture in my department	①	②	③	④	⑤
11. Research Data Management has become an important practice in my research	①	②	③	④	⑤

12. Publishing my research in Open Access Journals have increased citation counts	①	②	③	④	⑤
13. Having a research profile on social networking sites have increased the visibility of my work	①	②	③	④	⑤

41. Do you have any additional comments?

13.2 Interview schedule with Chemistry and Chemical Engineering PhD students

This section looks at the interview questions that was covered with Chemistry and Chemical Engineering PhD students at UNIBO and CPUT.

Section A: aimed at answering the research sub question 2.

Sub-question 2: What is the role of the researcher as a prosumer in the contemporary university?

1. Could you describe your role as a researcher in your department?

2. Briefly describe your current research practice, what does it entail and how it has changed since you started conducting your research project?

3. How do you feel about your research profile and visibility on the web?

4. Are you using social media or Web 2.0 tools for your research? (If so, please name them and explain how you are using it in research? And if not, explain why you are not using it?)

5. Do you think that social media enhances your visibility on the web?

6. Can you describe how social media enhances your research practices?

7. In what way has your research output /project contributed to procedures and guidelines in your department?

11. What are your perceptions, knowledge and experience of Open Access? (What, in your opinion, are the advantages and disadvantages of publishing in Open Access Journals?)

12. What role does Open Access content (books, journal articles) play in your research project?

13. What are your perceptions, knowledge and experience of Open Science?

14. What role does Open Science play in your field?

15. What are your perception, knowledge and experience of Research Data Management and what role does it play in your research?

Section B: aimed at answering research sub-question 3.

Sub- question 3: How do the researchers perceive the role of the library in supporting research?

17. Could you please describe your experience of the library in supporting your research? What is your perception of the faculty librarian's role in supporting your research?

18. Are you currently communicating with your faculty librarian about your research? (If yes, what are you communicating on? (Literature, methodologies?) If no, can you explain why?)

19. How do you use the library to benefit your own research?

20. Is your faculty librarian involved in assisting you with your research? And how?

21. How do you normally communicate with your faculty librarian? (Telephone, email or other?)

22. Describe the library resources you are using particularly for your research?

23. What is your opinion on the library assisting with managing your research data? Do you think it is a function the library should be managing and why?

24. What is your opinion on the faculty librarian being a contact on your social networking sites that are specifically used for your research?

Section D: **The following questions aim to answer the research question which is to explore what chemistry and chemical engineering researchers need and want from the library in supporting their research, and how the librarians perceive their role in supporting these researchers:**

25. What are your thoughts on librarians and PhD students working together to enhance Library services for research?

26. What do you perceive the librarian's role to be in supporting research?

27. Are you currently collaborating with your faculty librarian to enhance Library Services specifically for research? (If so, what do you collaborate on? If not, what are the reasons for not collaborating?

28. Are you satisfied with the functionality of the Library? (If not, how can the Library be improved to support research?)

29. What resources are you accessing from the Library specifically for your research?

30. Do you discuss any Library issues or share new ideas or discoveries with the librarian? (If yes, could you please give one example? If no, what are your reasons for not sharing?)

31. What other areas in your research process do you need assistance with, and would you like the library or faculty librarian to assist with these?

33. Are you currently collaborating with researchers or other PhD students (locally and internationally) in your field? (If yes, how did you get in contact with the researchers?)

34. Who provides you with information on your research?

35. Which of the following library services & facilities have you used for **your research** in the past year? More than one may be ticked.

1	Borrowed Library's print resources	
2	Used Library's E- resources (e-books, online journal databases etc.)	
3	Library's Inter-Library Loan & document delivery services	
4	Used the Library's quiet study area or Research Commons or computer lab	
5	Faculty librarian's reference/information services	
6	Attended a training workshop on E-resources or databases	
7	Other (Please specify)	

36. How many times in the past year have you had contact (in person, by phone or email) with your faculty librarian **in connection with your research**?

37. How would you rate the library in supporting your research? Tick as appropriate from 1 for non-existent to 10 for indispensable.

Non existent 1 ……	Weak 3……	Adequate 5……	Good 7…….	Indispensable ……..10

38. If you rated it as lower than 5, please tick the following possible reasons as appropriate. More than one may be ticked.

Collection in my area is not adequate		1
Network / databases too slow		2
The Library website is not user-friendly		3
I do not know how to search for information on the Library website		4
Other (Please specify)		5

39. Please rate the importance to you of the following possible Library research support services

A	Providing a reading list on my topic and providing advice on my literature review	Very important 1	Useful 2	Not important 3
B	Advice on my research topic	Very important	Useful	Not important
C	Ongoing updates on new information resources	Very important	Useful	Not important
D	Advice on research proposal writing	Very important	Useful	Not important
E	Advice on bibliographic referencing	Very important	Useful	Not important
F	Database training	Very important	Useful	Not important
G	Maintaining of research repositories	Very important	Useful	Not important
H	Training on Social Media use for research	Very important	Useful	Not important
I	Training on mobile apps for research	Very important	Useful	Not important
J	Advice on Open Access publishing	Very important	Useful	Not important
K	Advice on Research Data Management	Very important	Useful	Not important

L	Any other? (Please specify)	Very important	Useful	Not important

40. Please rate the following by ticking your views in the relevant box below.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
14. The University's Library collection and resources cannot support research	①	②	③	④	⑤
15. Librarians do not have the subject knowledge to help my research	①	②	③	④	⑤
16. I source information directly from the Internet and so no longer need the Library	①	②	③	④	⑤
17. Researchers outside my university provide me with information on my research	①	②	③	④	⑤
18. I share Knowledge about my research with my faculty librarian	①	②	③	④	⑤
19. Faculty librarians are updating me on the latest information accessible via the Library electronic resources for my research	①	②	③	④	⑤
20. Now that I use the Library website, I don't need to visit the physical library	①	②	③	④	⑤
21. Research is essential to my job	①	②	③	④	⑤
22. The university needs to build a stronger research culture	①	②	③	④	⑤
23. International collaboration builds a stronger knowledge culture in my department	①	②	③	④	⑤
24. Research Data Management has become an important practice in my research	①	②	③	④	⑤
25. Publishing my research in Open Access Journals have increased citation counts	①	②	③	④	⑤
26. Having a research profile on social networking sites have increased the visibility of my work	①	②	③	④	⑤

41. Do you have any additional comments?

13.3 Interview schedule with Faculty Librarians

This section looks at the interview questions that was be covered with Faculty Librarians supporting Chemistry and Chemical Engineering researchers and PhD students at UNIBO and CPUT.

Section A: aimed at answering the research sub question 4.

1. **Sub-question 4: How do the librarians perceive their role in supporting research?**

1. Could you describe your role as a faculty librarian supporting research in the Chemistry or Chemical Engineering department?

2. Briefly describe your current research support practices, what does it entail and how it has changed since you started supporting research?

3. How do you feel about your librarian profile and visibility on the web?

4. Are you using social media or Web 2.0 tools specifically to support research? (If so, please name them and explain how you are using it in research? And if not, explain why you are not using it?)

5. Do you think that social media enhances your visibility on the web?

6. Can you describe how social media enhances research practices?

7. In what way has your research output /support contributed to procedures and guidelines in the university?

8. In your opinion, does research support enhance teaching and learning? (If yes, how does research output enhance teaching and learning? If no, please explain)

9. How has your research support improved student development and success?

10. In your opinion, does your research support contribute to community engagement?

11. What, in your opinion, are the advantages and disadvantages of publishing in Open Access Journals?

12. How is Open Access publishing being promoted to Chemistry or Chemical Engineering departments?

13. What are your perceptions, knowledge and experience of Open Science?

14. What role in your opinion, does the library play in promoting Open Science?

15. What are your perception, knowledge and experience of Research Data Management and what role does it play in supporting research?

16. What role do the Library Association (LIASA or AIB) play in your profession to support research?

17. Are you currently a member of the Library Association? (Why?)

18. Are you currently involved in a research project, participating in the Library Association by presenting at conference, or publishing in journals?

19. Do you think it is important for librarians to be involved in conducting research to enhance research support? (How and why?)

Section B: aimed at answering research sub-question 3.

Sub- question 3: How do the researchers perceive the role of the library in supporting research?

17. Could you please describe your experience of supporting faculty and PhD students' research? What is your perception of the faculty's attitude towards you supporting their research?

18. Are you currently communicating with faculty and students about their research? (If yes, what are you communicating on? (Literature, methodologies?) If no, can you explain why?)

19. How is your support benefitting faculty and students' research?

21. How do you normally communicate with faculty and students? (Telephone, email or other?)

22. Describe the library resources you are promoting particularly for research support?

23. What is your opinion on the library assisting with managing research data? Do you think it is a function the library should be managing and why?

24. What is your opinion on being a contact on your faculty and students' social networking sites that they are specifically using for their research?

Section D: **The following questions aim to answer the research question which is to explore what chemistry and chemical engineering researchers need and want from the library in supporting their research, and how the librarians perceive their role in supporting these researchers:**

25. What are your thoughts on librarians and researchers working together to enhance Library services for research?

27. Are you currently collaborating with your faculty and students to enhance Library Services specifically for research? (If so, what do you collaborate on? If not, what are the reasons for not collaborating?

28. Are you satisfied with the functionality of the Library? (If not, how can the Library be improved to support research?)

29. What library resources in your experience, are mainly accessed by faculty and students specifically for their research?

30. Do you discuss any Library issues or share new ideas or discoveries with the faculty and students? (If yes, could you please give one example? If no, what are your reasons for not sharing?)

31. What other areas in the research process do you think faculty and students need assistance with, which you or the library can offer in the future?

32. Are there any areas that you feel you need training on that will assist you with supporting research? Please explain.

33. Are you currently collaborating with researchers (locally and internationally) in your field specifically to support research? (If yes, how did you get in contact with the researchers?)

35. Which research support services have you provided to faculty and students in the past year?

36. How many times in the past year have you had contact (in person, by phone or email) with faculty and students **in connection with their research**?

37. How would you rate the library in supporting research? Tick as appropriate from 1 for non-existent to 10 for indispensable. Why?

Non existent	Weak	Adequate	Good	Indispensable
1 ……	3……	5……	7…….	……..10

39. Please rate the importance to you of the following possible Library research support services

A	Providing a reading list on faculty and students' research topic and providing advice on their literature review	Very important 1	Useful 2	Not important 3
B	Advice on their research topic	Very important	Useful	Not important

C	Ongoing updates on new information resources	Very important	Useful	Not important
D	Advice on research proposal writing	Very important	Useful	Not important
E	Advice on bibliographic referencing	Very important	Useful	Not important
F	Database training	Very important	Useful	Not important
G	Maintaining of research repositories	Very important	Useful	Not important
H	Training on Social Media use for research	Very important	Useful	Not important
I	Training on mobile apps for research	Very important	Useful	Not important
J	Advice on Open Access publishing	Very important	Useful	Not important
K	Advice on Research Data Management	Very important	Useful	Not important
L	Any other? (Please specify)	Very important	Useful	Not important

40. Please rate the following by ticking your views in the relevant box below.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
27. The University's Library collection and resources cannot support research	①	②	③	④	⑤
28. Librarians do not have the subject knowledge to help my research	①	②	③	④	⑤
29. Researchers today no longer need the Library	①	②	③	④	⑤
30. Researchers outside my university provide me with information on my research	①	②	③	④	⑤
31. I share Knowledge about Chemistry or Chemical Engineering research with	①	②	③	④	⑤

researchers					
32. Faculty librarians are updating researchers on the latest information accessible via the Library electronic resources for my research	①	②	③	④	⑤
33. Now that researchers use the Library website, they don't need to visit the physical library	①	②	③	④	⑤
34. Research is essential to my job	①	②	③	④	⑤
35. The university needs to build a stronger research culture	①	②	③	④	⑤
36. International collaboration builds a stronger knowledge culture in the library	①	②	③	④	⑤
37. Research Data Management has become an important practice in supporting research	①	②	③	④	⑤
38. Publishing research in Open Access Journals have increased citation counts	①	②	③	④	⑤
39. Having a research profile on social networking sites have increased the visibility of my work	①	②	③	④	⑤

41. Do you have any additional comments?