Research Data Management:
An Exploration of the Data Librarian Role in New Zealand Research Organisations

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By

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Abstract

Modern research practice has been affected by disruptive developments involving technological advancements, for example e-Research and Open Access. These developments imply changes both in the way research is conducted as well as the way research outcomes are communicated. This has huge benefits as well as challenges. The need for researchers to understand how to undertake high quality research in the digital era and how to manage voluminous research data has become critical. To this end, academic librarians, as longstanding custodians of memory institutions and stakeholders to learning and teaching, may play a role in developing this understanding.

The study was guided by a model developed from Abbott's (1988) *The System of Professions* and the literature. Placed within the constructivist worldview the study adopted a case research approach to explore the dimensions of the data librarian role in four universities and five Crown Research Institutes in New Zealand. The interviewees comprised library managers, library and information professionals, repository managers, researchers and an Information and Technology Services manager. Data from the literature and an exploratory study of five e-Research experts in two Australian universities, and the analysed 43 data librarian position information from relevant websites were triangulated to provide a filter to help interpret the interview data.

The Data Librarian Role Blueprint (the Blueprint) emerged from the findings of the study in its three main areas. First, there are factors from national, organisational, research and motivational contexts whose relationships at the level of their components may influence the data librarian role positively or negatively. In terms of performing the role: it was mostly taken to be at the institutional level with subject librarians preferred to be in the role; it has identifiable responsibilities and requirements; and as a specialist individual role, it can exist short-term for purpose of training librarians and in the future when the need or responsibility grows. Finally, training needs for the role were identified in eight areas and the most commonly preferred option to address them was learning on the job through personal and organisational opportunities.

There are benefits from the study. For the library and information professionals and those interested in supporting research data management the Blueprint provides a theoretical understanding of the role. The findings are also beneficial to the library and e-Research communities by contributing to the literature in the area and enabling library schools to modernise their curriculum to ensure that graduates relevant to researchers' needs are produced.

However, as the study adopted a single case research design, the findings may not be generalised beyond the case institutions in the study. But, they may provide insight into research data management efforts in places where supporting e-Research and research data management is at infancy or does not yet have any national or institutional direction.

Furthermore, the Blueprint may find application or prove to be useful in related research areas.

Keywords: *Data Librarian; E-Research; Research data; Research data management; Research data services; Research organisations.*

Dedication

I dedicate this dissertation to the Almighty God for His loving kindness and graces on me, the latest evidence being the privilege to undertake a PhD study. I also dedicate this dissertation to all the members of my natural and Christian families as well as personal, family and Christian friends who have made sacrifices or supported and encouraged me throughout my study.

Acknowledgement

Foremost, I wish to appreciate God for the opportunity to undertake a PhD study as well as for His providence throughout the duration of the programme. Unto Him, I say wholeheartedly, thank you Lord.

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List of Abbreviations and Acronyms

ACRCR – Australian Code for Responsible Conduct of Research

ALA – American Library Association

ALIA – Australian Library and Information Association

ANDS – Australian National Data Service

AP – Australian Positions

API – Application Programming Interface

ARCHER – Australian ResearCH Enabling enviRonment

ARROW – Australian Research Repositories Online to the World

CARL – The Canadian Association of Research Libraries

CONZUL – Council of New Zealand University Librarians

CRI – Crown Research Institute(s)

CSS – Cascading Style Sheets

DART – Dataset Acquisition, Accessibility and Annotations e-Research Technologies

DC – Dublin Core

DCC – Digital Curation Centre

DDI – Data Document Initiative

DL – Data Librarian(s)

DMP – Data Management Planning

EML – Ecological Metadata Language

ER – E-Researcher

GIS – Geographic Information System

GNP – General Non-management Positions

HTML – HyperText Markup Language

HLP – Hybrid Librarian Positions

IASLIC – Indian Association of Special Libraries and Information Centres

ICPSR – Inter-university Consortium for Political and Social Research

IFLA – International Federation of Library Associations and Institutions

IR(s) – Institutional Repository(ies)

IRM(s) – Institutional Repository Manager(s)

IT – Information and Technology

ITS – Information Technology Services

ITSM – Information Technology Services Manager

JT – Job Title

LIANZA – Library and Information Association of New Zealand Aotearoa

LIP(s) – Library and Information Professional(s)

LIS – Library and Information Science

LTER – Long Term Ecological Research

MARC – Machine Readable Cataloguing

MBIE – Ministry of Business, Innovation and Employment

METS – Metadata Encoding and Transmission Standard

MIT – Massachusetts Institute of Technology

MLIS – Master of Library and Information Science

MLS – Master of Library Science

MODS – Metadata Object Description Schema

MP – Management Positions

NEC – National Executive Council

NeSI – National eScience Infrastructure

NSF – National Science Foundation

OAI – Open Archives Initiative

PBRF – Performance-Based Research Fund

PhD – Doctor of Philosophy

PHP – PHP (Personal Home Page): Hypertext Preprocessor

PREMIS – PREservation Metadata: Implementation Strategies

RDM – Research Data Management

RDMF – Research Data Management Forum

RDS – Research Data Service(s)

RIF-CS – Registry Interchange Format – Collections and Services

RO – Research Organisation(s)

RSL – Research Support Librarian

SAS – Statistical Analysis Software

SP – Subject-related Positions

SPSS – Statistical Package for the Social Science

TEI – Text Encoding Initiative

UK – United Kingdom

USA – United States of America

UL – University Librarian(s)

UN – University

UP – USA Positions

XHTML – Extensible HyperText Markup Language

XML – EXtensible Markup Language

CHAPTER 1: INTRODUCTION TO THE STUDY

> The mission of librarians is to improve society through facilitating knowledge creation in their communities.
> (Lankes, 2011, p.15)

1.1 Introduction

The primary motivation behind this study is to explore the involvement of academic/research libraries in research data management (RDM). Data is the fuel for research. Therefore, managing research data is core to the research enterprise and its sustainability. Besides, RDM may be costly but it represents a great investment since the value of data in terms of its potential for re-use is more than the cost of its acquisition (Ashley, 2012). My further interest in RDM comes from the fact that knowledge created from re-using data can actually improve the society. The new mission of librarians proposed by Lankes (2011) pitches them with the researchers as facilitators, moderators and collaborators in the research process. This supplants the obsolete materials-centred or artefact-centric view of librarians and represents the all-time value that librarians bring to the research process. Research process forms a nexus between researchers and librarians that has persisted through many, especially technology-driven, changes over time. Thus, Friend (1998) argued that the library has always had to re-interpret and fulfil its mission against a background of change. The mission of academic/research libraries is aligned to that of their parent organisations which span the areas of teaching, learning and research. So, these libraries exist to play some roles in these areas.

The latest of the changes that academic/research libraries are faced with is e-Research which comes with the challenge of managing the associated voluminous and variegated data that could be re-purposed for other researches. A related challenge is that there are individual researchers whose research has generated some useful but obscure data that no one else would know of or re-use unless such are managed and made available. However, consistent with its age-long role, academic/research libraries are increasingly being seen to have a part to play in RDM. As an evolving area, the exploration done in this study is needed in order to provide the needed understanding and facilitate the usefulness of libraries and librarians in that role.

In this introductory chapter, I present the fundamental aspects that are necessary to provide an understanding of the study. These include the context and background behind the problem

statement as well as the study's aims, research questions, justification, methodology, scope, definition of the key terms, and an outline of the thesis.

1.2 Context of the Study

Universities anywhere in the world support teaching, learning and research, while research remains a common denominator between universities and research institutes. However, the libraries of both types of an organisation serve as the hub of research activities. The context of this study is RDM, mostly but not limited to the upheavals in the research space occasioned by technological advancements, as well as the response library and information professionals (LIPs) could give to the inherent challenges. Since its invention over the last three decades, the World Wide Web (WWW) with the Internet has impacted every facet of life, especially the research space. As such, the e-Research phenomenon and Open Access principle are typical foreground capabilities of the WWW and the Internet.

E-Research is a derivative of e-Science, which is the "shorthand for the set of tools and technologies required to support collaborative, networked science" (Hey, T. & Hey, J., 2006, p. 517). The term is more inclusive of non-scientific disciplines (Appelbe & Bannon, 2007; Jones, 2008; O'Brien, 2005). It represents the fourth research methodology or paradigm of science, also referred to as "networked" or "data-driven" science (Hey, T. & Hey, J., 2006), that is preceded by theory, experimentation and large-scale computational simulation paradigms (Lynch, 2009).

The whole idea about e-Research is to empower scientists to do their research in faster, better and different ways through applications that will enable them to access, move, manipulate and mine data (Hey, T. & Hey, J., 2006) across space and time. However, it must be noted that e-Research appears to have both unique characteristics and benefits that equally pose some challenges for information professionals. Lewis (2010, p. 8) summed its characteristics as:

- Data-intensive: generating and often using large volumes of data
- Collaborative: involving researchers across multiple institutions, and often transitionally
- Grid-enabled: using high-capacity networks and middleware.

Carlson, Fosmire, Miller and Nelson (2011) provided insight into the benefits of e-Research. First, it increases the capabilities of researchers to ask new questions. Second, it reduces the

barriers of time and geography to form new collaborations. Finally, it promises to produce important and priceless cultural and scientific data. However, Carlson et al. (2011, p. 630) observed that the capture, dissemination, stewardship and preservation of digital data constitute the critical issues in the development and sustainability of e-Research.

Apart from e-Research, another important source of research data that is worth discussing is the "long tail of science." This refers to small-scale scientific projects yielding "research" level data collections that "in aggregate are highly heterogeneous and tend to be isolated in scientists' offices and laboratories, yet they account for a substantial portion of the data assets at any given research university" (Palmer, Cragin, Heidorn & Smith, 2007, "Introduction," para. 1). Ray (2013, p. 3) provided a justification to pay attention to data from the long tail of science when she observed that "data that result from smaller projects often are more difficult to manage than big data because they are highly heterogeneous, require more individual attention per byte, and tend to be less well documented."

However, arising from e-Research and the long tail of science is the challenge of preserving data in a form that they can be used by scientists other than those who created them (Hey & Trefethen, 2003, p. 13). Moreover, data differ fundamentally from text-based research output in a number of aspects such as the nature of the information content, the role it plays in the scholarly communication cycle, metadata required for effective discovery, its potential use, intellectual property right ownership, and contributors' perception to archiving. The implication of all these is a transformation in the scholarly communication cycle and managing datasets will require an approach different from that used for text-based publications. This translates to a new role in RDM which is contextualised in this study as the data librarian (DL) role.

However, there is the need to clarify between the data librarian in this study (see Section 1.11) and other contexts of the term. For instance, the data librarian as discussed by Liscouski (1997) is a software package designed to manage data files created by laboratory instrumentation. Also, as seen in the works of Martinez-Uribe and Macdonald (2009) and Xia and Wang (2014) the term referred to a category of information professionals who manage social sciences data.

1.3 Background to the Study

It is within the challenges of e-Research, notably the generation of large amount of data (Borgman, 2010; Salo, 2010) and transformation of the scholarly communication cycle

(O'Brien, 2005), that university libraries (a type of research organisation) have a partnership and data stewardship role (Brandt, 2007; Hey, T. & Hey, J., 2006). Currently, institutional repositories (IRs) are being utilised to actively support the e-Research lifecycle (Wong, 2009; Henty, 2008). Moreover, e-Research implies that it is now critical for researchers to understand how to undertake high quality research in this technology era as well as manage their voluminous data. It must be noted that academic libraries have been longstanding memory institutions and stakeholders to learning and teaching so that their staff may play a role in developing this understanding. Such a supportive role of the library as an e-Research stakeholder translates to RDM involvement and points to the role of the DL (Martinez-Uribe & Macdonald, 2009).

It is apparent that the DL role in relation to e-Research/RDM support seems to not enjoy much attention yet in the research literature. Rather, data roles are considered within two broad perspectives. First, some authors focused on RDM: Cox, Verbaan and Sen (2012), Pryor and Donnelly (2009), and Swan and Brown (2008). Second, some other authors focused on e-Science librarianship: Alvaro, Brooks, Ham, Poegel and Rosencrans (2011), and Kim, Addom and Stanton (2011). However, the aspect of library involvement in e-Research and data management has witnessed very scanty research generally but in New Zealand especially. Also, the RDM literature tends to focus on academic/research (university) libraries (e.g. Henty, 2008; O'Brien, 2005; Soehner, Steeves & Ward, 2010) and institutional repositories (e.g. Bennett, 2010; Otto & Ralston, 2012; Wong, 2009) and excludes research institute libraries or information centres.

Of the available studies, consideration was given to how libraries can play a RDM role (Puttenstein, 2012) as a stakeholder (Melnarowicz, 2012) in particular universities and the exploration of research data hosting or services in a university library or institutional repository (Bennett, 2010; Wong, 2009).

However, for New Zealand in particular, there are very few RDM or the broader research support-related studies. Elliot (2009) reported of a biodiversity data management project at the University of Otago. She observed that the project activities brought the Library into the offices of the scientists and other researchers and reminded many of "the library's potentials in the emerging e-Research environment". Through a survey strategy, Brown (2010) investigated the level of involvement of academic librarians in the practice of data curation in New Zealand higher education institutions. Although she found out that the involvement of

the librarians in actual data curation projects was very low, she also identified a considerable potential for librarians to use their expertise in collaborative data curation projects with researchers. However, only the University of Canterbury was included in a later study on the research support role and skills of subject/liaison librarians conducted by Auckland (2012). Another study involving (all 8 universities of) New Zealand, the UK, Australia and Ireland confirmed relatively low levels of RDM activity in all four countries (Corall, Kennan & Afzal, 2012; 2013; Kennan, Corral & Afzal, 2014). These few RDM-related studies involving New Zealand partly justify New Zealand as a case situation for this study.

1.4 New Zealand as Case Situation for the Study

Beside the fact that a few RDM-related studies on New Zealand exist, there are developments from the New Zealand e-Research landscape that indicate that "data deluge" may be around the corner. The situation requires urgent preparation for much-needed early intervention. First, the e-Research New Zealand Community, notably, has been running annual symposia since 2010 and has drafted *A Framework for e-Research Adoption* (2012). This document observed that there are growing expectations for robust data management within the New Zealand research community (p. 30) to enable sharing among researchers.

Second, the National e-Science Infrastructure (NeSI) project was articulated in 2010 "to empower New Zealand researchers to fully realise their potential through the provision of, and ready access to, world-class computational and data-intensive research infrastructure" (*National e-Science Infrastructure Investment Case*, 2010, p. 8). The effective utilisation of this infrastructure by the researchers will translate to producing much data that need to be managed, preserved and made available to those who may need them.

Apart from these developments, there are other points of note that make New Zealand a research interest. For instance, information regarding RDM in New Zealand research organisations (ROs) is sketchy. *A Framework for e-Research Adoption* (2012, p. 10) mentioned that the New Zealand universities are only advanced in (non-data) open access publishing using institutional repositories while a few Crown Research Institutes (CRI) seem to be embracing RDM. Thus, RDM in New Zealand ROs appears fragmented. This may be due to the fact that the emphasis of the government as well as the e-Research New Zealand Community is on high performance computing (HPC) only. The non-consideration of RDM suggests that New Zealand may be at risk of losing much of its research data. Moreover, it is revealing that *Open*DOAR records of the New Zealand university institutional repositories

reflect low content on the average. This is partly due to the fact that these repositories have traditionally been focused on (text-based) journal publications and preprints (Otto & Ralston, 2012) to the exclusion of research data.

From the foregoing discussion, an exploratory study of the DL role in New Zealand ROs was contemplated and deemed necessary.

1.5 Statement of Problem

The specific problem this study sought to explore is that RDM appears fragmented and uncertain in New Zealand ROs. This is particularly critical when weighed against two important facts. First, scientists increasingly value their raw data more than the bibliographic expression of that data (Joint, 2007). It is data, whether the big data from cyberinfrastructure or small data from the long tail of science, that fuels research. If such heterogeneous and voluminous data would not be managed, invariably they will be lost with their intrinsic value and will undermine the sustainability of e-Research and reproducibility of research.

Second, in the developed countries with strong e-Research tradition, such as the USA, UK and Australia, RDM has had to strenuously chase after data deluge. It becomes sensible to think of early intervention in the case of New Zealand with a bourgeoning e-Research landscape through focusing on the DL role. However, the factors that can influence this role in the ROs are unclear. Furthermore, the specific training needs for the information professionals to step up to that role as well as the appropriate up-skilling mode for satisfying them are also not known. Thus, it became expedient to undertake this study aiming to understand these issues in order to provide a necessary background for early RDM intervention in New Zealand ROs.

1.6 Justification for the Study

The justification for this study could be found on many fronts. First, it follows that "well-managed data in digital form have great potential to be searched, accessed, mined and re-used" (Wong, 2009, p. 125). Also, Ray (2013, p. 7) reasoned that "good management practices ensure that data can be discovered and validated if it is challenged or needs to be re-examined for any reason." Such a RDM role defaulting to the library as an e-Research stakeholder translates to the role or position of the DL (Martinez-Uribe & Macdonald, 2009). RDM hinges on the purposes of scientific record, of which data is a part of its aggregate (Lynch, 2009). According to Lynch (2009, p. 178), "the scientific record is intended to do a number of things," as summarised below:

- It is to communicate findings, hypotheses and insights from one person to another, across space and across time.
- It is a vehicle for building up communities.
- It is a vehicle for a form of large-scale collaboration across space and time.
- It can be used to establish precedence for ideas and results.
- It enhances reproducibility which is tied to trustworthiness, collaboration and building upon the work of others.

In relation to the last point, it follows that additional work will help "to place the initial results in better context, to perturb assumptions and analytic methods, and to see where these changes lead" (Lynch, 2009, p. 179).

The second justification for this study relates to the nature of data-intensive science which consists of three basic activities: capture, curation and analysis (Bell, 2009, p. xiii). The activities are in a continuum so that any gap creates a distortion and frustrates the process. Bell (2009, p. xiii) argued that uncurated data is guaranteed to be lost. This fact must be weighed against the backdrop, as was mentioned earlier and must be reemphasised, that the capture, dissemination, stewardship and preservation of digital data constitute critical issues in the development and sustainability of e-Research (Carlson *et al.*, 2011, p. 630).

Finally, this study finds justification in its benefits to RDM stakeholders. First, it may enable the LIP in New Zealand ROs to step up to the implied role and skills needed to support e-Research and boost research through RDM. Second, the study equally offers insight to the managers of New Zealand university and CRI libraries on how to initiate or review and improve their response to the RDM challenge. Third, it may enable library schools to turn out graduates relevant to e-Research/RDM support. Besides, it boosts the literature on the skill/training needs of LIP for the DL role and library involvement in RDM. Finally, the study contributes to the theory and practice of academic librarianship with particular respect to the model, Data Librarian Role Blueprint (the Blueprint).

1.7 Aims of the Study

The specific aim of this study is to explore the dimensions of the DL role in New Zealand ROs.

Lewthwaite (2006, p. 300) submitted that "a role is a position defined within a group that is defined by expectations and needs" and that "roles in an organisation can be defined by titles and job descriptions." It is the different but related aspects of a role such as the influencing factors, duties and requirements (performance components), and the training needs for its prospective occupants that constitute its dimensions.

1.8 Research Questions

In relation to the above aim, the main question which this study seeks to answer is:

What are the dimensions of the DL role in New Zealand ROs?

However, in order to make for manageability, this question is divided into the following specific questions:

1. What factors may influence the DL role in New Zealand ROs?
2. What are the performance components of the DL role in New Zealand ROs and how are these different from those of the research support librarian (RSL) role?
3. What is the nature of the training needs of the LIP and what are their options for meeting them in order to play the DL role in New Zealand ROs?

1.9 Overview of the Conceptual and Methodological Basis of the Study

The parameter of professional work from Abbot's (1988) *The System of Professions* provided the conceptual background to the model that guides this study. The study follows the social constructivism paradigm and case research approach which is amenable to exploratory investigation and studying emergent phenomenon. The case in this study is *the DL role in New Zealand ROs* and the case design favoured is Creswell's (2007, p. 74) 'single instrumental case study' design clarified as where a researcher focuses on an issue or concern before selecting one bounded case to illustrate it. So, the case is bounded within New Zealand and the ROs including some universities and CRIs were chosen as the case institutions for the study.

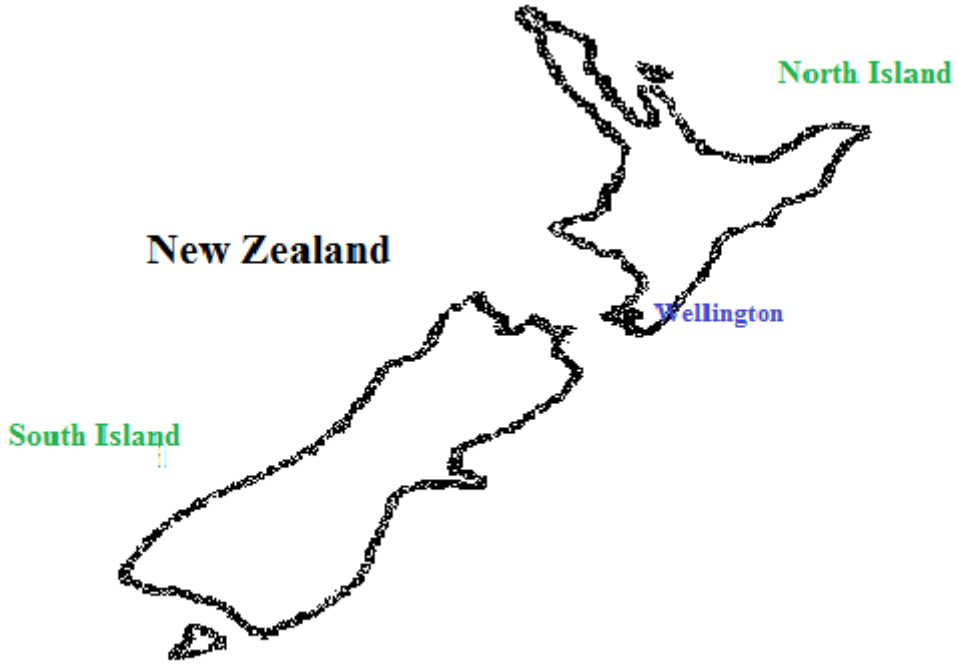
1.10 Scope of the Study

This study is delimited to the role of academic/research librarians in terms of supporting e-Research/RDM in New Zealand ROs. While New Zealand is the case situation or country of study its ROs are the case institutions.

1.10.1 New Zealand.

New Zealand (Aotearoa) is a small independent island country (an archipelago) of about four and half million people that has Wellington as its capital city and lies in the South Pacific about 1,000 miles (1,600 km) southeast of Australia and southwest of Polynesia (Dalziel, 2016; Walrond, 2015). It is a parliamentary democracy but also a constitutional monarchy (Wilson, 2015). Figure 1.1 shows a map of New Zealand and its capital and two main parts.

Figure 1-1: Map: New Zealand.



(Adapted from Infoplease.com)

The choice of delimiting the country of study to New Zealand arises from a combination of factors. First, there's the need to close a gap in the literature[1]. Second, it is based on personal interest arising from developments in the New Zealand e-Research landscape in relation to the country's RDM profile. Third, it is the country of my academic institution that gives me the advantage of logistics in terms of proximity. Fourth, it makes for a manageable scope of study within the constraints of a PhD study in terms of the time and money required to cover a wider scope.

[1] See the last paragraph of Section 1.3 for more information on this.

1.10.2 Research organisations.

The study is delimited to the university and CRI categories of ROs that are both government-supported and also provide a context of research support services.

In terms of the history of universities in New Zealand, the University of Otago established in 1869 comes first. However, it was in 1961 when the University New Zealand education system was dissolved that the formal history of universities[2] began (Pollock, 2015). Nathan (2014) revealed that it was in the 1960s that research-based PhD degrees started to be awarded. Currently, there are altogether eight universities in New Zealand. They include Auckland University of Technology (Auckland), Lincoln University (Lincoln, Canterbury), Massey University (Palmerston North, Auckland, Wellington), University of Auckland (Auckland), University of Canterbury (Christchurch), University of Otago (Dunedin) and (Invercargill), University of Waikato (Hamilton), and Victoria University of Wellington (Wellington).

Nathan (2014) provided some insight about the New Zealand universities. First, the purpose and role of these were defined by the Education Act 1989. The universities are seen as "institutions of advanced learning, where research and teaching are interdependent, and where teaching is conducted by people active in advancing knowledge." As such, they serve as "the critic and conscience of society." Second, research in New Zealand universities is of different types and in a wide range of disciplines. However, more applied research is undertaken by other types of ROs such as the CRIs.

The CRIs emerged in the wake of a continuing reorganisation of government departments from the 1980s as a replacement for the Department of Scientific and Industrial Research (Nathan, 2014). The website of the Ministry of Business, Innovation and Employment (MBIE) provides further information on the CRI. Initially eight in number, the CRIs formed in 1992 are scientific research companies owned by the Crown or New Zealand Government. They include AgResearch, Institute of Environmental Science Research (ESR), Institute of Geological and Nuclear Science (GNS), Landcare Research, National Institute of Water and Atmospheric Research (NIWA), Plant and Food Research, New Zealand Forest Research Institute (Scion), and Industrial Research (that has ceased to be a CRI and as of February 1, 2013 became Callaghan Innovation).

[2] As the polytechnics, the universities in New Zealand are publicly owned (Pollock, 2015).

Nathan (2014) provided further information about the purpose, revenue and role of the CRIs. The government established the CRIs in 1992 for the respective sectors of the economy or grouping of natural resources in order to undertake research in strategic areas of science that are of long-term relevance to the country and serve a range of clients. Both the public and private sectors constitute the sources of revenue with about half from the government funds mainly allocated through the MBIE. In terms of their functioning, there are three clear roles. One, they are to carry out research in applied sciences in relation to national research priorities. Two, they are to do consulting work in their field of expertise with the aim of a quick transfer of the research results to clients. Finally, they are to carry out essential services funded by the government such as fish stock assessment, forensic work, etc.

1.11 Definition of Key Terms

Data Librarians are "people originating from the library community, trained and specialising in the curation, preservation and archiving of data" (Swan & Brown, 2008, p. 1).

E-Research "is the more general version of e-Science and includes non-scientific research, such as humanities and social sciences, and is also characterised by the need to use distributed computing resources for collaboration and sharing of knowledge" (Hunter, Cook & Pope, 2004, p. 2).

E-Science "is the term that is given to large scale science that is increasingly being carried out through distributed, global collaborations, enabled by the Internet and related technologies" (Hunter, Cook & Pope, 2004, p. 2).

Institutional repositories: "An institutional repository is a type of digital library that 'capture[s] the original research and other intellectual property generated by an institution's constituent population active in many fields'"[3] (Burns, Lana & Budd, 2013, para. 2).

Performance components are "are the component attributes of the performer as well as the components of occupational tasks" (Ranka & Chapparo, 1997). However, in this study they are limited to the duties and requirements for a professional role such as the DL.

Research data are "the factual records (e.g. microarray, numerical and textual records, images and sounds, etc.) used as primary sources for research, and that are commonly

[3] This quotation part of the definition was picked from a position paper by Crow (2002).

accepted in the research community as necessary to validate research findings" (CARL Data Management Sub-Committee, 2009, p. 4).

[Research] Data management: "Practices through the entire lifecycle of the data, from planning the investigation to conducting it, and from backing up data as it is created and used to long term preservation of data deliverables after the research investigation has concluded" (*Texas A&M UL Research Guides*).

Research Data Services: "Research data services are services that address the full data lifecycle, including the data management plan, digital curation (selection, preservation, maintenance, and archiving), and metadata creation and conversion" (Tenopir, Sandusky, Allard and Birch, 2012, p. 2).

Research Organisation: "An entity, such as university or research institute, irrespective of its legal status (organised under public or private law) or way of financing, whose primary goal is to conduct fundamental research, industrial research or experimental development and to disseminate their results by way of teaching, publication or technology transfer" (*Community Framework*, 2006, p. 9).

1.12 Outline of the Thesis

This thesis is structured into seven chapters. In this chapter, I provided the introduction to the study. Beginning with the motivation for the study I extended to other areas that constitute a necessary background for understanding the study. In Chapter 2, I review the core literature that is relevant for the study. In Chapter 3, I present the conceptual model that undergirds the study and describe the research approach that I employed for the study. Chapter 4 provides an analysis and synthesis of three sources of data that provide a filter for discussing the findings of the main study presented in Chapter 5. Chapter 6 presents a discussion of the emergent Data Librarian Role Blueprint in the light of the findings. Finally, in Chapter 7, I provide a reflection on case research approach that was used for the study and outline the quality, contributions/implications and limitations of the study, as well as the areas for future research.

CHAPTER 2: LITERATURE REVIEW

This study aimed to explore the dimensions of the data librarian (DL) role in New Zealand research organisations (ROs). In this chapter I review the key literature in order to provide relevant background to this study. The search strategy used is first provided followed by the review. However, the review is organised around three main sections: academic librarianship; the e-Research paradigm; and the pervading influence of e-Research and data on the library domain. The ever-changing domain of academic librarianship provides a background for understanding the implications of the e-Research paradigm which is the latest challenge impacting it.

2.1 A Literature Search Strategy

Pickard (2013, p. 25) clarified that a literature review could do the following:

- Clarify your own research aims
- Provide you with the depth and breadth of subject knowledge
- Form the theoretical framework for your own empirical investigation
- Contribute to your research design

These underline the pivotal place of literature reviews in studies. However, to realise the aims of doing a literature review a good search strategy needs to be put in place. The reason for such a search strategy is to identify the key literature that may provide the necessary understanding regarding the area of the intended study.

In this study, the aim of a search strategy that was put in place was to identify the key literature relevant to the understanding about the involvement of academic libraries in e-Research/research data management (RDM) support role. Therefore, the initial search question was how are academic libraries involved in e-Research/RDM support? The Victoria University of Wellington's databases/systems for information studies were primarily searched. These were Library, Information Science & Technology Abstracts, Emerald, EBSCOhost, Scopus, Library and Information Science Abstracts, and Encyclopedia of Library and Information Science (3rd edition). The initial keywords used for the searching were e-Science, e-Research, RDM, academic libraries, academic librarians/hip, data curation and institutional repositories. However, data librarian and data librarianship were later added to the list.

In terms of the search techniques employed, the key words were stringed for Boolean or phrasal searching. Also, the references of some literature were used for backward searching. The limiters to the search comprised the literature in English Language and those published from 2000[4] onwards. Moreover, Google and Google Scholar were also used for searching. The results of searches were subjected to an evaluation and the main selection criterion was perceived relevance. A source was adjudged relevant in relation to enhancing an understanding of e-Research, RDM, and academic libraries/librarians or if it focused on the relationship between e-Research/RDM and academic libraries and/or institutional repositories.

The types of sources selected were limited to journal articles, books/book chapters, conference papers, research reports, theses/dissertations, white papers and Web documents. The selected literature from different sources was de-duplicated and content-analysed. The result of the analysis in the form of themes are used to discuss the review further below. The three main areas covered are academic librarianship, the e-Research paradigm and the influence of e-Research and data on the library domain.

However, it was anticipated that more publications on the subject of study would be produced before the study would be completed. As such, the literature would require being updated. This was done through Scopus in a few ways. First, the names of leading authors (e.g. Carlson, Corrall, Cox, Creamer, Kennan, Lyon, Pinfield, Verbaan, etc.) were entered into Scopus to identify their current works. Also, the keywords e-Research, RDM and academic libraries were singly used and stringed to perform keyword, Boolean and phrasal searching to identify current works in the study area by other authors. The results were evaluated and the relevant sources were retrieved, analysed and used to update the literature.

2.2. Academic Librarianship

Academic librarianship is the profession practised by those who work in libraries associated with institutions of higher education of various types and levels (Moran & Leonard, 2010, p. 1). Such publicly or privately funded libraries of institutions of higher education are called academic libraries (Curzon & Quinonez-Skinner, 2010, p. 11). These academic libraries are related to research libraries. However, a difference must be made between ‘research libraries’ as a configured term and a perspective from the United States of America (USA), and the

[4] The year 2000 was chosen as a starting point because it followed the year that the term e-Science was coined. See Section 2.2.

same term as a concept. As a configured term, *the International Encyclopedia of Information and Library Science* (2003) revealed that the term emerged since the formation of the Association of Research Libraries in 1932 as an umbrella term of practical utility rather than as a concept. In relation to this, Anderson (2011, p. 289) clarified that, as currently configured, the phrase 'academic research library' is designed and organised for solving common problems of the members of the Association of Research Libraries. These member libraries include the university, public and special library categories from the USA and Canada.

On the other hand, as a concept, *Harrod's Librarians' Glossary and Reference Book* (2005) defined a research library as "a library consisting of specialised documents and information sources, and providing facilities for undertaking exhaustive investigation". The academic libraries of research universities may include research libraries/information centres of the constituent or affiliated research institutes/centres of their parent institutions. Research libraries can also be part of non-university organisations like the research institutes. However, supporting research and researchers in its parent organisation appears to be common to both academic and research libraries. In this sense, a discussion on research support within academic librarianship is deemed relevant to research libraries. The next section focuses on the mission and role of academic libraries.

2.2.1. The mission and role of academic libraries.

Buckland (1989, p. 389) pitched the foundations of academic librarianship on two basic elements: mission and role of academic libraries. The *Merriam-Webster Online Dictionary* defines mission as "a pre-established and often self-imposed objective or purpose". Since the university is a functioning centre for teaching, researching and learning with the library as the hub of its work (Kargbo, 2001), the academic library is tied to the mission of the university (Dillon, 2008). Accordingly, a consistent and acceptable core mission of academic libraries and primary mission of academic librarians is to support teaching, learning and research efforts of the parent institution's faculty, staff and students (Thachill, 2008; Cain, 2003). Dillon (2008) emphasised that "such a purpose is noble, and to some extent immune from shifts in technology, though one must accept both the threats and opportunities that such shifts might enable" ("Library as the accelerator," para. 1).

A secondary mission, especially for academic libraries of publicly supported institutions, is providing "at least limited services to individuals not formally affiliated with the institution"

(Moran & Leonard, 2010, p. 1). However, the role of academic libraries ought to be discussed and/or viewed against the background of their mission. It follows that the role is a functional position to reach some goals defined by the mission statement that should support the university's strategic plan (Svenningsen & Cherepon, 1998).

It is important to note first that the academic library is a complex socio-technical system serving many stakeholders (Dillon, 2008). However, the role of academic libraries can be viewed from two perspectives. In a general sense, as the hub of university work, academic libraries primarily play an educational supportive role to their constituency (Kargbo, 2001) as well as the accelerator of discovery (Dillon, 2008). In this regard, Kargbo (2011, p. 91) listed their aims and objectives as follows:

- Provision of facilities for study and research, geared closely to academic setting of the parent institution.
- To secure, organise and service book and non-book materials required for the instructional programme.
- Provision of current reading materials for keeping lecturers abreast of their fields of teaching and doing individual research.
- Instructing students, specifically freshmen, on the effective use of the library and its holdings.
- Encouraging students to develop the habit of self-education in order that library stock may contribute to their intellectual development and output.
- Cooperating with other libraries in and outside the country through exchange and inter-library loans.

These aims and objectives appear typical of the traditional academic libraries of the print regime and definitely are not enough for the challenges of the digital era. Factors exerting influences on the roles of academic libraries are discussed in subsequent paragraphs. However, their impacts have been discussed for both the present time and the future in terms of evolving specialties (Cox & Corrall, 2013), changing (Thamaraiselvi, 2009) or new roles and services (Kumar, 2009; Thachill, 2009), features (Tikeker, 2009) and models (Gayton, 2008; Wawrzaszek & Wedaman, 2008; Lewis, 2007) for academic libraries.

However, in a specific sense, academic libraries may appear "to change in response to the changes in their parent institutions" and "to vary in the types of staff they employ, in the services they offer, and in the roles they play within their parent institutions" (Moran & Leonard, 2010, p. 2). Certain factors are responsible for influencing changes in academic libraries. While some of them are peculiar to given environments others are universal and have salutary effects.

Factors affecting academic libraries have been conceptualised as barriers to the fulfilment of its mission (Friend, 1998), forces of change (Curzon & Quinonez-Skinner, 2010; Hazen, 2000; Butcher, 1999) and paradigm shifts (Martell, 2009; Ross & Sennyey, 2008; Rice-Lively & Racine, 1997). Although most of these authors appear to be biased towards the United States of America (USA), nonetheless, their views may be universally applicable. Cullen and Calvert (2001, p. 394) pointed out that "in the digital environment it might seem that all academic libraries are grappling with the same issues and being forced into the same decisions." It must also be clarified that of the three groups of factors mentioned above, technology is the most commonly mentioned or thread running through them.

In the face of technology-driven changes, one question of consideration is whether the pace of change has altered the mission of academic libraries. The plausible answer is that it does not re-define or change academic libraries' mission which has been fulfilled against a background of change and, so, only needs to be re-interpreted (Friend, 1998) and necessitates looking for ways of harnessing change to fulfil the mission of libraries. However, accommodating changes within academic libraries may entail forcing more responsibilities from them either by expanding or refining the job jurisdiction of their staff, especially the professional category. Dolan and Schumacher (1997) revealed that libraries have had to respond to changes by either re-defining or designing new jobs which amounts to changing role performance components for academic librarians.

2.2.2. The changing role performance components of academic librarians.

As a complex system, the academic library has a mixture of personnel in its staffing (Curzon & Quinonez-Skinner, 2010; Moran & Leonard, 2010). However, Moran and Leonard (2010) gave the perspective of the USA where the personnel are categorised into professional librarians, who have an ALA- American Library Association-accredited master degree from a library and information science (LIS) graduate programme or its equivalent, and the paraprofessional or support staff constituted by those without the fore-mentioned credential.

But, Curzon and Quinonez-Skinner (2010) offered the picture of what appears generally to be obtainable elsewhere and include the categories of librarians (having a degree in LIS), library assistants (specialists in the work of libraries without an LIS degree), clerical staff, student employees, administrators, and other specialists in the fields of accounting, personnel, building management and technology. Although the number of professional or academic librarians may be small relative to the total number of personnel, as Curzon and Quinonez-Skinner (2010) informed, they enjoy greater prominence and visibility than others that their role warrants a focused attention.

In discussing the role of academic librarians, the perspective of paradigm shifts discussed briefly in the previous section should readily come to mind. In the first paradigm the academic librarian functioned as keeper of knowledge whose role included organising and providing access to the collection, maintaining the facilities that house those collections, and easing access for the reader to gain knowledge (Rice-Lively & Racine, 1997, p. 34). But, in the second or digital paradigm the academic librarian has become an information professional described as an informer, a communicator and a network navigator (Rice-Lively & Racine, 1997, p. 33). Following this paradigm shift is the evolution of academic library specialties among the academic librarians (Cox & Corrall, 2013).

In order to understand the role dimensions of the academic librarians, attention must be turned to their work setting or environment where they function. Generally, everyone working in the library is meant to fulfil the library's mission (Moran & Leonard, 2010). However, specific to academic librarians, they have traditionally had to work in three functional areas housing the service units that imply certain duties and requisite skills as can be seen from Table 2-1.

Table 2-1: Functional Areas, Service Units/Services and Skills/Traits of Academic Librarians.

FUNCTIONAL AREA	SERVICE UNITS/SERVICES	SKILLS & TRAITS RELEVANT TO ACADEMIC LIBRARIANS
General	All service units	Effective communication; Ability to use technology; Ability to change, learn and grow; Collaboration; Team work; Assessment and evaluation; Marketing; Leadership; and Innovation
Technical Services	Collection development; Acquisitions; Conservation; Preservation; Library systems; and Information technology	Project management; Working knowledge of cataloguing standards; Metadata; Scholarly communications; Automation; Database management; Bibliographic control; Library materials selection theory; Negotiations; Intellectual property; and licensing skills (for acquisitions)
Public or User Services	Circulation; Reference; Interlibrary loan; Outreach; Security; Instruction; Special collections; Journals and microform; Government documents/maps; Computer assistance; Imaging services; Course reserves; Exhibits; and Service for specialised collections	Passion for customer service; Instructional design; Planning ability; Presentation skills; Knowledge of copyright law; Subject expertise; Ability to collaborate with users and colleagues; Ability to evaluate and assess services; Ability to integrate information literacy in more places than in the one-shot instruction session
Administration	Office of the University Librarian as well as management and staff personnel associated with planning, policy-making, budget, personnel, facilities, security and fund-raising (e.g. assistant or associate university librarians)	Leadership; Ability to develop and maintain the library budget; Analyse trends for decision-making; Advocate for the library; Provide vision; Understand the higher education processes, collaborate with other libraries and with other administrators; and Communicate within and without the library

Note: The table is based on Curzon & Quinonez-Skinner (2010) and Moran & Leonard (2010).

Table 2-1 shows the service units/services and the applicable skills and traits relevant to the academic librarians working in each functional area. Quinonez-Skinner (2010) offered some useful hints on these functional areas. While the Technical Services division oversees the acquisition of materials for the collection in enhancing the fulfilment of the mission of the library's parent institution, the Public Services division is purposed to connect the user to resources and encourage the use of those resources in scholarly activities. On its part, the Library Administration is burdened with the task of providing leadership in managing

resources, decision-making and enforcing policies and regulations. However, in terms of the positioning of the academic librarians on the organogram, the heads of the Technical Services and Public Services divisions are accountable to the management staff (Associate University Librarians) who in turn report to the University Librarian (UL).

The factors affecting academic libraries that were discussed earlier are also, by extension, influencing the roles of academic librarians and their performance components. Some of these and other factors are discussed in some literature. Simmons-Welburn (2000, p. 9) noted in the particular case of a survey of member libraries of Association of Research Libraries as it relates to the role of librarians, that "the changes have been caused, in part, by technological advances, reorganisations, more focus on libraries as learning organisations, the use of teams and team-based approaches to tasks, and a recognition of diversity's importance to organisational development". Shupe and Pung (2011) contextualised these factors as technological changes and shifts in the instructional needs and models used in universities. Overall, technology is consistent among all the mentioned factors as the single dominant factor occasioning changes in the role of academic librarians. To this end, it appears that the digital age has exerted more impact on the library domain than any other phenomenon.

Examining "the changing nature of work in academic libraries", Lynch and Smith (2001) discovered, among other things, that by 1998, all academic library jobs routinely included computer technologies. Also, Butcher (1999, p. 350) confirmed that "most library work is done on computers with software that is being upgraded regularly". However, Choi and Rasmussen (2009) noted that the adoption of digital technology has consequences for organisational structure, staff resources, workload and existing practices in academic libraries. Indeed, the digital age has raised some issues and challenges against which librarians must play new roles such as the following discussed by Thamaraiselvi (2009, p. 141):

i. New generation of learners
ii. Copyright
iii. Privacy/confidentiality
iv. Online/virtual crimes and security
v. Technology challenges

vi. Manpower

vii. Collection of digital e-resources

viii. Organisational structure

ix. Preservation/archiving of digital e-resources

x. Lack of clarity in vision

The literature shows that academic libraries have had to respond to the digital challenge in a number of ways. Some of these ways include organisational restructuring of the library, and staff allocation and hiring of new skilled personnel in support of the changing needs (Choi & Rasmussen, 2009). Dolan and Schumacher (1997) described the latter response in terms of the academic librarian's jobs being either redefined or newly designed. Put succinctly, Butcher (1999, p. 350) asserted that "no matter where librarians work, behind the scene or with the public, the nature of their work has changed dramatically". In line with this, Thamaraiselvi (2009) predicted the roles of future academic library professionals to include leadership role, proactive information professional role, role as masters of the Web, role of information scientists in digital libraries and e-Literacy, role of digital space manager of academic institutions, and role of e-Resource managers. Some words in these roles indicate the new dimensions of the Web, digital libraries or space, e-Literacy (pointing to e-Learning) and e-Resources- birthed by the digital paradigm- being added to the role of academic librarians.

The implication of the scenario playing out is that the academic librarian roles and the performance components of those roles are changing. This is indexed by the titles of emerging positions (Dolan & Schumacher, 2010; Johnson, 2010) and in the findings of some content analysis studies (Choi and Rasmussen, 2009; Croneis and Henderson, 2002; Lynch & Smith, 2001). These studies elucidate the fact that academic librarian roles with their performance components are changing either by redefinition or expansion of existing positions, or by designing new positions, all in an attempt to face new challenges.

However, it appears that the changing role of library professionals implies a set of updated skills needed for facing the arising challenges (Thamaraiselvi, 2009, p. 143). Nonthacumjane (2011) reviewed the literature to discover the skills and competences of LIS professionals for the digital era (pp. 283-284). Her findings were articulated into three broad categories of skills set. First, there are personal skills such as being analytical, creative, flexible, reflective,

able to deal with a range of users, detective-like, adaptable, responsive to others' needs, enthusiastic and self-motivated. Second, she identified generic skills such as information literacy, communication, critical thinking, team work, ethics and social responsibility, problem solving and leadership. Finally, her discipline-specific knowledge, mostly technical in nature, comprises metadata, database development and database management systems, user needs, digital archiving and preservation, collection development, and content management systems.

2.2.3. Training needs of academic librarians.

Addressing the knowledge and skill gaps in professional positions require training and development (T & D) following needs assessment. Training implies "the process of altering behaviour and attitudes in a way that increase the probability of goal attainment" while development "means increasing knowledge" (Sahoo & Pradhan, 2013, p. 10). In the literature, training needs studies are of various sorts reflecting different foci, approaches and preferred modes. The foci include: academic librarians only (Fadehan & Ali, 2010; Ondari-Okemwa, 2000); academic librarians among other staff categories (Sahoo & Pradhan, 2013; Abba & Dawha, 2009); specific categories of academic librarians such as subject and liaison librarians (Auckland, 2012; Simmons & Corrall, 2011), bibliographic instruction librarians (Mandernack, 1990) and digital librarians (Bawden, Vilar & Zabukovec, 2005); specific categories of librarians working in academic and other libraries such as health (sciences) librarians (Tsalapatani & Kalogeraki, 2010; Petrinic & Urquhart, 2007) with science and technology librarians (Creamer, Morales, Crespo, Kafel & Martin (2011; 2012a); and institutional repository staff working in universities (Simons & Richardson, 2012).

The authors' methodologies are various but mostly quantitative [survey] (Sahoo & Pradhan, 2013; Creamer et al., 2012a; Simons & Richardson, 2012; Abba & Dawha, 2009; Mandernack, 1990). Qualitative methodologies such as observation and interviews (Ondari-Okemwa, 2000), interviews only (Petrinic & Urquhart, 2007) and literature analysis (Bawden et al., 2005) were also used as well as mixed methods such as literature reviews and surveys (Auckland, 2012) and survey and interviews (Tsalapatani & Kalogeraki, 2010). In the findings of these studies, the identified or preferred training modes or techniques include internal and external training programmes (Sahoo & Pradhan, 2013); in-service training and online workshops/seminars followed by formalised education (Fadehan & Ali, 2010); informal training such as supervisor or colleague-assisted training (Simons & Richardson, 2012); adapting formal education and continuing professional development to cover aspects

of required knowledge (Bawden, Vilar & Zabukovec, 2005); and open and distance education training online lessons and workshops (Tsalapatani & Kalogeraki, 2010).

From the foregoing, it can be deduced that choice of needs study approach should be such that is workable in a given environment and based on intent, while the preferred mode of training should be determined by the subjects of such studies.

2.3. The e-Research Paradigm

The following section is focused on a current phenomenon within the digital paradigm, the e-Research, which is having a salutary impact on academic libraries. The history of e-Research in its earlier and narrower form, the e-Science, could be traced to 1999 when John Taylor[5] coined the term (Jankowski, 2007) (see definition in Section 1.11). However, as a phenomenon prompting great shifts and continuing impact in the way that researches are being carried out in many academic fields, the more-inclusive e-Research represents a paradigm shift that now enjoys the discussion of many a researcher. As such it merits further discussion in the following subsections.

2.3.1. The concept of e-Research and related terms.

Thomas (2011) conceived e-Research as incorporating some activities, systems and services including collaborative technologies, research data management (RDM), scholarly communication, computation, visualisation, and data collection and analysis. Yet, the task of defining the concept is not that simple. Applebe and Bannon (2007) highlighted two challenges in defining the concept of e-Research. First, individual, organisational or geographical bias is blamed. Second, there is the confusion of whether the term refers to the infrastructure or the research conducted using it. Each of the existing definitions may represent either of the two types (for instance those of Hey, T. & Hey, J., 2006, p. 517 and Hunter, Cook & Pope, 2004, p. 2). But reasoning that e-Research is more about research projects than about technology is the justification for agreeing with Applebe and Bannon (2007) that it is research conducted on supporting infrastructure. However, the fact that there are infrastructure-based definitions may stem from viewing e-Research as synonymous with its tools or related terms, the cyberinfrastructure or grid (Jones, 2008; O'Brien, 2005).

[5] He was the Director General of the Office of Science and Technology in the UK and the focus of e-Science then was on the natural and biological sciences.

2.3.2. The e-Research infrastructure.

The term e-Research infrastructure (e-infrastructure) or cyberinfrastructure, given currency by Atkins et al.'s (2003) National Science Foundation (NSF) Report, refers to an infrastructure of distributed computer (grid), information and communication technologies (Jankowski, 2007, "Terms and Definitions," para. 3). Hey and Trefethen (2005) further clarified that this is a mixture of middleware services and grid. As such, cyberinfrastructure can be analysed from three perspectives. Organisationally, it is a socio-technical environment or system composed of "hardware, software, services, personnel, [*and*] organisations" (Atkins et al., 2003, p. 13) in which "trained and knowledgeable people are the single most important component" (Jones, 2008, p. 2).

As a layered architecture, the e-Infrastructure "brings together many technologies (hardware, software, processing, storage, communication, etc.) to provide a coherent end-to-end functionality in support of applications; that is, at its heart e-Infrastructure is a technological system" (Atkins et al., 2003, p. 52). First, "the base technologies underlying e-Infrastructure are the integrated electro-optical components of computation, storage, and communication". Second, "above the e-Infrastructure layer are software programs, services, instruments, data, information, knowledge, and social practices applicable to specific projects, disciplines, and communities of practice". Third, "between these two layers is the e-Infrastructure (*middleware*) layer of enabling hardware, algorithms, software, communications, institutions, and personnel" (Atkins et al., 2003, p. 5).

Finally, when viewed as services offering, O'Brien (2005, p. 74) articulated two broad aspects. The first aspect has to do with *technical infrastructure and services* (ICT infrastructure including high performance computing [HPC], networks, data management and storage, repository management grids, digitisation, statistical support, data preservation, authorisation and authentication mechanisms, and help desk). The other aspect is *leadership and coordination* (brokering the needs of academics, providing a management structure for e-Research across the university, and collaborating with the other relevant bodies on campus to foster knowledge sharing across campus communities). However, Atkins et al. (2003, p. 7) captured the comprehensive picture of the components of e-Infrastructure thus:

> The cyberinfrastructure should include grids of computational centers, some with computing power second to none; comprehensive libraries of digital objects including programs and literature; multidisciplinary, well-curated federated collections of

> scientific data; thousands of online instruments and vast sensor arrays; convenient software toolkits for resource discovery, modeling, and interactive visualization; and the ability to collaborate with physically distributed teams of people using all of these capabilities. This vision requires enduring institutions with highly competent professionals to create and procure robust software, leading-edge hardware, specialized instruments, knowledge management facilities, and appropriate training.

The inclusion of "libraries of digital objects", "highly competent professionals" and "knowledge management facilities" in this frame of thought invariably makes libraries and librarians part of the e-Research world.

2.3.3. Data, data challenge and implication for libraries.

Given the capabilities of cyberinfrastructure, collaborative and networked research is done within and across disciplines with much data being generated. This section examines the concept of data, and its challenges and implications for libraries.

The data

Krier and Strasser (2014) observed that data types can vary widely at different institutions and in different fields of study. As such the term "data" has been variously defined and conceptualised. The National Science Board (2005, p. 18) indicated that the rubric "data" is heterogeneous in its scope with its diverse nature ranging from numbers, images, video or audio streams, software and software versioning information, algorithms, animations to models/simulations. The four main kinds of data described by the National Science Board are observational data, computational data, experimental data and records (p. 19). However, data categorisation by Thomas (2011, p. 38) as outlined below is observed to be based on the processes used to gather or generate data:

- experimental data generated by lab equipment;
- computational/simulation data generated from computation models;
- observational data of specific phenomena at specific time or location;
- derived data produced via the processing or combining of other data (e.g. data mining);
- canonical data extracted from reference data sets;

- data storage solutions; and
- data curation.

Krier and Strasser (2014) discussed two main distinctions of data that suggest the forms of expressing data as well as the level of gathering them. One distinction was qualitative and quantitative data. The other was primary and secondary data that could take the form of any of observational, experimental or computational data.

However, Borgman (2015) provided a very elaborate discussion on data. She discussed the definitions and conceptual distinctions of data. She noted that data can be defined by examples in relation to what the concept includes such as the scope provided by the National Science Board cited earlier. Data can also be defined in operational contexts as done by organisations. Data can also be defined by categories in terms of distinguishing or grouping them in useful ways. The descriptions of data by other authors cited in this section are of this category. Reflecting the nuances of the various disciplines, Borgman (2015) suggested that the categorisation of data may be by degrees of processing, origin and preservation value and collections.

Borgman (2015) also addressed the conceptual distinctions in relation to the main categories of disciplines. For example, in the sciences and social sciences the distinction is between 'raw' and 'processed' data whereas in the humanities the distinction is in terms of primary, secondary and tertiary data. Borgman also clarified that, as a term, data is a plural noun, however, it is used in the singular form when referring to the concept.

As discussed in this section, the nature and scope of data imply some definite challenges to managing them. While most authors discuss these challenges in relation to all kinds of data specific attention was given to big data (Bicarregui et al., 2013) and confidential data (Lagoze, Block, Williams, Abowd & Vilhuber, 2013). The data challenge is discussed next in a general sense.

The data challenge

It follows that e-Research is encouraging the generation of immense data of different kinds. Hey and Trefethen (2003) forecasted the imminence of a 'data deluge' (flood of scientific data) in the next generation of experiments, simulations, sensors and satellites. This prediction is observed to have been fulfilled quite early so that there is the concern about how

data can be captured, curated, described, maintained, shared or accessed and retrieved for use by others besides their creators over the long term (Borgman, 2011; 2010; Gold, 2007a).

However, in addition to the size and scope of data is the challenge from their other characteristics such as variability, backlog, project orientation, and non-standard data and data formats (Salo, 2010). Equally of note is the appreciating interest of research projects in data in addition to their need for the discrete publications from various studies based on or including them. Joint (2007, p. 452) particularly noted that "increasingly, scientists value their raw data more than the bibliographic expression of that data, and view the preservation of raw data as the prime curational challenge for the knowledge professions such as librarians and archivists". This challenge has been differently pictured as an animal (Cox, Verbaan & Sen, 2014) and a "wicked problem" (Awre et al., 2015; Cox, Pinfield & Smith, 2014). Thus, RDM requires separate attention and occasions a shift in the scholarly publication cycle and model (O'Brien, 2005; Hey and Trefethen, 2003).

The implications for libraries

These data challenges have role implications for the library as a traditional custodian of knowledge: "evolving from a focus on reader services to a focus on author services" (Borgman, 2010) and "shift[*ing*] from primarily acquiring published scholarship to managing scholarship in collaboration with researchers who develop and use the data" (Lynch quoted in Goldenberg-Hart, 2004, p. 1).

Traditionally, libraries have usually not been involved in the pre-publication phase of scholarly communication. But, libraries, as memory institutions with resource management infrastructure, and librarians, as information professionals with resource/research management expertise, are believed to have capabilities to deal with the data challenges (Borgman, 2010; Jones, 2008). However, Borgman (2010) emphasised that librarians' expertise would need to be adapted through partnerships and study in order to manage data. An expanded role for research libraries in digital data stewardship was forecasted in an NSF report in 2006 (Witt, 2012) and reinforced by Soehner et al.'s (2010) findings from the survey of Association of Research Libraries (ARL) member institutions. Heidorn (2011, p. 663) advanced the following arguments for libraries to curate digital research data:

- Curation of data is within the libraries' mission, and libraries are among the only institutions with the capacity to curate many data types.

- The data are critical to the scientific and economic development of society.
- There is a large volume of data not currently being curated adequately.
- Governmental and non-governmental funding bodies are beginning to recognise the importance of data and are creating rules for people receiving funds for research and development.

To be added to this list is the fact that "throughout history, the librarian has led the way in designing and utilising new information sources and services (Allard, Mack & Feltner-Reichert, 2005). In respect of these arguments, Luce (2008) proposed three key roles for research libraries: supporting creation, connecting communities and curation. These key roles, in turn, will require the challenges of developing supporting infrastructure, disruptive thinking and novel solutions, new organisational structures and campus relationships, economic sustainability and re-skilling staff (Case, 2008; Luce, 2008).

The new data role for the libraries comprises the "upstream" (pre-publication) and "downstream" (post-publication) sides of the e-Research cycle (Gold, 2007b), and entails a range of activities which could be summed up as RDM[6]. Pinfield, Cox and Smith (2014) identified the components of an institutional RDM programme to be strategies, policies, guidelines, processes, technologies and services. However, Ray (2013) discussed both the archival and library perspectives of RDM. The archival perspective emphasises that documenting all the changes around the digital objects in the course of their preservation is necessary for secondary users requiring access to a wide range of digital content. On the other hand, the library perspective goes beyond the preservation and re-use of digital objects by others to emphasise that creators ought to be able to find their own data after its initial use.

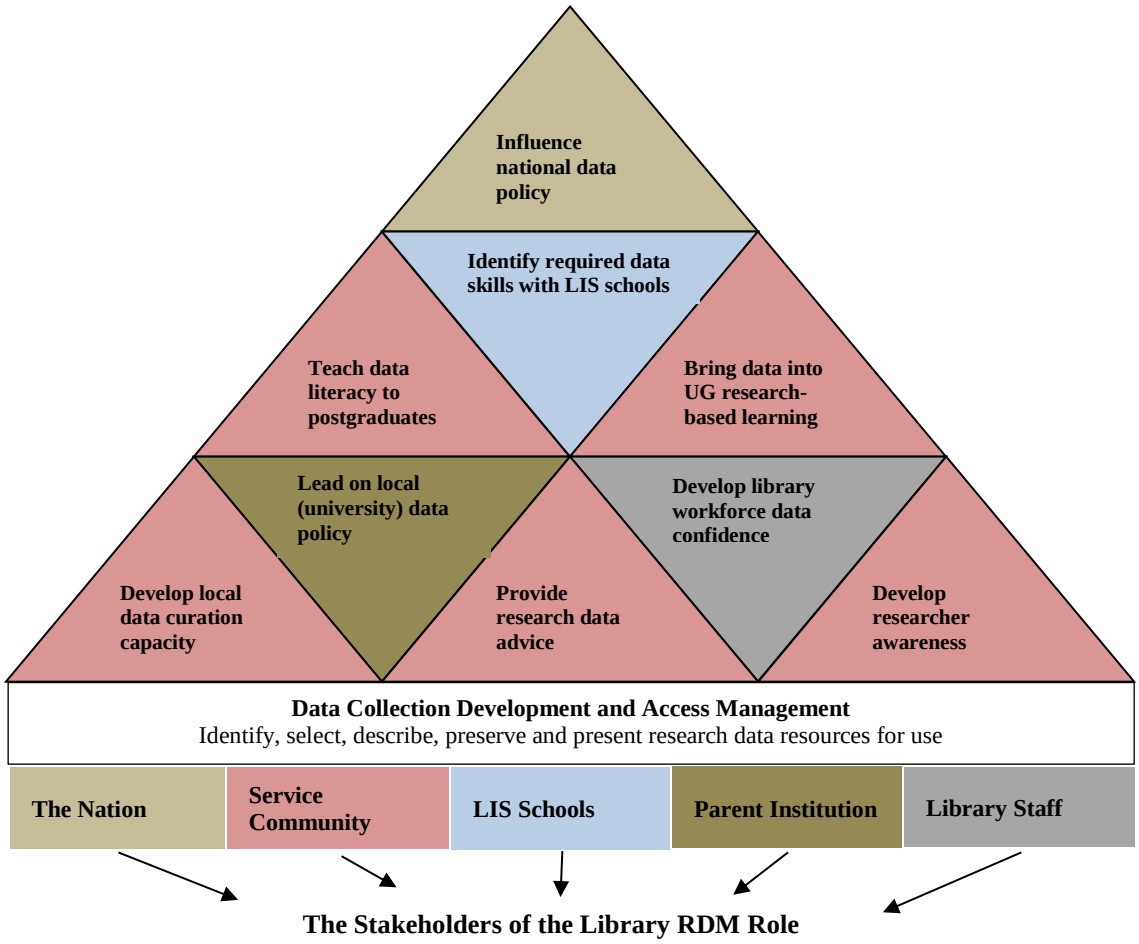
The library perspective of RDM is not only a justification for its involvement in RDM as it is also indicative of the nature of the attendant support that it could provide. The expectation that libraries and librarians are involved in RDM is evident in some studies that aimed to evaluate their respective involvements. Cox and Pinfield (2014) surveyed some UK universities in order to explore the ways in which libraries were involved in RDM and the extent to which the development of RDM services was a strategic priority for them. Also, Akers, Sferdean, Nicholls and Green (2014) investigated building support for RDM by using the case studies of eight research universities rated by the Carnegie Foundation as having

[6] See Section 1.11 for its definition.

'very high' research activities. However, Antell, Foote, Turner and Shults (2014) focused on science librarians' participation in data management at the Association Research Libraries' institutions. Studies such as Lewis' (2010) went further to look at the specific areas of library involvement in RDM.

Lewis (2010) articulated the RDM pyramid for libraries (the Pyramid) as shown in Figure 2-1. The colour depicting each triangle of role points to the corresponding stakeholder at the foot of the diagram.

Figure 2-1: Research Data Management Pyramid for Libraries.



Adapted from modified Lewis' research data management pyramid for libraries (Corrall, 2012, p. 111).

Lewis (2010) warned that the list is neither exhaustive nor definitive. Thus, Corrall (2012) added a base layer of collection development and access management to the Pyramid. She clarified that even with the base layer the pyramid falls short of the Digital Curation Centre (DCC) Curation Lifecycle Model's complete set of activities and represents a concentration

on the areas reflecting competences of librarians that are applicable to RDM. However, Lewis (2010) clarified that underlying the library RDM roles are the two key non-technical strategic challenges of funding and policy, and workforce development.

It must first be noted that the academic library is a complex socio-technical system serving many stakeholders (Dillon, 2008). The library data roles as analysed in Table 2-2 is around Lewis' (2010) Pyramid as it relates to the various stakeholders of academic libraries. The literature showed that different institutions are approaching RDM differently based on their own circumstances and needs (Pinfield et al., 2014; Ray, 2013) with different stakeholders such as the support services and academic staff becoming involved (Pinfield et al., 2014). Also, it shows that the components of the Pyramid have been written on within some related topics.

Table 2-2: Library Data Role Indices.

LIBRARY DATA STAKEHOLDERS	LIBRARY DATA ROLE (RDM Pyramid)	RELATED TOPICS IN LITERATURE	AUTHORS
Library Staff	Develop library workforce data confidence	Research data workforce	E.g. Varvel, Palmer, Chao & Sacchi (2010)
LIS Schools	Identify required data skills with LIS schools	Assessment of e-Science educational needs of librarians; Evaluation of e-Science librarianship programme	E.g. Creamer, Morales, Crespo, Kafel & Martin (2011); D'Ignazio, Qin & Kitlas (2012)
The Nation	Influence national data policy		
Parent Institution	Lead on local (university) data policy	Data management and distribution policies; (Research) data sharing	E.g. Steinhart (2006); Green, Macdonald & Rice (2009); Borgman (2010); Nicholson & Bennett (2011)
Service Community (researchers and students [PG/UG])	Bring data into undergraduate research-based learning	Data literacy	E.g. Stephenson & Caravello (2007)
	Develop local data curation capacity	Data curation; Data curation profile or data interview; Data hosting (institutional repository [IR])	E.g. Lage, Losoff & Maness (2011); Martinez-Uribe & Macdonald (2009); Wong (2009)
	Develop researcher awareness	Data services: assessing needs/promoting services	E.g. Read (2007)
	Provide researcher data advice	Data [support] services	E.g. Reznik-Zellen, Adamick & McGinty (2012); Bennett (2010)
	Teach data literacy to postgraduates	Data literacy	E.g. Carlson, Fosmire, Miller & Nelson (2011)

Note: Table 2-2 is developed around the Pyramid.

These library data role activities can be contextualised as specialised services unit within the Public Services area (see Table 2-1). It is observed from this table that while some roles have enjoyed some attention in the literature others have not. However, *Influence national data policy* is observed to be yet in need of the attention of authors. Instead of academic libraries, the information from Jones (2012) shows that the library community at national levels and various corporate research bodies are more proactive in this respect as her examples found in Australia, the UK and the USA suggest.

In Australia, the National Health and Medical Research Council, the Australian Research Council and Universities Australia jointly issued the Australian Code for the Responsible Conduct of Research (2007). The introduction to section 2 of this document which focused on 'management of research data and primary materials' reads: "Policies are required that address the ownership of research materials and data, their storage, their retention beyond the end of the project, and appropriate access to them by the research community".

In the UK, the Digital Information Specialists Committee produced a guide "intended to be used as a decision-making and planning tool for institutions with digital repositories in existence or in development that are considering adding research data to their digital collection" (Green et al., 2009, p. 3).

In the case of the USA, the jurisdiction for scientific research falls within the NSF's purview. Through its National Science Board, the Task Force on Data Policies was established in February 2010, under the Committee on Strategy and Budget (National Science Board, 2011). Aiming to further refine the NSF data policies, the Task Force was charged "to address key challenges and outline possible options to more effectively use digital research data to meet the mission of NSF" (National Science Board, 2011, p. iv). The work of the Task Force resulted in the report *Digital Research Data Sharing and Management*.

2.3.3.1 Conceptualising research data management.

Besides policies, equally important in library data roles are conceptual frameworks which enjoy some attention in the literature. Conceptual frameworks appear to be geared towards theoretical positioning and understanding of RDM which is necessary in preparing for undertaking the RDM role. A number of conceptual frameworks or models in the literature pointing either to the library institution or its librarians have been proposed or utilised in particular instances for supporting e-Research/RDM.

First, there is the conceptual framework of participatory librarianship. Lankes, Cogburn, Oakleaf and Stanton (2008) described participatory librarianship as being "grounded in conversation theory and seeks to organise information as a knowledge process rather than as discreet objects in some taxonomy". The participatory librarianship proposed by Lankes et al. (2008) anchors on the concept of Cyberinfrastructure Facilitator defined as "a vital member of the research enterprise who works closely with researchers to identify extant tools, data sets, and other resources that can be integrated into the research process of pursuing a research objective". The authors implied that such librarians that should participate in e-Research support need be grounded in such framework as a proper fit for success in that role.

Another phrase for participatory librarianship used by Carlson and Kneale (2011) is embedded librarianship which, according to them, can be either project-based or programme-based. These have been respectively utilised by the Purdue University Libraries and National Solar Observatory, both in the USA. The whole idea of this model is to embed librarians to research projects in order to collaborate with faculty either within the duration of a project or work full time as a partner in a programme.

Parsons et al. (2011) proposed a conceptual framework for managing diverse data within interdisciplinary science. Put in a sentence, theirs is a statement clasping together some five concepts or principles: data should be discoverable, open, linked, useful and safe. These are understood to be meant to guide measures to be taken by library professionals to manage such data.

Drawing from the experience with the activities set up to support e-Research at the Queensland University of Technology, Australia, Stokker (2008) reported on a model for developing and embedding innovation. This is a comprehensive research support plan featuring the "the embedding of new services and work groups across the Library and IT [information and technology] Services". The three main components of this model are specialist roles, strategic planning and ongoing roles.

All of these conceptual frameworks show that the necessity and practice for effective e-Research/RDM support has been to primarily conceptualise the processes and requirements to ensure that the e-Research challenge is not overwhelming to the library domain. However, these conceptualisations also position and inform practice in the form of research data services (RDS).

2.3.3.2 Research data services.

Library participation in RDM is of recent history (Corrall, Kennan & Afzal, 2013). A survey carried out by Tenopir, Birch and Allard (2012) indicated that by the time of their study only a minority of academic libraries in the USA and Canada offered RDS. Since the library is known for its services, its involvement in RDM translates to RDS. RDS represent one of the names by which data services in academic libraries may be called; other synonymous names are numeric data services, electronic data services, data library, data centre, and data archive (Read, 2007, p. 62). RDS refer to the services a library offers to researchers which include the informational and technical aspects (Tenopir, Birch, et al., 2012). As such, its purpose is to help academics, staff and students to find appropriate data to answer their specific research questions (Read, 2007).

However, it is evident from the literature that librarians rendering RDS should be aware of the methodological and disciplinary differences among faculty ranks in terms of their RDM practices and perspectives (Akers & Doty, 2012; 2013; Scott, Boardman, Reed & Cox, 2013; Sewerin, Dearborn, Henshilwood, Spence & Zahradnik, 2015). The implication is that "rather than adopt a blanket, 'one-size fits' all model, these RDS should be provided with a detailed and nuanced understanding of their user" (Weller & Munroe-Gulick, 2014). This necessitates investigating the researchers' needs. The literature shows that there is a number of ways to go about this. First is the use of interviews within projects such as the data literacy project (Carlson, Johnston, Westra & Nichols, 2013) or in the form of data interviews based on tools such as the Data Curation Profile Toolkit (Carlson, 2011; Witt, Carlson, Brandt & Cragin, 2009).

A second method being used to investigate researchers' needs is survey. This could be as part of projects such as ADMIRe project (Parsons, Grimshaw & Williamson, 2013). It could also be for the evaluation of researchers participating in a RDM workshop (Carlson, 2013) or at universities within a geographical area (Kennan & Markauskaite, 2014). Finally, there were authors that employed mixed methods to investigate researchers' needs. For instance, Mattern, Jeng, He, Lyon and Brenner (2015) used focus group and visual narrative inquiry method while Rolando, Doty, Hagenmaier, Valk and Parhan (2013) used a survey, interviews, the analysis of data management plans submitted with NSF grants, and data archiving case studies.

Moreover, Bennett (2010) argued that because RDS are still evolving there is no single definition that can encompass all of the activities that they may include. However, Tenopir, Sandusky, Allard and Birch (2012, p. 2) provided a definition that gives insight into the constituent parts[7] and also implies that the involvement of library in RDM stretches through the phases of the research cycle.

Although some authors who have reflected the USA academic library perspective in their view of RDS as being part of reference services (e.g. Bennett, 2010; Read, 2007; Wang, 2013), Read (2007) conceded with some illustrations that broad-scale RDS may transcend the library to involve partnering with other units of a university. Other units of the library may also be involved. For instance, in relation to the needs of researchers, Martinez-Uribe (2007) and Wong (2009) explored the use of digital/institutional repository to manage data.

Also, prominent in the literature are the discussions about RDS in relation to tiers or levels of service (Bennett, 2010; Reznik-Zellen et al., 2012; Wang, 2013) and areas for RDS development (Searle, Wolski, Simons & Richardson, 2015). Bennett (2010) proposed an approach to RDS that he described in a five-tier continuum. Viewed as part of the basic functions of an academic reference librarian, Tier 1 data services refer to such things as identifying existing data sources in support of the researchers' needs. Tier 2 data services, involving a higher degree of expertise, have to do with offering instruction and training in finding and using data in conjunction with or different from other scholarly resources. Tier 3 data services entail possessing the capability to confidently recommend specialised datasets for acquisition in support of institution-based research and teaching. Tier 4 data services centre on consultative services for effective use of datasets. Finally, tier 5 data services involve curatorial services in terms of developing and disseminating guidelines to facilitate RDM by individual researchers within disciplines and institution-wide.

In a case study of the new data services at the University of New Jersey, Wang (2013) provided an inventory of three main data services levels: data reference services, data collecting services and data computing services. These were offered to three categories of user groups: teaching and research faculty; campus departments, research centres, and offices; and graduate students. However, another case study which focused on RDS development at Griffith University discussed four areas of RDS development (Searle et al.,

[7] See Section 1.11, Definition of Key Terms.

2015). These are policy, infrastructure, developing knowledge and skills [of researchers in RDM] and advisory services.

However, through a web audit and environmental scan of RDM and curation services at eighteen peer and model institutions Reznik-Zellen et al. (2012) arrived at three categories of service levels. These are education, consultation and infrastructure. The authors provided a summarised description of these (p. 32-33). In tier 1 level of service-Education "libraries educate their communities about data management." In tier 2 level of service-Consultation "libraries consult with faculty and researchers on a variety of issues relevant to the management of research data." Finally, in tier 3 level of service-Infrastructure "libraries provide infrastructure for data management and curation to their campus communities." As shown in Table 2-3, Reznik-Zellen et al. (2012) tiers of research data that support services may represent a framework under which the related views of the aforementioned authors can be subsumed.

Table 2-3: Tiers of Data Services Framework.
(Adapted from Reznik-Zellen et al., 2012)

Tiers of Service (Reznik-Zellen et al., 2012)	**Components from Other Authors**
Education	• Instruction and training in finding and using data- A • Develop and disseminate RDM guidelines and policies- A • Policy- B • Developing knowledge and skills- B
Consultation	• Identifying existing data resources- A • Recommending the acquisition of specialised datasets- A • Consultative services for effective use of datasets- A • Advisory services- B • Data reference services- C
Infrastructure	• Infrastructure- B • Data computing services- C

Key: A-Bennett (2010); B-Searle et al. (2015); C-Wang (2013)

Table 2-3 shows that any requirement of the researchers can be fitted as a component of any of these tiers of service.

2.4. The Influence of e-Research and Data on the Library Domain

RDS are a product of the impact of e-Research and data on academic/research libraries. The purpose of this section is to discuss the impact of e-Research and the data produced through it on the library domain. Library involvement in e-Research has a pervading influence on the

library roles within its parent institution as well as the professional field and practice, and education of the LIPs.

2.4.1. E-Research and the university/research library institutions.

As large research organisations, university libraries have had to structurally develop some units or sub-institutions in order to render some services towards meeting emerging needs. Particularly, data libraries and IRs seem to be on the receiving end of the influence of e-Research.

Data libraries date back to the USA in the 1960s and the UK in 1983 (Martinez-Uribe & Macdonald, 2009). The early focus was on social sciences data held in machine readable files and reference librarians rendered data services (Burnhill, 1985; Jones, 1982). But, "today's data libraries comprise collections of electronic data resources and a range of support services to help researchers to locate, access and use data" (Martinez-Uribe & Macdonald, 2009). However, full assumption of data services responsibility would be a later development. Today, the wealth of knowledge and experience gained from decades of social science data librarianship can be extended to other disciplines (Witt, 2012), so that the DL is best suited to manage research data (Uribe & Macdonald, 2009). However, van der Graaf and Waaijers (2011, p. 18) observed that "the role of data librarians in the new setting of supporting researchers in data publishing and data-sharing has yet to be developed".

A recent development within the technology paradigm is the presence of institutional repositories in academic environments for managing the research outputs of their various research communities. Allard et al.'s (2005) review of literature for the librarian's role in institutional repositories found no data responsibilities. A current development is that they are being used for purposes other than text-based publications including RDM (Wong, 2009; Henty, 2008). Justifying this, Wong (2009) argued that, being an essential component of research output, data from research projects of universities naturally fall into the jurisdiction of institutional repositories. This has the implication of additional or specialised roles for librarians as well as addressing technical problems arising from characteristics of the institutional repository: institutionally bounded, optimised for articles, cookie-cutter look and feel, and inadequate staffing (Salo, 2010).

2.4.2. Data role and data librarians in academic libraries.

Data roles refer to the various professionals working as key stakeholders in the data 'world'. Swan and Brown (2008, p. 1) identified four such roles in this regard: *data creator, data*

scientist, *data manager* and *data librarian* (DL). Lyon, Acker, Mattern and Langmead (2015) discussed three data preservation roles, namely *data librarian*, *data steward/curator* and *data archivist*. However, these data roles might appear to be distinct positions, but Swan and Brown (2008) observed that in practice the demarcation may currently be blurred. This is especially true of the data scientist and the DL. For instance, Carlson and Kneale's (2011) embedded model for the librarian fits the definition of data scientist. Similarly, the DL has been seen as related to or a type of or the same as the data scientist (Luce, 2008; Lyon, 2007; Lyon & Brenner, 2015; National Science Board, 2005). In particular, the National Science Board (2005, p. 27) listed both librarians and archivists as types of data scientists. The picture painted here is typical of an evolving area and shows the widening role performance components of academic librarians at the emergence of e-Research.

It must be observed that of the data roles data librarian was consistently mentioned by the different authors and seems to be getting increasing attention in the RDM domain. Lyon and Brenner (2015) suggested that a university or research institute constitutes a typical location for data librarians while advocacy, RDM and training constitute their focus. Since the RDM area is nascent, it is necessary to understand the factors that may influence the DL role.

2.4.2.1 Factors influencing the data librarian role.

Moreover, factors that may influence the DL role are not given focused treatment in the literature. They can only be gleaned from a few articles in the literature, for example, responses to research question 3 in the work of Tenopir, Sandusky, et al. (2012). Also, common themes emerging from the case studies in the e-Science and data support services survey of ARL member libraries (Soehner et al., 2010) only provide a clue as also the Purdue University Libraries' particular experience reported by Newton, Miller, & Bracke (2011) and Brandt (2007). These are analysed and mapped to the applicable contexts in Table 2-4.

Table 2-4: Contextual Factors Influencing the DL Role.

Contexts	Factors	Authors
National	Collaborations between libraries of different institutions, between libraries and the departments they serve, between various departments on interdisciplinary subject areas and between institutions	Soehner et al. (2010)
	As an evolving area funded programmes will provide models and information on strategies for data curation, management and preservation	Soehner et al. (2010)
	Incentivising of researchers by national bodies (e.g. NSF) to consider data set management as an important component of their research workflow	Newton et al. (2011)
Organisational	Faculty interest and institutional support at the administrative level	Soehner et al. (2010)
	Priority to e-Science activities by academic/research libraries within difficult budget times	Soehner et al. (2010)
	Relationship or collaboration between librarians and researchers or the faculty	Newton et al. (2011); Brandt (2007)
	Researchers' view of libraries as trusted partners and their perception of tenure track faculty librarians as peers on campus and potential collaborators on research	Brandt (2007)
	Libraries having a role in multidisciplinary research which may help looking at scholarly publication in new ways	Brandt (2007)
	Having a research support structure that could be adapted to meet new challenges e.g. Purdue Libraries' liaison librarian	Newton et al. (2011)
	Innovativeness with technology-oriented projects on the part of library management e.g. Purdue University Libraries' distributed institutional repository (DIR) framework	Brandt (2007)
	Opportunities at grant call-outs, workshops and seminars to mention libraries' interactions and projects boost librarians' image as collaborators on research	Brandt (2007)
	If one's institution becomes more involved in RDS; and If one's institution develops an institutional repository that accepts data	Tenopir, Sandusky, et al. (2012)
	Acceptance (of RDM)	Pinfield et al. (2014)
	(Organisational) culture	Pinfield et al. (2014)
	Roles by the stakeholders	Pinfield et al. (2014)
	Governance (in organisations)	Pinfield et al. (2014)
	(Organisational) politics	Pinfield et al. (2014)
	(Available) resources	Pinfield et al. (2014)
	Projects in organisations	Pinfield et al. (2014)
	Communications (within organisations)	Pinfield et al. (2014)
	Organisational setting	Pinfield et al. (2014)
Professional	The requirement of direct experience with data curation/management or MLS with emphasis on data management in a majority of data positions. Connections between faculty and librarians appeared easier to begin and sustain if the advanced science or engineering degree had been obtained from the institution in which the librarian was now employed	Soehner et al. (2010)
	If one learns more about research data services (RDS)	Tenopir, Sandusky, et al. (2012)
	Library's claim of RDM jurisdiction	Pinfield et al. (2014)
	Presence of the required skills in an organisation, including libraries	Pinfield et al. (2014)
Research	If RDS become important to the subject disciplines being supported; and If patrons request RDS	Tenopir, Sandusky, et al. (2012)
	Researchers' RDM needs (storage, security, preservation, compliance, quality and sharing), demand and incentives	Pinfield et al. (2014)

However, a few clarifications may be made regarding Table 2-4. First, it must be pointed out that some of the factors such as tenure track faculty position and the influence of NSF are peculiar to North America and the USA respectively. Therefore, it follows that every environment may have factors peculiar to it and it is enough motivation to using this as an incentive to carry out an investigation on these in other environments. Secondly, Pinfield et al.'s (2014) study had identified some drivers and factors influencing the RDM activities by

the library and other institutional stakeholders. It must be observed that as good as their conceptualisation appears to help the understanding of RDM in academic institutions, what they termed drivers with the exception of jurisdiction are actually researchers' needs. These can only drive RDM if the researchers have a demand or incentives for RDM. Demand and incentives were among the factors influencing RDM identified by Pinfield et al. (2014). There appears not to be a clear difference between the drivers and influencing factors so that they are better seen as contexts of factors influencing RDM activities.

2.4.2.2 Data librarian role performance components.

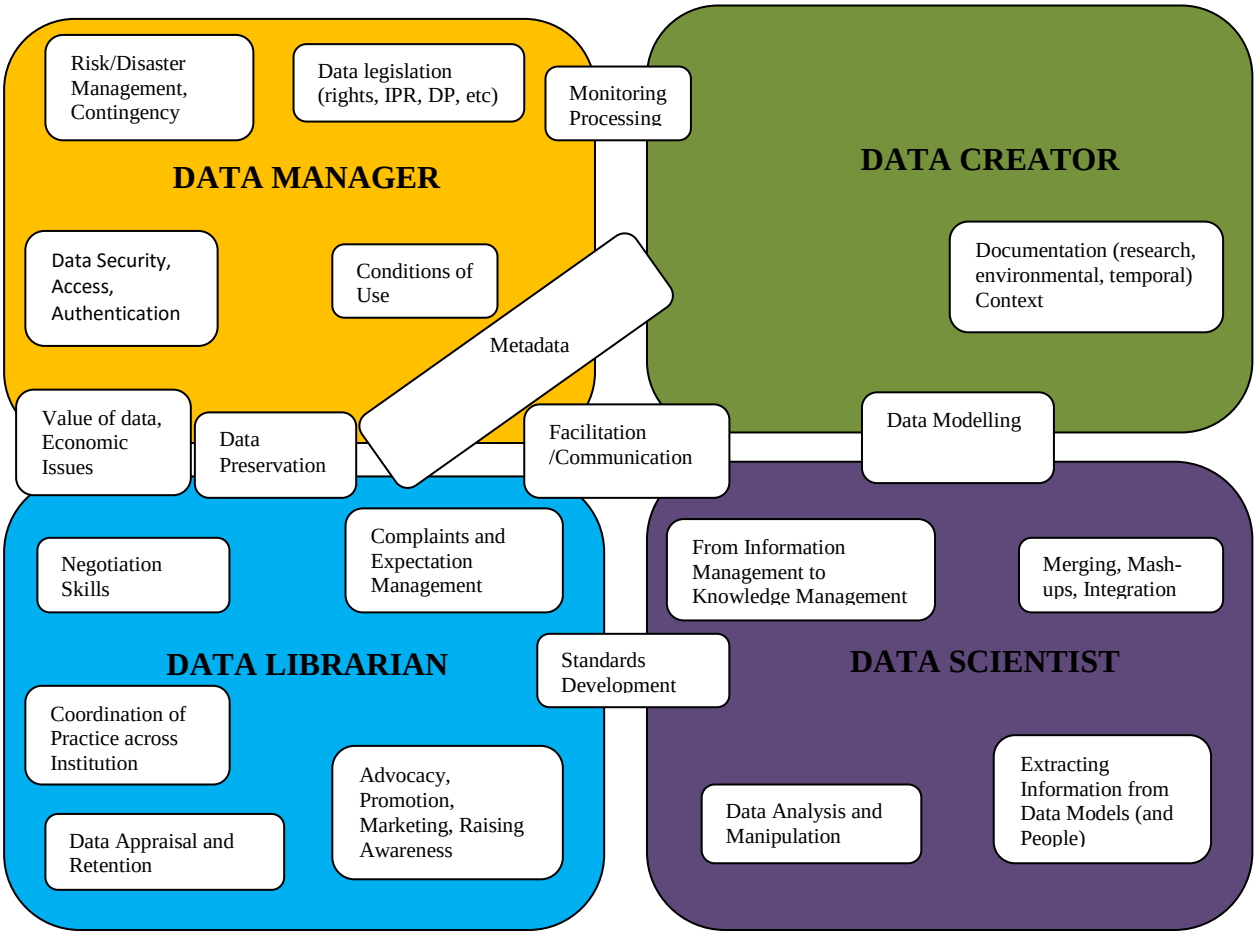
Nevertheless, the literature has had to focus on the generic e-Science librarianship and RDM rather than the DL position. However, Alvaro et al. (2011) study identified three categories of librarians supporting e-Science: *subject librarians* combining traditional librarianship with limited data responsibilities; *e-Science librarians* with more data responsibilities; and *data librarians* with full data responsibilities. Puttenstein (2011) confirmed two forms in which the DL positions exist in the Netherlands to be either expanding an existing staff's role or hiring a new staff to fully devote to RDM.

However, the analysis of positions of e-Science librarians would normally contain the aspects of their performance components. Kim, Addom and Stanton (2011) employed Fine and Cronshaw's (1999) job analysis framework in their study (see Tables 2-5 and 2-6 for their findings). Much of that role is summed up as data curation (Martinez-Uribe & Macdonald, 2009) requiring RDM skills set. Data curation is part of digital curation and entails a range of RDM activities. The DCC defines the former thus, "digital curation involves maintaining, preserving and adding value to digital research data throughout its lifecycle."

Regarding RDM, Cox et al. (2012) drew insight from Corrall's (2012) discussions on Lewis' (2010) Pyramid and proposed three main roles for local institutions and for liaison librarians aligned to existing library practices and mapped to their requisite competences[8]. However, in a white paper, Pryor and Donnelly (2009) reviewed previous investigations and provided an overview of the roles and responsibilities for RDM through the lens of Research Data Management Forum (RDMF) community. Figure 2-2 indicates a set of core skills mapped to each of the four roles described by Swan and Brown (2008) that were discussed at the beginning of this section.

[8] See Section 2.3.2.3 for a detailed discussion of Cox et al (2012) proposed roles.

Figure 2-2: Core Skills for Data Management.



(Adapted from Pryor & Donnelly, 2009, p. 165)

The diagram shows both the skills peculiar to each role as well as those being shared by the roles. While it is true that the authors warned that their exercise might not be definitive, it is observed that they did not give the DL any stake in metadata that many would think belongs to the library domain. However, this has been amended in Figure 2-2 so that the DL can liaise with the data creator and data manger over such issues as data preservation which requires metadata application.

Perhaps, in an attempt to provide a clue to the performance components of the DL, it will suffice to aggregate the responsibilities and requirements for RDM support responsibilities as found in the literature. The analysis is based on Kim et al.'s (2011) framework which follows Fine and Cronshaw's (1999) model, a hybrid job analysis framework that combines work-oriented and worker-oriented methods of job analysis. The work-oriented methods seek to

describe what a worker does while the worker-oriented methods aim to identify what a worker needs to successfully perform job tasks (Morgeson, 2007, p.380).

In Kim et al.'s (2011) framework there are the two aspects of work and worker characteristics. The work characteristics refer to a worker's responsibilities or duties with respect to working with "people," "things" and "data" while worker characteristics are the competencies or requirements such as "knowledge," "skills" and "ability." Kim et al. (2011, p.129) provided some explanations about these terms. While "knowledge refers to a body of information that must be memorised or mastered" skills refer to "acquired competencies subject to education, training and improvement with practice." Also, they explained that "ability refers to one or more intrinsic talents an individual possesses." They tried to differentiate ability from skills thus: "abilities may overlap with skills in that ability signifies the capacity to perform in a certain class of tasks (e.g. perceptual acuity), whereas a skill represents the extent to which a task has been mastered through practice."

Tables 2-5 and 2-6 respectively show the role performance components for RDM support activities as found in literature that comprise the two broad aspects of work characteristics and worker characteristics.

Table 2-5: Work Characteristics for RDM Role in the Literature.

CATEGORY	DUTIES	AUTHORS
Data	Collect primary data (*clean and check data, collect original data, and understand data needs*) and/or secondary data (*such as previous literature or public/commercial data sets*)	A, B
	Storing data (*create databases, manage metadata, and store data*)	A, B
	Manage data (clean, annotate, manage, maintain, and plan data for the future)	A, B
	Analyse data (*statistical analysis, processing scripts*)	A, B, E
	Present data (*post data for wide access, deal with data ownership, and write about data*)	A, B
People	Perform outreach/locate collaboration opportunities	A, B
	Communicate with others	A
	Enable collaborations (with faculty and researchers) and organising teams	A, B
	Analyse researchers' technology needs	A
	Coordinate between researchers and information technology experts (e.g., with technology requirements and specifications)	A
	Liaise with	A, B
	Ensure compliance (e.g. of researchers, users and re-users with grants, policies and standards)	A
	Instruct/train researchers and others in using technologies; Data literacy	A, B, C
	Support data services (deliver expert data informatics advice and guidance, awareness and re-use promotion)	C, D
	Facilitate access to datasets (for PIs, research staff, postgraduate and undergraduate students	D
	Provide user statistics	E
Things	Investigate/recommend technology solutions (by comparing technologies)	A, B
	Audit and manage repository management (Identify data sets and RDM needs, manage access to data and develop local data curation capacity)	C
	Implement IT for researchers (installing operating systems, installing software applications, managing collaborative technologies, and configuring systems by using scripting)	A, B
	Design, maintain and manage the technologies (systems, tools/technologies, institutional repositories, social media and IT usage)	A, B, E
	Prepare, compile and manage documents	A
	Manage budgets and project processes	A
	Support scholarly publication	B
	Provide reference and information services	B
	Assist with collection development	B
	Carry out e-Science responsibilities	B

Key: A-Kim et al. (2011); B-Alvaro et al. (2011); C-Cox et al. (2012); D-Lyon (2012); E-Maattah (2013).

Table 2-6: Worker Characteristics of RDM Role in the Literature.

CATEGORY	DUTIES	AUTHORS
Knowledge	Databases (including those for locating and depositing disciplinary data)	A, H
	Terminology and methods in scientific subject domain area (e.g., Physics)	A, B
	Information technology	A, D
	Programming or scripting languages	A, B
	Metadata standards (and schemas for data discovery and preservation)	B, D, E, H
	Data and related aspects (formats, selection and appraisal, audit, and assessment tools, domain ontologies, identifiers, citation, licensing, etc.; research data management principles, planning activities and roles through research lifecycle)	D, E, H
	Researchers' needs and available material	D
	Research (broader environment, process and scholarly communication)	F
	Legal and regulatory framework	F
	Trends/current research	G, H
	Funders' data management requirements	H
	Appropriate disciplinary data centres	E
Skills		
Non-technical	Administration (including leadership and management)	A, B
	Communication (oral and written) and interpersonal	A, B, F, G, H
	Collaboration	B
	Analytical and organisational	H
	Service oriented	B
	Instruction/ /Pedagogy/Teaching data literacy	B, C, D
	Data/audit interview with researchers	C, D
	Working with researchers on data (security issues; compliance with grants' regulations and data management requests)	C
	Consulting with researchers on their data lifecycle, archival and conservancy issues	C
	Accessing and locating data sets for patrons' original research papers	C
	Helping patrons understand the intellectual property and copyright issues	C
	Promoting digital data sharing, open access, and/or participation in an institution's IR	C
	Advertising library's data services to researchers in an institution	C
	Reference interview	D
	Data quality	G
Technical	Database management	A, C
	Programming and scripting languages (e.g. XML, SQL, etc.)	A, C
	Web 2.0 technologies	C
	Data archiving and preservation services	C
	Informatics	E
	Metadata standards (e.g. Dublin Core, MODS, OAI-PMH, etc.) - manipulation, crosswalk, validation and portals (e.g. description, indexing, storing, etc.)	C, F
	Virtual tools to manage and curate data	C
	Maintaining an institutional repository	C
	Data mining, analysis, interpretation, representation and visualisation	C, G
	Digital lab notebook applications	C
	Project management (including translating 'IT speak')	A, F, H
	Licensing	D
	Understanding of RDM best practices as they apply to relevant disciplines	D
	Research	A
	System administration	A
	General computer	A
Ability	To work well in a team environment	A, H
	To quickly learn new material	A
	To communicate with others	A

Key: A-Kim et al. (2011); B-Alvaro et al. (2011); C-Creamer et al. (2012a); D- Cox et al. (2012); E-Lyon (2012); F-Simons & Searle (2015); G-Affelt (2013); and H-Lyon et al. (2015).

2.4.2.3 Training needs and education for the data librarian role.

The literature shows various approaches used to identify the training needs of librarians for RDM responsibilities as well as some efforts aimed at their training or education. Some examples of works on the latter are Paris (1996), Kim et al. (2011), Cox et al. (2012) Bresnahan and Johnson (2013), and Johnson and Bresnahan (2015).

Paris (1996) focused on the need to train academic librarians in data related issues but contextualised it to South Africa. According to her, elements of training (which could amount to training needs for some librarians) must include basic data analysis, the nature of interfaces, networks and databases, network search commands, search software of specific social science and other databases, and end-user instruction. Among her recommendations for training strategies are: that any training or retraining must be in line with and address all levels and needs of clients; and the application of technology towards helping information seekers, increasing their awareness of and teaching them how to use equipment. To assist in training, she also emphasised the inclusion of stakeholders within the library and information services field such as library professional associations, vendors of technological and commercial products, university and academic library administrators, and government departments. But, the fact that she did not include library schools in her listing raises the issue of whether the library schools must concern themselves only with preparing prospective professionals for their career and not to be involved with the professional development of LIP.

Kim et al. (2011) used the qualitative analysis of focus groups and interviews with lab directors and researchers, together with some descriptive analysis of rating data and coded work activity logs by five summer internship master's students to arrive at some roles and their requirements. They coded their findings following Fine and Cronshaw's (1999) job analysis framework categories. On the basis of their findings, Kim et al. (2011, p. 133) recommended a list of top ten courses that may be taught those aspiring to be e-Science professionals, a type of which could be the DL. The courses include:

- Digital data curation optimally in a course specialised toward the curation of large scientific or engineering datasets;
- Database design and management, focusing on large scale relational databases;
- Project management, including project planning and budgeting;

- Essentials of scientific research, including literature review, study design and descriptive statistical analysis;
- Overview of cyberinfrastructure, including cloud and grid computing;
- Geographically distributed collaboration, with a judicious division of time between the human issues and the technological issues;
- Web content management and web interaction design;
- Scripting or practical introductory programming;
- Data mining, with a focus on either quantitative data for the natural sciences or mixed data types for the social sciences and humanities;
- Information system management and server administration, including general IT and computer knowledge.

Based on Corrall's (2012) discussions on Lewis' (2010) Pyramid, Cox et al. (2012) focused on local institutional roles, and the liaison librarians in particular, and proposed three main roles in RDM and the required competencies mapped to existing roles in academic libraries. These competencies can be part of the professional knowledge required for such roles that could be taught or learnt. However, the three main roles with their required competencies in parenthesis are as follows:

1) Policy and advocacy (strategic understanding and influencing skills)
2) Support and training (Understanding RDM best practices as they apply to relevant disciplines; Pedagogic skills; Reference interview; Knowledge of RDM principles; Knowledge of institutional and extra-institutional resources; Knowledge of institution; Knowledge of researchers' needs; and Knowledge of available material)
3) Auditing and repository management (Audit interviews; Knowledge of RDM principles, Metadata, Licensing, and Relevant technologies and processes).

On their part Bresnahan and Johnson (2013) surveyed some twenty subject librarians in a university based on a list of training topics related to research data. Their aim was to evaluate the gaps in the latter's skills set and develop a plan for their training that would take into account potential trainees' opinion of relevance, current knowledge or lack of it, feelings of anxiety and comfort, and preferences for training formats. Among their findings was the

participants' preference of the following training format: one-day workshops, panel sessions, practical handouts, and informal discussions. As a result, the authors developed a day-long workshop called *DataDay* that targeted expanding and translating the skills of subject librarians into the context of RDS (Johnson and Bresnahan, 2015).

The participants were evaluated through pre-survey, post-survey and follow-up survey instruments. The findings are noted to have fulfilled the set objectives, for instance: improvement in their perceived understanding of the basic stages of data lifecycle; feeling confident discussing the issues around RDS; defining the role of the library in RDS in terms of archiving, sharing and stewardship of data; seeing a strong role in extending information literacy to data literacy within the plan for outreach activities to promote new RDS; the applicability of skills from the workshop to novel research data situations; and their idea of engaging with researchers effectively when advocating for how the library can support their research data.

However, Pryor and Donnelly (2009, p. 166) highlighted Professor Corrall's main proposition that data skills be made a core academic competency which suggests that workshop and short training course are not as effective as curricular courses or programmes in terms of specialist qualifications. In other words, workshop and short course may be better suited for professional development than for the education of librarians. It is evident from the works of Pryor and Donnelly (2009), Corrall (2012), Creamer, Morales, Kafels, Crespo and Martin (2012b), Keralis (2012) and Vervel, Bammerlin and Palmer (2012) that there are many existing and emerging courses and programmes related to data curation and management in the LIS field at different universities around the world especially in the USA and the UK.

Varvel et al. (2012) analysed 475 courses in 158 programmes at 55 schools and grouped them into Data Centric, Data Inclusive, Digital and Traditional LIS categories. However, the percentage of Data Centric (8%) courses which focus exclusively on data-related topics and Data Inclusive (11%) courses is limited. Similarly, Creamer et al. (2012b) identified only 13 (22%) institutions teaching courses that met the competences they looked at and concluded that LIS programmes have not embraced RDM as a key component of the curricula. However, developing some courses for the training of librarians for RDM support role seems to be gaining attention more recently. De Smaele, Verbakel and Potters (2013) reported on the Data Intelligence 4 Librarians course developed by the libraries of three Dutch

universities of technology at the end of 2011 to provide online resources for their staff. This underlines the collaborative curriculum development approach that was also evident in the work of Cox et al. (2014). Also, Lyon (2016) reported on two new graduate higher-level courses on RDM and research data infrastructures designed and delivered within the MLIS programme at the School of Information Sciences, University of Pittsburgh between January 2014 and May 2015.

Also evident in the literature are different methods and principles for developing curriculum for RDM support role. The methods include the employment of funded projects such as the RDM/Rose project (Cox et al., 2014) and position advertisement analysis (Lyon et al., 2015) to develop RDM courses while transnational (Lyon et al., 2015) and open educational resource (Cox et al., 2014) principles were given considerations in this regard.

Moreover, Corrall (2012, p. 123) pointed out some common themes within the literature regarding a curriculum for data management and curation. In the form of three key issues in data management education these are:

1. The importance of emphasising digital lifecycle stages in the core curriculum development for data management and curation.
2. The requirement and role of technology in the digital curation curriculum.
3. The value of practical field experience, typically internships with real projects to work on.

Corrall (2012, p. 126) also touched on two positions concerning the training of librarians. The first position is the view of members of the International Data curation Education Action that they are training information professionals to work in digital or data curation and not training digital or data curation professionals. The second position is seeing data curation as an emergent specialist career. Either of these views held by the management of any academic/research libraries will influence their approach to preparing LIPs for the DL role.

2.4.2.4 Data curation models.

The literature indicates that data curation models and/or programmes as well as metadata standards are needed for RDM. Models refer to how people conceptualise or approach things to make them easier to be understood or utilised. Over time, some disciplines or institutions in different countries have devised models of data stewardship or curation specifically.

Visible within these efforts is the emergence of lifecycle and continuum models. Traditionally, the former has a repository and custodial orientation and is a fragmented framework that uses a birth-to-death analogy to describe the stages through which records pass while the latter sees the stages of records as related and forming a continuum (An, 2003). While An (2003) compared the two models in a way that favours the continuum model as being better suited for integrating and managing records and archives, Upward (2000) laboured to model it as a paradigm shift in records and archival management. However, regarding the curation lifecycle model, Heidorn (2011) gave the insight that there is a little distinction between the steps needed to curate data and the management of any digital object. Pennock (2007, p. 2) argued for the necessity of a lifecycle approach with the following reasons:

- Digital materials are fragile and susceptible to change from technological advances throughout their lifecycle, i.e. from creation onwards;
- Activities (or lack of) at each stage in the lifecycle directly influence our ability to manage and preserve digital materials in subsequent stages;
- Reliable re-use of digital materials is only possible if materials are curated in such a way that their authenticity and integrity are retained.

The literature shows some patterns in the RDM efforts regarding the respective curation models or programmes used in different countries. In Australia, the concept of continuum, rooted in the view of Australian Ian Maclean in the 1950s, that has been applied to records and archives management (An, 2003), is now being extended to data management. First adopted and developed in its multi-dimensional form as "data curation continua" by Monash University (Treloar & Harboe-Ree, 2008), the model is currently being promoted by the Australian National Data Service [ANDS] (ANDS, 2011). The Monash experience had three projects as its antecedent: Australian Research Repositories Online to the World (ARROW), the Dataset Acquisition, Accessibility and Annotations e-Research Technologies (DART), and the Australian ResearCH Enabling enviRonment (ARCHER) (Treloar & Harboe-Ree, 2008).

In the UK, Higgins (2008) revealed that the DCC's life cycle approach to the management of digital materials was informed by the review of a number of disciplines and projects that researched and developed domain-specific lifecycle models as frameworks for planning. She

further clarified that "the DCC is committed to promoting a lifecycle approach to the management of digital materials, to enable their successful curation and preservation from initial conceptualisation to either disposal, or selection for re-use and long-term preservation" (p. 135). However, the DCC's Curation Lifecycle Model appears to be a type of life cycle model as Carlson (2013) clarified three types: individual-based, organisation based and community-based to which the DCC's Curation Lifecycle Model belongs. Carlson (2013) also observed some limitations of the life cycle models. These are the tendencies to: present the ideal rather than reality; overlook the complexity of working with data (i.e. the heterogeneity and diversity of approaches and practices).

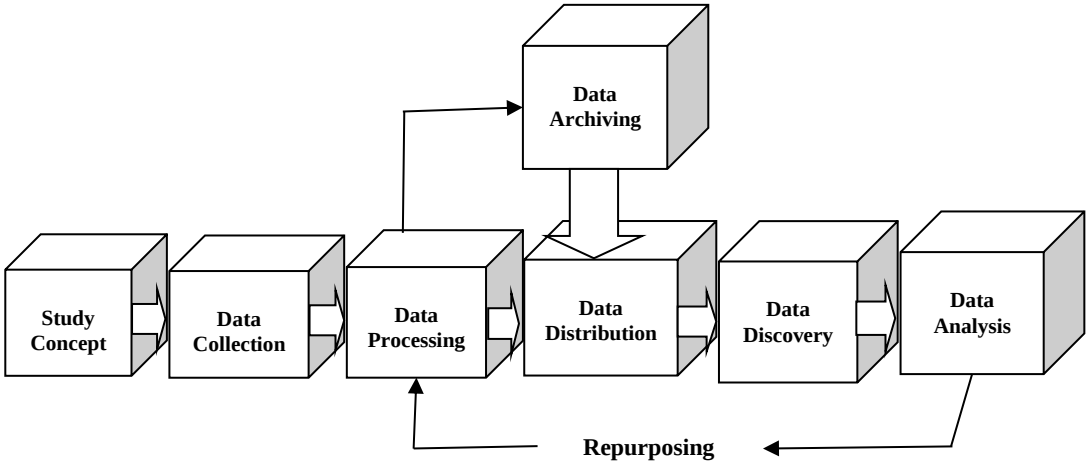
The case of USA in terms of research data curation efforts is different. Unlike Australia and the UK, Walters (2009, p. 88) revealed that "research universities in the United States lack models for data curation program(me) development to guide them through pre-program(me) initiation, and growth". He articulated some pathways to propose a model for a data curation programme development in the USA. While the policies of the National Institute of Health and NSF require data access plans as part of research proposals submitted to their programmes may have some positive impacts (Walters, 2009), it is apparent that there is no public institution directly promoting any one curation model. Rather, what can be observed is "a story of positive, yet incremental progress and of enterprising individuals (*i.e. universities and disciplinary entities*) and their activities" (Walters, 2009, p. 84).

Some of the universities whose libraries and data centres were taking entrepreneurial steps into RDM mentioned by Walters are Johns Hopkins, California-San Diego, Illinois at Urbana-Champaign, Michigan, Cornell (*the DataStaR Project*-Steinhart, 2011; 2007), Massachusetts Institute of Technology (MIT) and the Georgia Institute of Technology. Walters suggested that institutional repositories were the antecedents to data curation programmes stemming from the libraries. Some other examples of data curation efforts found in literature include the Long Term Ecological Research (LTER) Data Stewardship Approach (Karasti, Baker & Halkola, 2006) and the Purdue University Research Repository (PURR) Workflow mapped to Open Archival Information System model (Witt, 2012).

The fact that metadata facilitates data discovery, access, preservation, use and re-use underlines its importance as an integral part of curation efforts. The literature, however, shows that there is the association of particular metadata standards with given data stewardship or curation approaches. First of such examples is the Data Documentation

Initiative (DDI) originally created by data archives to document the datasets which they archive and disseminate to researchers (Gregory, 2011). According to Vardigan, Heus and Thomas (2008, p. 108) "the DDI is an international XML-based standard for the compilation, presentation, and exchange of documentation for datasets in the social and behavioural sciences". Version 3.0 of the DDI includes a lifecycle model underlying it as shown in Figure 2-5.

Figure 2-3: The Lifecycle Model Underlying the DDI.



(Adapted from Gregory, 2011, p. 3)

Another example is the Ecological Metadata Language (EML) standard associated with the LTER data stewardship approach (Karasti *et al.*, 2006). However, it must be observed that these two examples have the common denominator of discipline-specific orientation (social and behavioural sciences, and ecology). Thus, the more generic approaches like the DCC Lifecycle Model or Data Curation Continuum model may be open to all disciplines so that it may well accommodate any metadata that any discipline may deem more suitable.

2.4.3. Data disciplines.

The emergence of disciplines aimed at developing or training the relevant personnel on the skills needed for RDM support could have been spurred by the challenges of data curation. Hillenbrand (2005, p. 166) offered that "the discipline can be broadly defined as the theoretical body of knowledge which is taught to students, exchanged amongst educators, studied by researchers, and communicated between professionals in the field". One of the

impacts of e-Research is the mentioning of some data-related disciplines within the field of librarianship in the literature. Among them are data science (Swan & Brown, 2008); data librarianship (Martinez-Uribe & Macdonald, 2009); and e-Science librarianship (Alvaro et al., 2011; D'Ignazio et al., 2012). However, this scenario points to an articulated body of knowledge or data field embodying RDM skills necessary to prepare adequately skilled DL relevant to the data challenges of the e-Research paradigm.

2.5. Knowledge Gap and Development of Research Questions

Various positions of the DL, or the broader e-Science librarian category, have been mentioned or used in some studies to explore the e-Science librarianship field (Alvaro et al., 2011) or RDM (Pryor & Donnelly, 2009; Swan & Brown, 2008) and the needed competences to promote data curation (Creamer et al., 2012a). But, the DL role has not usually been the main focus of studies, so that the role dimensions are only indicative, yet to be verified and validated. Therefore, it makes sense to ask "what are the role dimensions of the DL?" especially in New Zealand where low-level RDM support has been confirmed (Corall et al., 2012). There may not be a distinct DL role yet in New Zealand, but the RSL role could provide some cues. It is believed that a study focusing on answering this research question will help to explore and better understand what the role entails in terms of its responsibilities and the attendant requirements. This will pave the way for addressing any discovered gaps in the toolkits of LIP.

Besides, it is observed that the discussions on data management have been limited to academic (university) libraries (e.g. Corall et al., 2012; Reznik-Zellen et al., 2012; Bennett, 2010; Lewis, 2010; etc), institutional repositories (Otto & Ralston, 2012; Newton, Miller & Bracke, 2011; Wong, 2009; etc), and digital libraries and institutional repositories (Salo, 2010). Thus, research institutes' libraries/information centres are yet to be purveyed or brought within the purview of research.

Moreover, factors that may facilitate the DL role are not given focal treatment in the literature. As a result, they can only be gleaned from the literature such as observations from the e-Science and data support services survey of ARL member libraries (Soehner et al., 2010) and the Purdue University Libraries' particular experience (Newton et al., 2011; Brandt, 2007). Thus, an exploration is needed as such may provide the understanding about how the role may exist in a given environment such as New Zealand ROs where limited studies had been done.

The foregoing understanding from the literature constitutes the basis for the research question that this study has answered (see Section 1.8).

2.6. Chapter Summary

The aim of this chapter was to provide the necessary background to the study by way of a review of the literature on the relevant and related topics. The first section explored the dynamic domain of academic librarianship with regard to the mission and role of academic libraries that provide the context for understanding the changing role dimensions of academic librarians. It was confirmed that librarians have had to adapt their strategies, and re-interpret and fulfil their mission against a background of change (Friend, 1998). One of such challenges, and perhaps the most discussed in the literature, information technology, constitutes the platform on which e-Research was discussed in the second section. The last section dwelt on the impact of e-Research with data produced through it on the library domain which has necessitated the birthing of the DL role. However, the gaps observed from the review provide justification to the question this study asked as well as sought to answer.

CHAPTER 3: RESEARCH MODEL, PARADIGM AND DESIGN

3.1 Introduction

In this chapter I provide an overview of the research model, paradigm, design and specific areas that underlie the study. Altogether, they constitute a foundation to the direction I followed in conducting the study. The conceptual model undergirds and represents the conceptual positioning of the study. However, the research paradigm informs the design that includes the methodology and methods that I followed. I discuss each of these below in detail.

3.2 A Research Model for the Data Librarian Role

This section introduces the model that was intended to provide the conceptual lenses of the study. It is predicated on Abbott's (1988) theory, *The System of Professions* and complemented with the literature. Creswell (2003) clarified a number of ways in which theories are employed in qualitative studies including guiding a study and raising the question that one would like to address.

3.2.1 Abbott's the system of professions.

Abbott's (1988) theoretical synthesis is a product of historical and sociological analysis which seeks to address the concern of how and why professions evolve. Perhaps the specific issue it addresses is "how societies structure expertise" (Abbott, 1988, p. 323). His theory is an alternative to the functional, monopolistic, structural and cultural views of professionalization as developing in a common pattern. Defining professions loosely as "exclusive occupational groups applying somewhat abstract knowledge to particular cases" (p. 8), Abbott (1988, p. 17) faulted the following assumptions of prior theorising on professionalisation:

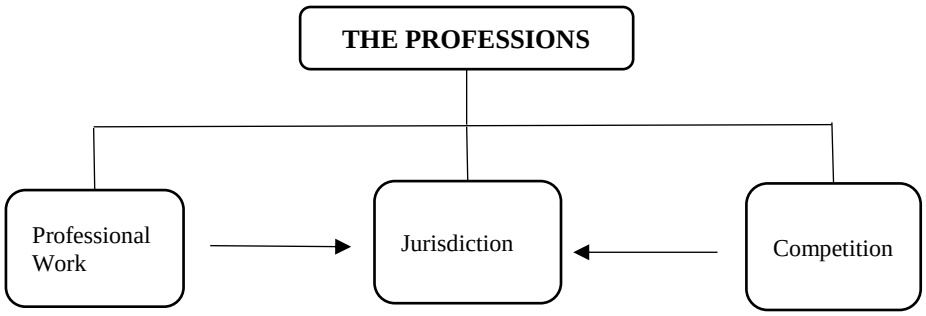
- That change is unidirectional; professions evolve towards a given form, structurally and culturally.
- That the evolution of individual professions does not explicitly depend on that of others.
- That the social structure and cultural claims of professions are more important than the work professions do.
- That professions are homogeneous units.
- That professionalisation as a process does not change with time.

Abbott (1988) argued that his System of Professions is both a systems and a loose vacancy model that has as its fundamental postulates:

> (1) that the essence of a profession is its work not its organisation; (2) that many variables affect the content and control of that work; and (3) that professions exist in an interrelated system. Change in professions can therefore best be analysed by specifying forces that affect the content and control of work and by investigating how disturbances in that content and control propagate through *The System of Professions* and jurisdictions. The proper unit of analysis is the jurisdiction, or more generally, the larger task area (p. 111).

Abbott (1988) anchored his theory on the three main constructs of "professional work", "jurisdiction" and "competition" as depicted in Figure 3-1.

Figure 3-1: Main Aspects of Abbott's (1988) *The System of Professions*.



3.2.1.1 Professional work.

Professional work embodies some tasks to be accomplished by given professionals. Abbott (1988, p. 35) offered some clarifications on professional work thus:

> The tasks of professions are human problems amenable to expert service. They may be problems for individuals, like sickness and salvation, or for groups, like fundraising and auditing. They may be disturbing problems to be cured, like vandalism or neurosis, or they may be creative problems to be solved, like a building design or a legislative program[me]. The degree of resort to experts varies from problem to problem, from society to society, and from time to time.

Abbott (1988, p. 35) described two kinds of properties of problems that make them vulnerable to change to be objective and subjective qualities. These properties point to both external and internal forces that impinge on professional work. The objective foundations are technological, natural, organisational and cultural in nature. However, the subjective foundations refer to the mechanisms of professional work in terms of the three parts of the profession's jurisdictional claims given as *Diagnosis*, *Inference* and *Treatment*. Abbott (1988) clarified these:

> Diagnosis and treatment are mediating acts: diagnosis takes information into the professional knowledge system and treatment brings instruction back out from it. Inference, by contrast, is a purely professional act. It takes the information of diagnosis and indicates a range of treatments with their predicted outcomes.

He further clarified that diagnosis has the two processes of *Colligation* and *Classification*. Colligation refers to the assembling of a picture of the client and consists largely of rules regarding the issue of degrees of relevance, validity and ambiguity (Abbott, 1988, p. 41). On the other hand, "classification means referring the colligated picture to the dictionary of professionally legitimate problems" (Abbott, 1988, p. 41). Against the background of diagnosis, treatment is a brokering process whereby the client is given results by way of prescription that replaces colligation (Abbott, 1988, p. 44). According to Abbott (1988, p. 49), inference, which "can work by exclusion or by construction", takes place when the connection between diagnosis and treatment is obscure. Abbott (1988, p. 52) concluded that, though diagnosis, inference and treatment are aspects of professional practice, professional work in most professions is tied directly to a system of *Academic Knowledge* that formalises the underlying skills. This academic knowledge accomplishes the three tasks of legitimation, research and instruction (Abbott, 1988, p. 56).

Abbott (1988, p. 59) revealed that "diagnosis, inference, treatment and academic work provide the cultural machinery of jurisdiction".

3.2.1.2 Jurisdiction.

Jurisdiction is defined as "the link between a profession and its work" and claiming jurisdiction implies a profession asking a society to recognise its cognitive structure through exclusive rights (Abbott, 1988, p. 20, 59). Abbott (1988) analysed the claim of jurisdiction from the three perspectives of audiences, settlement and internal structure (social structure of the group making the claim). In terms of audiences, jurisdictional claims can be made in the

arenas of legal system, public opinion and the workplace. However, Abbott (1988, p. 69) provided various options to professions for settling jurisdictional disputes as including:

- Laying claim to full and final jurisdiction
- Subordination of one profession under the other
- The dominant profession having cognitive control while allowing practical jurisdiction to be shared more widely
- Splitting jurisdiction into two interdependent parts and occasional sharing of areas without a division of labour
- Allowing one profession an advisory control over certain aspects of the work
- Dividing jurisdiction according to the nature of client rather than the content of work

Regarding internal structure, Abbott (1988, p. 79) claimed that a profession's social organisation has three major aspects of groups, controls and worksites. In other words, how the professional group is organised, what professional controls (education, qualification, licensing and ethical codes) it puts in place and the nature of its worksite(s) (exclusive or affiliated, private or public) determine how a profession fares within the competing system.

3.2.1.3 Competition.

Abbott (1988) argued that jurisdiction is exclusive within an interdependent system of professions and no profession can occupy a jurisdiction without either finding it vacant or fighting for it. His further argument is that "a move by one (*profession*) inevitably affects the other" (Abbott, 1988, p. 86). This move points to constraints on jurisdiction and disturbances in the system of professions. Two basic constraints are contextualised; while the first limits occupancy of a particular jurisdiction by various groups, the second limits occupancy of various jurisdictions by a particular group (Abbott, 1988, p. 88). According to Abbott (1988, 91, 96) disturbances occasioning change in the system of professions arise in two ways. First, external forces, especially technology and changes in organisations, may open or close areas for jurisdiction. Second, existing or new professions may seek new ground either by developing new knowledge or skill, or by the internal changes, including professionalisation, in the social structure of a profession. Unlike the external forces that may change jurisdiction, Abbott (1988, p. 97) explained that the "internal changes prepare professions to consolidate old jurisdictions or to invade new ones".

Abbott (1988, p. 98) informed that both these external and internal forces create vacant task areas and greedy professions. Invariably, this engenders inter-professional contests for jurisdiction requiring strategies to outwit one another. Abbott (1988) summed up these strategies in terms of "abstraction of professional knowledge", of which a typical type is "reduction" in its various forms. Thus, in order to maintain professional power a profession may seek to reduce a problem to its jurisdictional base. However, prominent among ways of maintaining optimum abstraction are the mechanisms of amalgamation and division (Abbott, 1988, p. 105). Abbott (1988, p. 111) concluded that the contests for jurisdiction may continue until the balance of forces stop them.

The next section discusses how the theory has been used in some studies.

3.2.2 Use of the theory in studies.

Abbott's (1988) *The System of Professions* seems to have enjoyed wide citation in academic studies. However, only some of these studies, more in other fields than in LIS, are founded on its various ideas or constructs, specifically professional work, jurisdiction and competition. Some of these singly focused on the theory (Billings & Andersen, 2010; von Knorring, de Rijk & Alexanderson, 2010; Silvers, 2003; Mieg, 2001; Ray, 2001; Danner, 1998; Freeman, 1997). Other researchers used a framework that combined it with components of other theories/concepts such as Institutional Theory (Suddaby & Viale, 2011), Theory of Gendered Organisation (Ladner, 2004), 'social closure' (Boon, Welsh, Kelner &Wellman (2004) and Bourdieu's Theory of Professionalism (Johannesson, 1996). Excepting the last author, all others focused on the jurisdiction component.

3.2.2.1 Non-LIS studies.

A number of items from the accessed literature show that Abbott's theory has been used in works done in some non-LIS fields including event management, administration, medicine, education, environmental sciences and treasury management. These works fall within the aspects of professionalization (Billings & Andersen, 2010; Boon, Welsh, Kelner & Wellman, 1998), professional work (Silvers 2003; Johannesson, 1996), jurisdiction (Suddaby & Viale, 2011; von Knorring et al., 2010) and competition (Mieg, 2001) in Abbott's (1988) *The System of Professions*.

Professionalisation appears to sum up these studies. Those on professionalisation seem to default to the constructs. For instance, Boon et al. (2004) focused on jurisdictional boundaries and social closure, both of which allude to competition. Similarly, studies on the constructs

tend to point to professionalisation. For instance, Johannesson (1996, Closing Comment, para. 3) concluded that his study on expertising teaching was part of a legitimation process (an important aspect of professionalisation).

Thus, it can be summed up that Abbott's (1988) theory is widely accepted and robust in addressing professional issues.

3.2.2.2 LIS studies.

Much of the LIS studies containing the application of Abbott's (1988) theory seem to belong to the competition component. Based on this component, Danner (1998) reviewed the literature of the professions particularly to gain insight into the workplace relationships among librarians and other information professionals. Similarly, Ray (2001) used the same theory to guide his investigation of the relationship between librarians and other professionals having jurisdictional tension over scholarly publication. Ladner (2004) worked on the career pattern of women librarians who were early adopters of the Internet while working in special libraries in the 1990s. She framed her work mostly on Abbott's (1988) theory complemented by Joan Acker's (cited in Ladner, 2004) Theory of Gendered Organisations. However, Freeman's (1997) study on the process of professionalisation of librarianship in the UK appears to embody the theory's constructs of professional work and jurisdiction. It was based on Abbott's (1988) ideas on the heartland of work and jurisdiction.

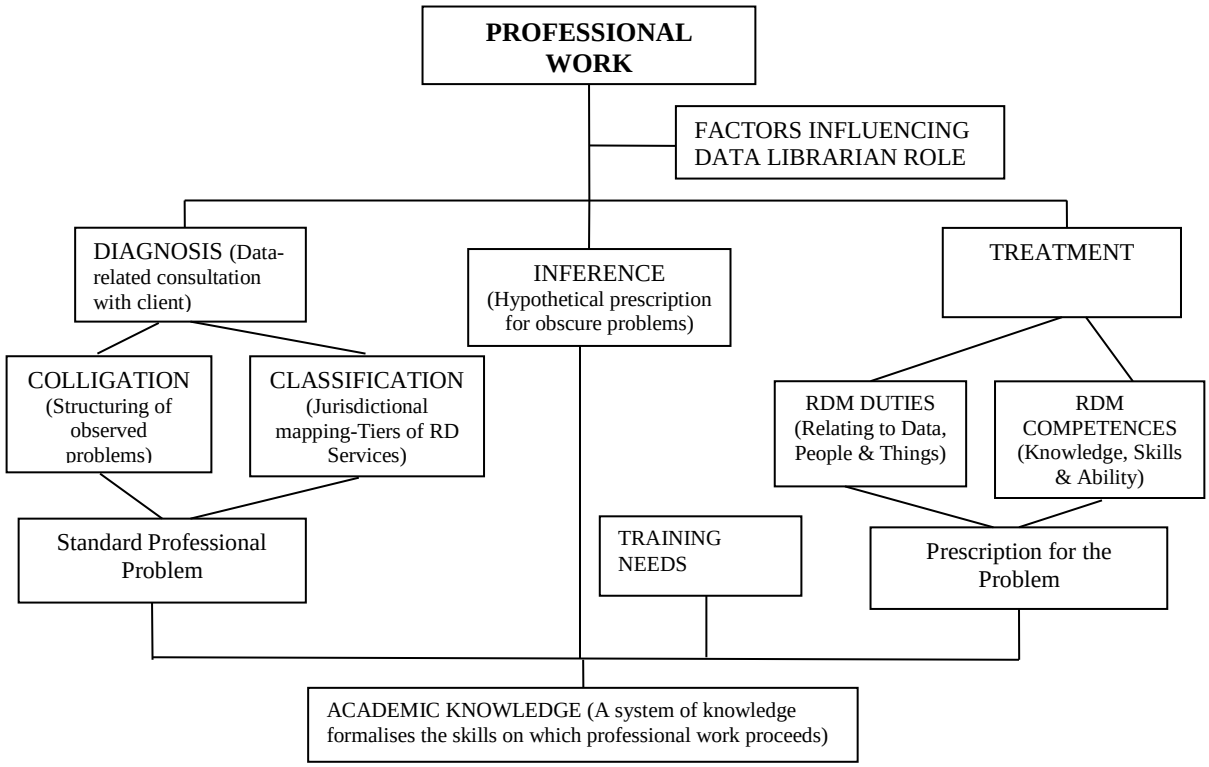
Beside these studies, Cox and Corrall (2013) used the theory differently as a theoretical framework for the analysis of the literature with respect to their study on evolving academic library specialties occasioned by forces impinging on academic libraries. Their study emerged with case studies of eight new specialties and a jurisdictional map of academic librarianship. However, studies in the RDM area show that Abbott's theory has been used or discussed by authors such as Cox and Pinfield (2014), Pinfield et al. (2014), Verbaan and Cox (2014a; 2014b) in relation to only the professional jurisdiction construct.

From the foregoing discussion in this section, it is apparent that the theory or any of its constructs could be applied to studies differently where they are deemed relevant.

3.2.3 The theory in this study.

This section discusses how the theory was used in my study. Abbott's (1988) theory complemented with literature components provide the background for the research model developed for this study. This is depicted by Figure 3-2.

Figure 3-2: Conceptual Model for Data Librarian (RDM) Role.



Source: Adapted from the Parameter of Work from Abbott's (1988) *The System of Professions* (Chapter 2).

The original components of the parameter of professional work from Abbott's theory include professional work, diagnosis, colligation, classification, treatment, inference and academic knowledge. However, the literature was used to contextualise some of them as well as create the complementary components for the purpose of the study. The components of the conceptual model are clarified below.

Professional Work refers to the tasks of professions that are amenable to expert service which may be for individuals or for groups (Abbott, 1988, p. 35). The degree of resort to experts varies from problem to problem, from society to society and from time to time. In this study professional work refers to e-Research/RDM support tasks for academic/research librarians.

Factors Influencing Data Librarian Role refers to circumstances, facts, people, things, environments, etc. that contribute to playing the DL role such as have been gleaned from the

literature (Bracke, 2011; Brandt, 2007; Soehner et al., 2010; and Tenopir, Sandusky, et al., 2012).

Diagnosis refers to a mediating act that takes information into the professional knowledge system (Abbott, 1988, p. 41). In this study diagnosis refers to the consultation of a librarian by one or more clients in respect of a RDM need or problem.

Colligation is an aspect of diagnosis that refers to the assembling of a picture of the client and consists largely of rules regarding the issue of degrees of relevance, validity and ambiguity (Abbott, 1988, p. 41). In this study, colligation is taken to be the structuring of the problem presented by a client as to eliminate ambiguity and establish it is valid and relevant problem requiring expert solution.

Classification is an aspect of diagnosis that refers the colligated picture to the dictionary of professionally legitimate problems (Abbott, 1988, p. 41). In this study, classification means the jurisdictional mapping of the structured RDM needs of the researcher(s) to Reznik-Zellen et al. (2012) tiers of data services.

Standard Professional Problem refers to the problem already established within a professional jurisdiction to which the client's needs profile can been mapped based on the knowledge limits of the DL.

Treatment refers to a brokering process whereby the client is given results by way of prescription that replaces colligation (Abbott, 1988, p. 44). In this study, treatment means the reduction of the structured and mapped RDM needs of client(s) to duties and employing the appropriate knowledge and skills to resolve them.

RDM Duties refer to the work characteristics component of Kim et al.'s (2011) job analysis framework that includes tasks involving people, things and data.

RDM Requirements refer to the worker characteristics component of Kim et al.'s (2011) job analysis framework that includes the professional requirements such as knowledge, skills and ability.

Prescription for the Problem refers to the programme design or a brokering process aimed at meeting the client's needs.

Inference refers to a professional act that takes place when the connection between diagnosis and treatment is obscure (Abbott, 1988, p. 49). In this study, inference means a hypothetical prescription based on expert knowledge for problems unclear in jurisdictional classification or mapping.

Training Needs refer to the gaps in the knowledge/skills required by the librarians to play the DL role.

Academic Knowledge refers to a system of knowledge that formalises the underlying skills, to which diagnosis, inference and treatment are directly tied, and which also accomplishes the tasks of legitimation, research and instruction (Abbott, 1988, p. 56). However, this component lies outside the focus of this study.

The following comprise the summary of the model:

1. Professional work is shaped by the factors influencing the DL role.
2. Professional work is executed through diagnosis, inference and treatment.
3. Through its components of colligation and classification, diagnosis leads to a standard professional problem for which the performance components of treatment provide the basis for a corresponding prescription.
4. Standard professional problem and the prescription for it provide the background for discovering the training needs and building academic knowledge for the DL role.

3.3 Research Paradigm and Design

Guba (1990, p. 17) defined a paradigm or worldview as "a basic set of beliefs that guide action." Thus, it is how we view the world that shows on our conduct of research (Creswell, 2007, p. 21) and that is defined by three main questions; the ontological, the epistemological and the methodological (Lincoln and Guba, 1985). Concerning these, Pickard (2007, p. 5) clarified that "'ontology' is the nature of reality; 'epistemology' is the philosophy of how we can know that reality; and 'methodology' is the practice of how we can know that reality." Research design is normally grounded within philosophical assumptions or research paradigms. In other words, a paradigm dictates the methodology and methods for collecting and analysing data.

3.3.1 Research paradigm.

Creswell (2007; 2014) identified and clarified four paradigms that inform qualitative research to be postpositivism, social constructivism, advocacy/participatory (transformative and

pragmatism. Postpositivism takes a scientific approach to research that "has the elements of being reductionist, logical, an emphasis on empirical data collection, cause-and-effect oriented, and deterministic based on a priori theories" (Creswell, 2007, p. 20). As such, it is associated with quantitative research approaches (Creswell and Piano Clark, 2007, p. 22).

Advocacy/participatory or transformative paradigm emphasises that "research should contain an action agenda for reform that may change the lives of participants, the institutions in which they live and work, or even the researchers' lives" (Creswell, 2007, p. 21). Creswell and Piano Clark (2007, p. 22) held the view that this worldview "is more often associated with qualitative approaches than quantitative approaches. Pragmatism (also known as mixed method) focuses on the problem being studied rather than the method and, as such, emphasis is "on the outcomes of the research-the actions, situations, and consequences of inquiry-rather than antecedent conditions (as in postpositivism)" (Creswell, 2007, p. 22).

Within the social constructivism, "individuals seek understanding of the world in which they live and work" by developing subjective meanings of their experiences towards certain objects or things (Creswell, 2007, p. 20). This worldview is often associated with qualitative approaches (Creswell and Piano Clark, 2007, p. 22) and interpretivism (Creswell, 2007; Pickard, 2007), which claims that truth is relative and dependent on one's perspective (Baxter & Jack, 2008). Here, reality is socially constructed as the researcher tries to make sense of the meanings others have about the world (Creswell, 2003). Lincoln and Guba (2000) informed that social constructivism uses relativism in its ontology, a transactional epistemology and a hermeneutical/dialectical methodology. However, Denzin and Lincoln (2008, p. 246) concluded that the "users of this paradigm are oriented to the production of reconstructed understandings of the social world."

I carefully studied these four paradigms before considering social constructivism as explained above to be the most suited for my study. As only a few works were done in my area of study, especially as it relates to New Zealand, I thought that I should do an exploratory study and use some RDM stakeholders within the selected research organisations as my research participants. I hoped to make sense of their views regarding library involvement in RDM from the New Zealand perspective.

3.3.2 Research design.

According to Leedy and Ormrod (2013) research design is about a researcher's general strategy or plan for solving a research problem including the procedure or approach to be

followed, and data collection and analysis. In other words, within a research design are types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures (Creswell, 2014, p. 12). These types of inquiries are known as research methodologies.

3.3.3 Research methodology.

According to Leedy and Ormrod (2013, p. 7) "the research methodology is the general approach the researcher takes in carrying out the research project" and represents "a way of thinking about and studying social reality" (Strauss and Corbin, 1990, p. 4). Every research follows either or a mixture of quantitative and qualitative methodologies. Quantitative methodology refers to inquiries based on deductive mechanism and objective standpoint that aim "to learn about the distribution of a set of characteristics (or attitudes or beliefs) within a population" (Mayan, 2001, p. 6).

Qualitative research is a process of enquiry that draws data from the context in which events occur, in an attempt to describe these occurrences, as a means of determining the process in which events are embedded and the perspectives of those participating in the events using induction to derive possible explanations based on observed phenomena (Gorman & Clayton, 2005, p. 3). This study follows a qualitative methodology approach.

However, "mixed methods involve combining or integration of qualitative and quantitative research and data in a research study" (Creswell, 2014, p. 14). This defaults to the pragmatism worldview that was discussed in Section 3.3.1.

3.3.4 Research approach: Case research.

Research approach entails the specific steps or strategies within research methodologies. Creswell (2014, p. 13-14) discussed five qualitative research approaches including narrative research, phenomenology, grounded theory, ethnography, and case studies. Narrative research from the humanities is a research design where individuals being studied are made to provide stories of their lives which the researcher eventually retells or re-stories into a narrative chronology. Phenomenology coming from philosophy and psychology is a research design where the researcher is preoccupied by the lived experiences regarding a phenomenon described by individuals serving as research participants. Ethnography, associated with anthropology and sociology, is a research design for studying the shared aspects of a cultural group in a natural setting. Found in many fields, case studies involve developing an in-depth analysis of a case which could be a programme, event, activity, process, or individual(s).

However, Yin's (2009, p. 18) definition appears more elaborate; "a case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

According to Baxter and Jack (2008) case study approach has been based on constructivism. Creswell (2007, p. 73) also contributed that "case study research involves the study of an issue explored through one or more cases within a bounded system (i.e. a setting, a context)." However, Stake (1978, p. 7) pointed out that 'cases,' referring to the object of such social inquiry, have often been narrowed to a person or an enterprise, but that it can be whatever "bounded system" that is of interest such as an institution, a programme, a responsibility (or role), a collection, or a population. Although Creswell (2003; 2014) included case studies as one of the strategies associated with the qualitative approach, Bryman (2012) and Yin (2009) argued that they are not exclusive to this approach.

However, following a social constructivism paradigm, the research approach I have chosen for this study is a qualitative exploratory case research approach. This is for two reasons. First, it is excellent for studying emergent practices (Voss, Tsikriktsis & Frohlich, 2002, p. 199). Second, this approach facilitates exploration of a phenomenon within its context using a variety of data sources (Baxter & Jack, 2008). But, what is case research? Does it exactly mean the same thing as case study? Voss et al. (2002, p. 197) clarified that, "case research is the method that uses case studies as its basis." This may explain why some authors use 'case research' and 'case study' interchangeably (e.g. Benbasat, Goldstein & Mead, 1987) or use the all-encompassing term 'case study (research)' for both (e.g. Creswell, 2007). It is safe to make two clarifications here. In this study I prefer to use the term case research. As a result, where authors using the term case study are cited in this study they are taken to mean case research.

3.3.4.1 The case and case institutions in the study.

Miles and Huberman (1994, p. 26) illustrated that a case may be defined by a role[9] such as responsibility or something associated with people in a profession, for example, a teacher, a school principal, police, etc. The case in this study is 'the data librarian role in New Zealand ROs'. This case is an emerging phenomenon in academic/research libraries as a result of the burgeoning e-Research and the need for RDM. However, in relation to this, the picture in New Zealand appeared obscure so that an exploratory investigation became necessary.

[9] See also Stake's (1978) clarification on 'cases' in the previous section.

The two main types of case institutions used in the study are the universities and Crown Research Institutes (CRIs). These include four universities and five CRIs. However, in an additional CRI only a researcher participated. These organisations were chosen for two reasons. First, both categories are government-supported. Second, both categories support research and researchers. Moreover, both collectively represent types of a New Zealand RO.

3.3.4.2 Case design for the study.

In terms of intent, Creswell (2007, p. 74) explained three types of case studies or design. The first type is the 'single instrumental case study' where a researcher focuses on an issue or concern before selecting one bounded case to illustrate it. This corresponds to Yin's (2009) single-case design. The second type is a 'collective case study' focusing on one issue or problem while selecting multiple cases to illustrate that. Again, this corresponds to Yin's (2009) multiple-case design. Finally, there is the 'intrinsic case study' with focus on the case itself because it is unusual or unique. This sounds rather like Yin's (2009) extreme or unique case which is one of his five rationales for a single-case design.

This study follows Creswell's (2007) single instrumental case study and fits into two of Yin's (2009) five rationales for a single-case design; the case is both extreme/unique and representative/typical[10]. The former applies to New Zealand as a unique entity while the latter fits the universities and CRIs as representative of a New Zealand RO.

In terms of research questions, Yin (2009) offered that case studies serve three purposes including exploratory, descriptive and explanatory. The nature of the research question addressed in this study defaults to exploratory investigation to which single instrumental case design chosen for this study is amenable. Moreover, the unique advantages of case research include its suitability for contemporary phenomenon, enabling in-depth investigation and accommodating the embedding of different data sources such as documents, artefacts, interviews, and observations, etc. (Yin, 2009; Stake, 1978).

3.3.5 The role of the researcher.

As earlier mentioned in Section 3.3 social constructivism is associated with interpretivism. Walsham (1995, p. 77) revealed that "interpretive researchers are attempting the difficult task of accessing other people's interpretations, filtering them through their own conceptual apparatus, and feeding a version of events back to others." He went further to point out that a

[10] Bryman (2012) prefers the term *exemplifying case* to avoid the confusion from the notions of representativeness and typicality.

researcher may play the role either as an 'outside researcher' or an 'involved researcher,' neither of whom is to be seen as an objective reporter because of the element of subjectivity in data collection and analysis. The former carries out "a study mainly through formal interviews, with no direct involvement in action in the field or in providing significant feedback to field participants" whereas the latter acts as "a participant observer or action researcher." However, Walsham (2006, p. 321) extended his views on the latter, adding that the involvement of a researcher should be viewed as more of a spectrum that changes often over time. According to him, at one end of the spectrum is the 'neutral observer' while at the other end is the 'full action observer,' "trying consciously and explicitly to change things in the way that they feel best."

Following Walsham (1995; 2006) and in line with the choice of research paradigm and approach for the study I opted for the outside researcher role, more so, as I had no intention of being directly involved and interview is my main data collection instrument. I reasoned that since I come from a different cultural background and have no personal or political stake in the case institutions it was better for me to operate from a distance to the research setting. But, this does not suggest that I am totally new to the western culture as I had studied for my second master's degree in a consortium of universities in Norway, Estonia and Italy, except that my data collection then was done unobtrusively. However, I acknowledge that viewing the setting from the perspective of an insider would have provided a stronger sense of the research setting. But, the outsider perspective gives me the advantage of enhanced neutrality by reducing any bias that would have arisen from involvement in the research setting. Moreover, I believe that I was adequately prepared for the data collection by my professional and academic background, and review of literature.

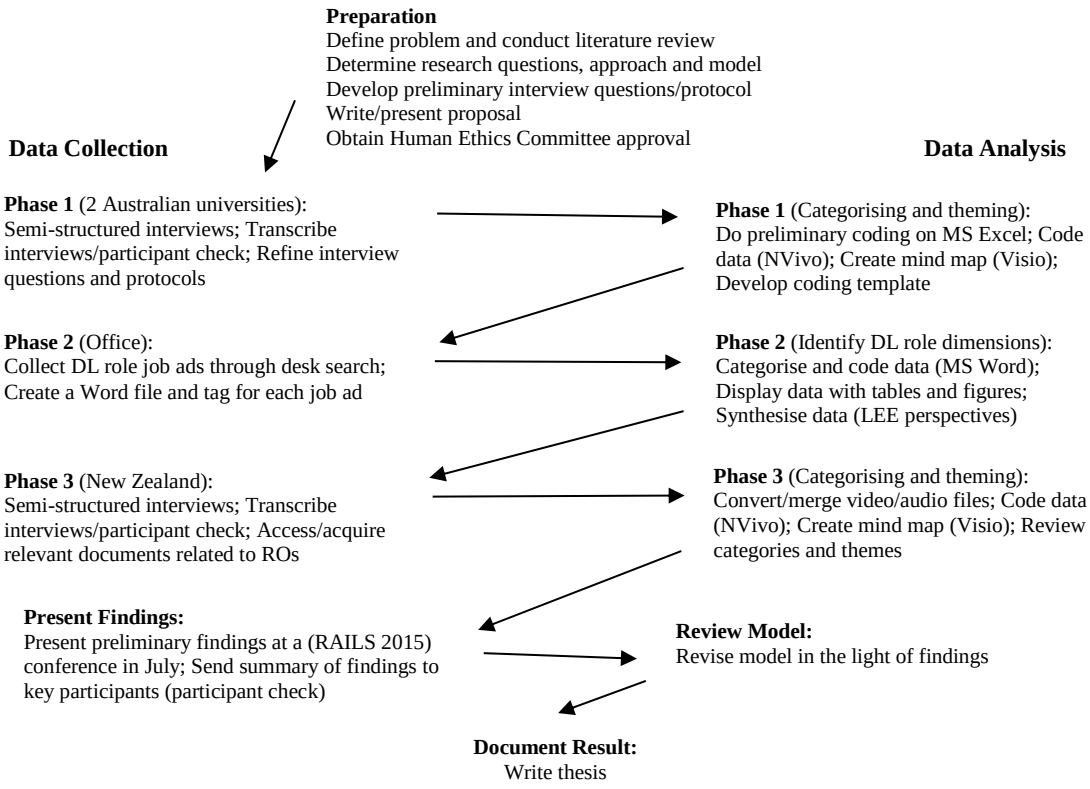
I sought and obtained the consent of the research participants. Generally, an initial informal email invitation was sent with a brief research proposal attached. Positive cues from prospective participants were followed by formal email invitation including the attached information sheet and consent form approved by Victoria University of Wellington's Human Ethics Committee. However, for the main study in particular, I approached the universities and the CRI slightly differently. I first contacted the university librarians (UL) who then provided me with the contacts of their library and information professional (LIP) staff to be involved in the research. Then, on my request, these participants provided me with the contacts of researchers they suggested to be included in the study. When I invited the LIP participants from the CRIs to be involved in the study I equalled sought and received their

assistance in the recruitment of their researchers for the research. However, because the LIP participants from both the universities and the CRIs were only able to suggest three researchers and assisted in the recruitment of two others, my personal efforts resulted in bringing one more researcher to participate in the study.

3.3.6 Research process.

Creswell (2014, p. 185) articulated the views of a number of authors in terms of the characteristics of qualitative research. These include (data collection in) natural setting, researcher as key instrument, multiple sources of data, inductive and deductive data analysis, participants' meanings, emergent designs, reflectivity, and holistic account. Some of these characteristics underline the fact that the qualitative research process is both iterative and reflective, and could be done in phases. In this study, data collection and analysis was done in three phases. Figure 3.3 shows an overview of the research process.

Figure 3-3: The Research Process at a Glance.



3.3.6.1 Phase 1.

In the first phase of the research an exploratory study was carried out within August 19-23, 2013 in two Australian universities. There were two main reasons for this study. First, I

needed more understanding about the e-Research support role and how librarians are/may be involved. As such, the context of views from experts was deemed relevant. Second, the literature available to me on DL role dimensions then were only indicative. So, there was the need for more pointed and complementary data that would, with the literature, help me to test and properly contextualise my interview questions and interview protocol.

3.3.6.2 Phase 2.

In order for more robust outcome, there was the need in the second phase to add the employers' context to the perspectives of literature and e-Research experts as sources of data for this study. To this end and in relation to the DL role dimensions in particular, between May 2012 and August 2014 I selected a total of 43 position advertisements containing 31 job titles from a number of USA and Australian job advertisement databases or websites for analysis. These included: the ALAJobLIST; HigherEdJobs; School of Library and Information Science, Indiana University's job list (obsolete); Australian Library and Information Association (ALIA); and the Australian National Data Service (ANDS).

The main criterion used for the selection of each position advertisement was relevance in relation to being an academic librarian position as well as having a focus on e-Research/RDM support. The following constitute the two main categories of job advertisements that I retrieved:

- Those with the words 'Data Librarian' appearing together or separately in job titles as a prefix, infix or suffix.
- Those containing either 'Data' or 'e-Research' occurring with either 'Specialist' or 'Coordinator' or 'Consultant' in the job titles.

3.3.6.3 Phase 3.

The third phase was used for the main part of the study on New Zealand ROs, namely the universities and CRI. Data collection within the first part of this phase took place from December 17, 2013 to January 31, 2014. It was stopped momentarily to allow for preliminary analysis up to early June 2014. However, in order not to miss some participants about four interviews were conducted in March 2014. Data collection within the last part of this phase spanned from June 17 to November 20, 2014. The general pattern was to begin with UL/LIP participants and proceed in the following order to interview institutional repository managers (IRM) and e-Researchers. Although it was not previously planned, following a recommendation by one of the participants from a university I deemed it necessary to

interview one information technology services (ITS) manager from her organisation. Moreover, the main data analysis followed the completion of the data collection up to April 2015.

In Chapter 4, perspectives of the literature (Chapter 2), the e-Research experts (Phase 1) and the academic/research library employers (Phase 2) are synthesised to provide a filter for discussing the findings of the main study (Phase 3) in Chapter 6.

3.3.7 Research participants.

According to Mayan (2001, p. 9) qualitative sampling is aimed at understanding the phenomenon of interest as opposed to generalisation which is the object of quantitative sampling. So, the purpose of the research is a key driver to selecting both the individuals and contexts that will provide the most and best information about the phenomenon under investigation. Miles and Huberman (1994, p. 27) indicated that, unlike those of quantitative approaches, qualitative samples tend to be purposive and small. They further clarified that qualitative sampling is often decidedly theory-driven and involves the two important actions of setting *boundaries* and creating a *frame* to undergird the study. However, they pointed out that qualitative samples may not usually be wholly pre-specified but can evolve once fieldwork starts.

In light of the foregoing clarifications, the key informants or research participants for the exploratory and main aspects of this study were drawn from the core stakeholders of the research support-patronage constituency of two Australian universities and the participating New Zealand ROs. In both aspects, the sampling technique was largely purposive but complemented with a snowballing procedure. In terms of the exploratory study, an e-Research expert I met at a conference gracefully agreed to participate and provided three other contacts for the study. However, one of these in turn assisted to bring in the only researcher who participated in the study. Overall, as Table 3-1 shows, the research participants were four e-Research experts and 1 researcher from two Australian universities, which I coded Grand and Techy.

Table 3-1: The Profiles of the Participants in the Exploratory Study in Australia.

PARTICIPANT		ORGANISATION
Responsibility	**Pseudonym**	
Project Manager	Mael	Grand
e-Research Specialist	Salvina	Grand
Research Data Co-ord.	Sapna	Techy
Project Manager	Nadia	Grand
Research Fellow	Aba	Grand

With regard to the main aspect of the study, Table 3-2 shows pseudonyms, codes and organisations of the 25 research participants. I have labelled the universities from UN1 to UN4 and the CRIs from CRI1 through to CRI6.

Table 3-2: The Profiles of the Participants in the Main Study in New Zealand ROs.

Pseudonym	Categories	**Organisation**	**Pseudonym**	**Categories**	**Organisation**
Hoku	UL	UN3	Sofia	LIP	CRI3
Lily	UL	UN2	Dacia	LIP	CRI4
Ngaio	UL	UN4	Riley	LIP	CRI5
Phoebe	UL	UN1	Dabir	ER	UN3
Charlotte	LIP	UN3	Jabal	ER	UN4
Georgia	LIP	UN3	Sabir	ER	UN1
Baron	LIP	UN2	Arana	ER	CRI4
Lyn	LIP	UN4	Jabneh	ER	CRI6
Daisy	LIP	UN1	Dae	ER	CRI2
Eden	LIP	UN1	Aala	IRM	UN2
Rewa	LIP	UN1	Maat	IRM	UN4
Maru	LIP	CRI1	Jafari	ITSM	UN4
Brady	LIP	CRI2			

The ULs were the prime contacts and provided the contacts of their staff who participated in the research. In turn, these staff helped to contact or provided the contacts of the researchers who participated in the study. But, in the CRI the LIP participants assisted in the recruitment of their researchers for the study in the same way as their counterparts in the universities. Altogether, 4 categories of people participated in the study. The first group comprised the ULs who were the prime contacts from each participating university (4). The second group was constituted by LIPs from the universities (those with responsibilities related to research support – 7) and CRI (library managers or their representatives – 5). The third category of participants was constituted by the institutional repository managers (IRM) from two universities (2). The last group was made up of researchers from the universities and the CRI who were involved in e-Research activities (e-Researchers – 6). However, following a lead

from one of the participants in the last part of this phase it became necessary to interview one Information Technology Services manager (ITSM) from her organisation.

3.3.8 Research methods.

Strauss and Corbin (1990, p. 3) defined research methods as "a set of procedures and techniques for gathering and analysing data." This section focuses on data collection and analysis for the study following exploratory case research design.

3.3.8.1 Data collection.

The main steps of data collection in qualitative research "include setting the boundaries for the study, collecting information through unstructured or semi structured observations and interviews, documents, and visual materials as well as establishing the protocol for recording information" (Creswell, 2014, p. 189). Embedding these different data sources for in-depth exploration of a contemporary phenomenon is an advantage that case research approach provides (Stake, 1978; Yin, 2009).

3.3.8.1.1 The method.

This study used interviews as its main data collection method during its exploratory and main phases (Phases 1 and 3). The interview case research is a method where interviewing appears more appropriate than observation and to be the dominant means of data collection (Gorman & Clayton, 2005). Gorman and Clayton (2005) revealed that this approach generally uses data collected from a series of individual interviews, though focus group may not be ruled out. Specifically, I used a semi-structured individual interview method primarily through face-to-face mode. However, for the Phase 3 in particular, I also conducted some interviews with tools such as Skype, Scopia and Lync as alternatives. On my part this was for logistics reason. Another reason was that some participants preferred using the tools available to them. The interviews were audio and video-recorded respectively with digital voice recorder, Free Video Call Recorder for Skype and Callnote.

In the Phase 1 of the study, five participants including four e-Research experts and one e-Researcher were individually engaged in semi-structured interviews. I used open ended questions and the average duration of each interview was one hour. Of the four e-Research experts three had a background in LIS while one had a background in computer science. For the interviews and in relation to their background, I used three different research interview protocols. Each interview protocol had two main sections although the questions were tweaked to the contexts of the different categories of participants. The introductory section

was aimed at setting the stage while the main section contained the questions ranging from the roles, background and interests of participants to the areas that constituted the lenses of the research, participants' concluding remarks and wrap up by me.

Similarly, I used open ended questions via semi-structured interview protocols for Phase 3 of the study (see Appendices A1-5). Also, the average interview session lasted for about an hour. There were primarily four different sets of questions for the different categories of participants. However, there was an additional set of questions for the ITS manager who was not originally conceived as a research participant. The structure of the interview questions was similar to those used in the exploratory study described above.

3.3.8.1.2 The interview process.

The interview process comprised two main stages; preparations for and the conduct of the interviews. With regard to the participants, preparation was in terms of making them aware of what was expected of them. This I achieved by initially sending them a brief research proposal informally, and the information sheet (Appendix B) and the consent form (Appendix C) with the formal invitation subsequently. The first two documents contained the description of the research that would enable a participant to consider being involved or not. But, the third document meant to be endorsed by the participants contained such issues bordering on their privacy, security and recording of their views and the requirement of their consent to use their views for the research and related publications. However, on my part, preparations included making the necessary contacts to schedule interview appointments, reviewing interview questions and developing interview protocols, reflecting on the questions and how to ask them, setting up Skype profile of participants, downloading and studying the participants' preferred or needed tools, and test-running recording tools including a borrowed digital voice recorder, Free Video Call Recorder for Skype and Callnote.

The conduct of the interviews has to do with the actual one-on-one interview sessions. Of the 30 participants in the study five took part in the exploratory study and were both interviewed face-to-face and audio-recorded. However, in the main study 23 participants were fully interviewed. One participant was interviewed half-way on account technology failure and had to provide answers to the remaining questions over the e-mail. The remaining participant was not interviewed because he felt he would be repeating the information his participating colleagues provided. Instead, he preferred to provide complementary information via e-mail. In terms of the interviews during the Phase 3, eight of them were face-to-face and audio-

recorded. While fourteen 14 of them were conducted via Skype, the remaining two were conducted respectively via Scopia and Lync. Of these interviews conducted with video tools, nine were video-recorded, two were audio-recorded while the remaining five could not be recorded. However, I took some notes during the interviews.

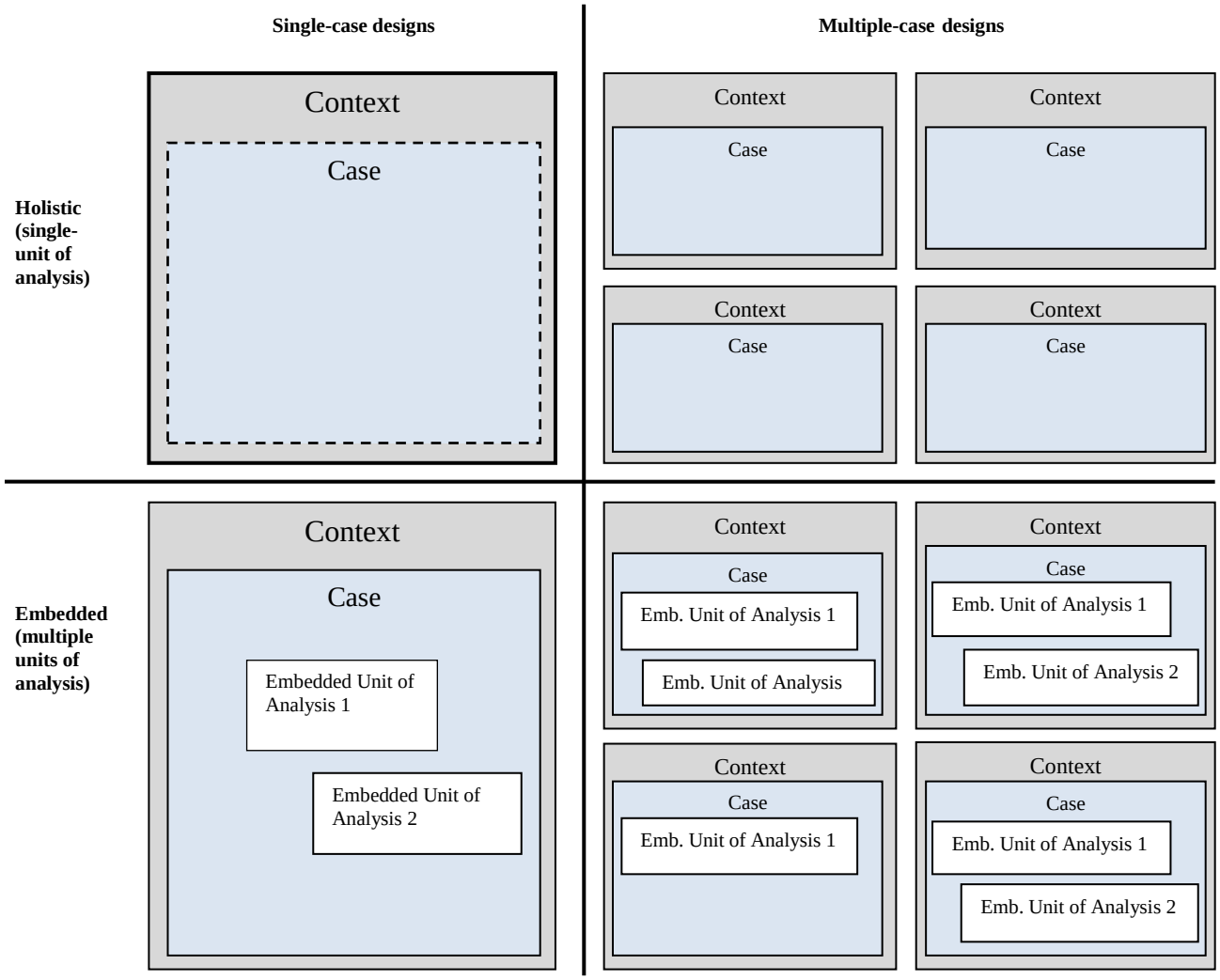
3.3.8.2 Data analysis.

Data analysis for the study followed the various phases as discussed in Section 3.3.6. While the exploratory and main aspects of the study (phases 1 and 3) covered the three main areas that constitute the lenses of the study, the DL position analysis (phase 2) covered only the DL role performance components. But, for all phases generally, the unit of analysis was the same and the data around the area of performance components were organised according to Kim et al.'s (2011) job analysis framework that I discovered from my review of the literature.

3.3.8.2.1 Unit of analysis.

As the subject (who or what) of the study, unit of analysis is the most basic element of a scientific research project (Long, 2004). Yin (2009) opined that this is the same as the case in a study and associated it with case designs. He showcased four types of case designs based on single or multiple units of analysis as shown in Figure 3-4. They include single-case (holistic), single-case (embedded), multiple-case (holistic) and multiple-case embedded designs.

Figure 3-4: Basic Types of Design for Case Studies.



(Adapted from Yin, 2009, p. 46)

This study followed a 'single instrumental case study' that corresponds to single-case (holistic) design and the 'data librarian role in New Zealand ROs' was the sole unit of analysis. The analysis was mainly on the individual level that, nonetheless, included organisational level in limited context where it was necessary.

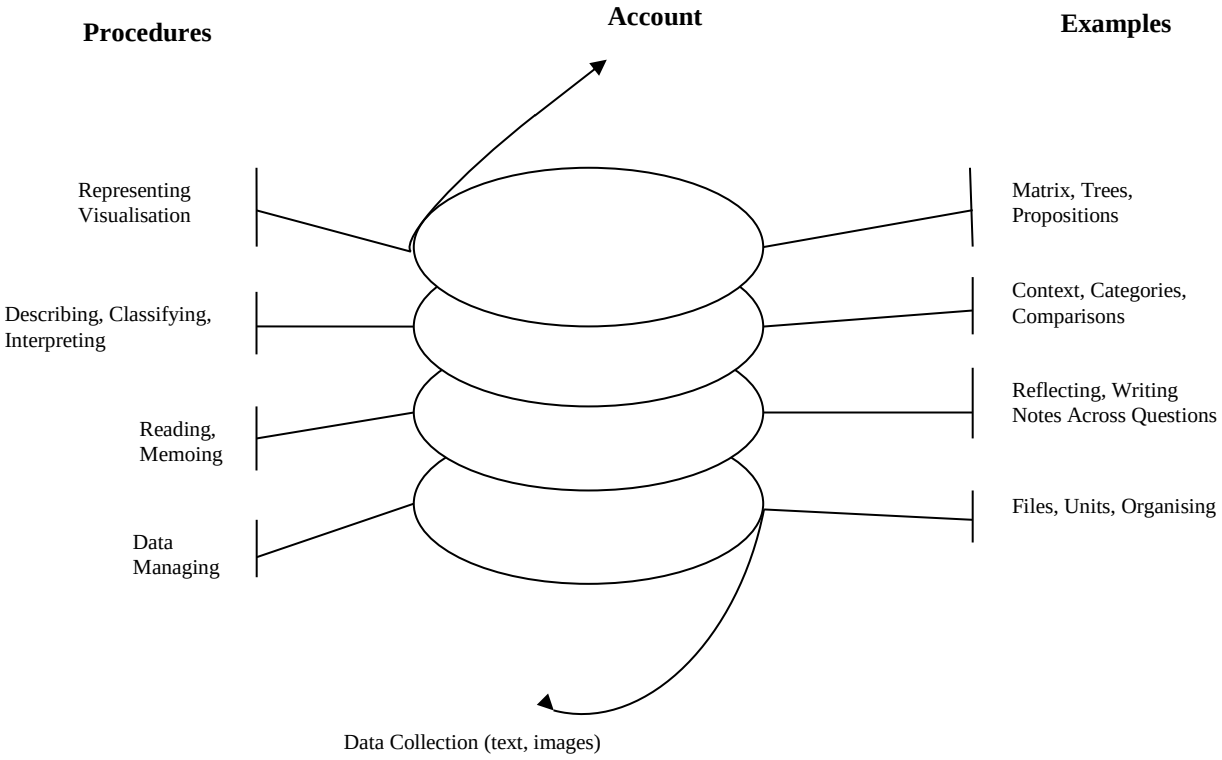
3.3.8.2.2 Procedures for data analysis.

According to Mayan (2001, p. 21), most qualitative data is content-analysed which follows either 'manifest' or 'latent' approaches. The former approach entails looking for specific words used or ideas expressed while the latter approach points to identifying, coding and categorising of primary patterns in the data. Latent content analysis seems to be the first of Miles and Huberman's (1994, p. 10) three concurrent flows of activity described as data

reduction, data display and conclusion drawing/verification. Data reduction implies reducing and transforming the chunk of qualitative data into sense-making bits in different ways including selection, simplification, abstracting, summary, etc. Data display is organising, compressing and assembling the reduced data in a way that permits conclusion drawing and action. The third stream of analysis activity is of dual nature. As a researcher begins to make sense of the observed regularities, patterns, causal flows, etc. possible conclusions begin to filter in, such as must be subjected to verification before they are taken to be valid.

However, Miles and Huberman's (1994) analytic strategy has been subsumed among others into Creswell's (2007) aggregated Data Analysis Spiral made up of four loops. Creswell (2007) argued that qualitative data analysis does not follow a fixed linear approach but moves in analytic circles as can be seen in Figure 3-5 below.

Figure 3-5: The Data Analysis Spiral.



(Adapted from Creswell, 2007, p. 151).

However, the data analysis spiral might appear to be general across different qualitative research approaches. Creswell (2007) went beyond this to tabulate its application to the

various research approaches. Table 3-3 shows its application to case research approach which was followed in this study.

Table 3-3: Application of the Data Analysis Spiral to Case Research Approach.

THE DATA ANALYSIS SPIRAL	
Data Analysis and Representation	**Case Research Approach**
Data Managing	Create and organise files
Reading, Memoing	Read through text, make margin notes, form initial codes
Describing, Classifying and Interpreting	
Describing	Describe the case and its content
Classifying	Use categorical aggregation to establish themes or patterns
Interpreting	Use direct interpretation Develop naturalistic generalisations
Representing, Visualising	Present in-depth picture of the case (or cases) using narrative, tables, and figures

Note: The data analysis spiral in Table 3-3 was adapted from Creswell's (2007, p. 156) Data Analysis and Representation, by Research Approaches.

In terms of managing the interview data I first used Freemake Video Converter to convert the Skype video call files to audio files. Next, I used Express Scribe for the transcription of all the audio files. Then, I stored all the interview transcripts and the developed notes I made during the unrecorded interviews in the folders and sub-folders created in my desktop computer. These were also backed up with a dedicated flash drive which, together with the printed copies of interview transcripts and notes, were kept in secure drawers.

Following ethical commitment to the participants involved in the exploratory and main phases of the study, I sent a soft copy of the interview transcript or notes of each participant to them for checking. After the necessary editing I read the 25 transcripts and five notes carefully, and used NVivo software for coding the interview data before exporting them to Word documents for further analysis. The reason for this switch was because of a technical hitch that I encountered while using NVivo. I was scared of losing my data and subsequently felt more comfortable doing my analysis on Word files instead of on NVivo. However, the position advertisements were coded and analysed on Microsoft Word documents. I analysed the data from Phase 1 (exploratory study) and used the coding template I developed from it to begin the analysis in Phase 3. The position advertisement analysis was done in between the two phases of the study.

Guided by the research questions around the lenses of the study and the conceptual model in my analysis, I noted and categorised groups of ideas with the quotations from the participants

around them. I created different Microsoft Word files for them. I also used an exercise book and a particular Microsoft Word file as memos for my thoughts about the data. As I went through all my records severally, I was able to note some arising patterns and consistent themes which I separated within some categories under the main areas of the study which are the influencing factors, dimensions and training needs for the DL role. I paid particular attention to note any convergence or divergence of ideas from the different categories of the participants.

However, the position advertisement data in Phase 2 were content analysed. In LIS content analysis of position advertisements is a proven method for conducting studies such as detecting trends in the profession (Xia & Wang, 2014), exploring the employment market for LIS graduates (Du, Stein & Martin, 2007) and doing curriculum mapping (Lyon et al., 2015). In particular, for studies aimed at detecting trends in the profession such as exploring a new professional role Xia and Wang (2014) provided some vital fundamental guides. Thus, a first step to position advertisement analysis is to make some necessary adjustments in the data. For instance, the position advertisement data may be divided into several fields such as job titles, background information of the advertising institution, professional preparations of the applicant, requirements and professional qualifications, and job responsibilities. In order to prepare the position advertisement data for analysis, I saved each of the position advertisements in a Word file with a tag derived from the abbreviation for 'job title' and a number starting from one (JT1 to JT43). The data saved for each position advertisement were divided into the job title, advertising institution, the date it was posted, the position information and the source of the advertisement. Xia and Wang (2014) also clarified that where text applications are to be used for the analysis, word cleaning, word coupling and word standardisation could be done. However, for this study manual analysis was preferred for the same reason mentioned in the last two paragraphs.

As Xia and Wang (2014) further highlighted, a common content analysis strategy I adopted was the creation of a category system for coding or indexing purposes based on: a review of the literature; counts of the frequency of the content-bearing terms in the position advertisements; and knowledge of the specific type of librarianship being analysed. There were two possibilities here: an analysis of word frequencies and an analysis of co-term frequencies or co-occurrences. The analysis in this study was limited to the former. Nevertheless, the need to ensure that an analysis does not become idiosyncratic or arbitrary prompted Xia and Wang (2014) to suggest using a framework, multiple methods approach,

and the application of the power law of word distributions. In this study, I primarily adapted the job analysis framework used by Kim et al. (2011) to organise the analysed content of the position advertisements.

The findings presented in Chapters 4 and 5 under the thematic areas that emerged from the study represent my conclusions from the data. The presentation of the findings are with texts as well as tables and figures while the interpretation of the findings are by way of their discussion and conclusions on them in Chapters 6 and 7. The use of tables, some of which have some quantified information, in relation to the social constructivist approach in this study needs to be clarified. Miles and Huberman (1994, p. 11) argued that "the most frequent form of display for qualitative data in the past has been *extended text*". However, this seems no longer to be the case as these authors argued that extended text can be cumbersome or extremely bulky, dispersed, sequential rather than simultaneous and poorly structured. According to them, other forms of data displays currently being employed such as matrices (two-dimensional tables), graphs, charts and networks

> are designed to assemble organised information into an immediately accessible, compact form so that an analyst can see what is happening and either draw justified conclusions or move on to the next step of analysis the display suggests may be useful. (Miles & Huberman, 1994, p. 11).

Also, Glesne (2011, p. 9) indicated that interpretivism which she believed could be synonymous with constructivism may make minor use of numerical indices.

However, in relation to ethical requirements, pseudonyms or codes can be used to represent the participants in a qualitative study where ideas are credited to them (Pickard, 2013). The next section has information on how this applies to the study.

3.4 Quality of the Study

The value or contributions of any research project stem from the quality of such a project in terms of adhering to research principles and good practices including the consideration of research ethics and trustworthiness. These are considered in the following subsections as they were applied to this study.

3.4.1 Ethical considerations.

Christians (2008, p. 192) intimated that "in value-free social science, codes of ethics for professional and academic associations are the conventional format for moral principles." To

this end, he revealed four guidelines directing inductive science: consent, deception, privacy and confidentiality, and accuracy. According to Pickard (2013, p. 89), these are issues that, to a greater or lesser extent, face all researchers when engaging with other human beings in the research process. They are so important that every researcher must consider them. They provide protection to a research participant and by extension they provide confidence for a researcher that s/he is doing research the right way. Overall, they give a moral tone and acceptability to a research endeavour within a given research community. Each of these principles may need to be explored a bit.

The principle of consent implies that research participants must agree voluntarily to participate in a study (Christians, 2008, p. 192). As such, s/he needs to be well-informed about the study in which s/he is willing to participate. So, when research participants give informed consent they show that they understand what they are agreeing to, accept what is being asked of them and are comfortable with the purpose of the research and the intended use of the data they are providing (Pickard, 2013, p. 89).

The principle of deception points to the fact that any deliberate misrepresentation in relation to the purpose of the research is forbidden (Christians, 2008, p. 193). Thus, the information about an intended study available to the prospective research participants must be unambiguously expressed.

The principle of privacy and confidentiality relates to providing safeguards to protect people's identities and those of the research locations from unwanted exposure, harm, embarrassment, etc. As such, all personal data ought to be secured or concealed and made public only behind a shield of anonymity (Christians, 2008, p. 193). However, Pickard (2013, p. 93) clarifies anonymity further by distinguishing it from confidentiality. The former implies that the research participant remains totally anonymous during and after the study whereas the latter means that the identity of the participant will not be revealed when using any data by him/her.

Finally, the principle of accuracy is about ensuring that the data collected from participants are accurately presented void of fabrications, fraudulent materials, omissions and contrivances (Christians, 2008, p. 194).

These principles were duly considered and applied to the study by way of fulfilling the Human Ethics Policy of the Victoria University of Wellington. This requires all research

involving human subjects or human tissues or otherwise affecting people's privacy, rights and freedom to be subject to approval by one of Victoria University of Wellington's Human Ethics Committees. As a result, ethical approval was obtained at different times prior to data collection for both the exploratory and main aspects of the study. In addition to seeking and receiving this approval, I obtained the informed consent of the participants that their voluntary participation would not involve any deception and that their privacy and confidentiality would be respected. In this regard, I chose pseudonyms over codes as a naming convention for the participants as to retain their personal element of being individuals (Pickard, 2013, p. 93). However, codes were chosen to represent the research organisations that participated in the study. Also, I promised and committed myself to the accuracy of the data that were used for the study. For the details on ethical considerations see Appendices C and D.

Ethical considerations are related with trustworthiness discussed in the next section.

3.4.2 Trustworthiness of the study.

Trustworthiness enhances the value of research findings given the particular methodology used. Four criteria of trustworthiness in qualitative research discussed by Pickard (2007) are credibility, transferability, dependability and confirmability. Miles and Huberman (1994, pp. 278-9) clarified these terms.

Credibility points to proof of veracity (whether the findings make sense or sound credible both to the studied and the readers), whereas transferability has to do with whether the conclusions of a study can have any larger import beyond immediate contexts. Underlying dependability is the question of whether the study process is "consistent, reasonably stable over time and across researchers and methods" (p. 278). As the qualitative approach's version of objectivity, the basic issue with confirmability is relative neutrality and reasonable freedom from unacknowledged researcher biases.

Given the above, the trustworthiness of the study was improved by the following measures.

Credibility

The transcribed interviews were sent to the research participants for respondent checking. Their feedback was used to make the necessary corrections and adjustments. Further, three other contexts to sources of data (the Triad) were triangulated as a basis for discussing the findings. These include the literature, views of e-Research experts through an exploratory

study, and the views of academic library employers filtered from forty-three selected job advertisements. The preliminary findings were also presented at a library and information professionals' conference in July 2015. Also, a summary of the findings was sent to the research participants in New Zealand ROs for checking. In both instances the feedback was positive and no major changes were suggested.

Transferability

The nature of the study may not permit generalisability beyond the case institutions in the study. However, the conceptual model for the study and data collection schedules and protocols could be used in similar studies elsewhere. Likewise, some of the diagrams showcasing some of the findings could be of relevance to similar discussions elsewhere.

Dependability

First, I received ethical approval for the research from a Human Ethics Committee of Victoria University of Wellington. Second, I was explicit with the chosen method and procedures and was on guard against any unacknowledged biases. Third, measures were taken to ensure consistency in procedures. For instance, a conceptual model was used to undergird the study. Moreover, a data interview protocol was used for each category of participants during data collection. Fourth, field notes were taken and the interviews were audio-recorded. Finally, I endeavoured to and provided detailed and thick description of data on the case being studied.

Confirmability

The researcher took time to do the transcription himself in order to produce the original representation of the views of the participants as far as possible. I endeavoured to focus on the views of the research participants and did not allow my initial thoughts and expectations about the research to interfere with the participants' views.

3.5 Chapter Summary

The purpose of this chapter was to introduce the preliminary research model, paradigm and design for the study. The first part focused on Abbott's (1988) *The System of Professions* and its main components and how its parameter of professional work are complemented with literature components to develop the research model that undergirds the study.

I have also laid out and justified my research paradigm and design including methodology and strategy. I conducted the study within the social constructivist philosophy in which

qualitative methodology that favours case research strategy is grounded. The case in this study is the ‘data librarian role in New Zealand ROs’ and I chose a single instrumental case study design because the case is both a unique and a typical one. Moreover, the main research question that I sought to answer defaults to exploratory investigation to which the chosen design is amenable.

As there was no dire need for direct involvement, I chose to conduct the study as an outside researcher with interview case research and content analysis as my main research methods. I duly described these methods as well as the research process and the participants in detail. The findings for the various phases of the study are presented in the next two chapters.

CHAPTER 4: PERSPECTIVES ON THE DATA LIBRARIAN ROLE

4.1 Introduction

Beside the main research interviews, I also used three other sources of data for this study. They comprise the perspectives of each of three groups: authors in the literature, e-Research experts through an exploratory study in Australia and employers in academic libraries through the job advertisements collected unobtrusively from some relevant websites. While the perspective from the literature can be found in Chapter 2 the other two perspectives are separately presented in this chapter. However, all three contexts are synthesised at the end of this chapter in order to provide a filter for discussing the research findings in Chapter 6. Taken together, all three perspectives are termed the Triad (for the Literature, Experts and Employers). I begin with the e-Research experts' perspective.

4.2 The e-Research Experts' Perspective

Professionals or experts who are practitioners in any field are expected to have or acquire considerable experience in the field so as to be able to provide informed views about their profession. Such views are invaluable for entrants into the profession as well as professional managers who make decisions in the various organisations. In relation to this, an exploratory study in two Australian universities was conducted regarding the RDM role of librarians in research organisations (ROs). The specific goal was to properly contextualise the interview questions for the main study in relation to their clarity and relevance. In this section the views of e-Research experts in that context are presented. The factors influencing the data librarian (DL) role comes first. Next follow the dimensions of the DL role and the training needs of librarians for the DL role (see Figure 6-1).

4.2.1 Factors influencing the data librarian role in research organisations.

Developments or factors which could influence people or other entities either positively or negatively cannot be neglected or it would be difficult to understand or manage their influences. Such factors are important considerations for success in any endeavour or for the attainment of given goals. From the views of e-Research experts, five broad contexts of factors that could influence the DL role were identified. They comprise national, organisational, international, disciplinary, and professional contexts including some challenges associated with each. Each of them is discussed below.

(a) National context

Certain developments that could influence RDM in Australia which were highlighted by the experts include:

1. National research codes and obligations for federally funded projects/programmes

The government policies which encourage e-Research and RDM in Australia include the Australian Code for the Responsible Conduct of Research (ACRCR) (2007) and the Australian Government's reporting policy called HERDC (Higher Education Research Data Collections) (2014). Mael clarified that the ACRCR was developed by the National Health and Medical Research Centre and the Australian Research Centre which are two bodies that provide funding to researchers. At the moment the required metrics do not include research data but Mael is optimistic that it may happen in the future. Mael and two other participants believe that the ACRCR is a major incentive to RDM. However, while one of them, Nadia, spoke about sub-policies being created at various universities in relation to this code Salvina pointed out that the code is not as strong as a mandate for researchers: it only encourages them to put their data in an open repository which may be either an institutional or a subject repository. However, Mael and another participant, Sapna, alluded to funding obligations for the researchers receiving government funding to make their data publicly available.

With regard to HERDC Nadia had this to say:

> The other motivator for output is policy but it is the Australian Government reporting policy. It is called HERDC and it is basically that if your researchers do research and they produce articles you can report that to government and the government gives you money based on it; it is funding related. That has driven what is in our repository because if money is a great incentive basically the researchers have to do that so that the university can continue to be funded.

2. Australian National Data Service (ANDS) infrastructure

The Australian Government set up ANDS which, according to Sapna, has received funding up to 2016 and has been pivotal in supporting and raising the profile of data librarianship and digital librarianship in Australia. Salvina gave the following details:

> You probably read about the Australian National Data Service (ANDS) that funded a lot of projects that have been located in the university libraries that have allowed for staff to be employed for six months or 12 months or couple of years sometimes. So,

> through the ANDS funding a lot more librarians have been exposed to the concepts and have perhaps gotten to put some of that into practice in a limited way. The other thing that ANDS has done is provided a lot of information on their website and a lot of training opportunities in the form of webinars on different topics like data licensing and data citation. And I think those are good because people can just go in from their desktop in the lunch hour. You don't need any money to do that; you don't need to ask anyone for staff development money for those. They have run some bigger training courses as well; not recently but probably a couple of years ago. They ran a week sort of data curation workshop and a lot of people went along. So, they have been doing their best.

(b) Organisational context

With regard to the organisations, the participants observed the following factors that may be enablers for the e-Research/RDM role:

1. Availability of research infrastructure and services

In relation to the availability of research infrastructure and services, Nadia spoke about having repositories for journal articles/research outputs and PhD theses and RDM planning tutorials. According to Salvina there ought to be services that could be offered to the researchers before expecting them to be involved in RDM. Furthermore, Sapna pointed out that they had a Research Office that at one point started gathering the data. She also observed that theses submission and high performance computing (HPC) applications, etc. could lead to some types of infrastructure.

2. Positive perception of librarians as collaborators in the research process

The participants who are library and information professionals (LIP) believed that the researchers hold a positive view of librarians as being benevolent and useful. The following views of Aba, a researcher, corroborate this:

> My perception is that they are highly qualified professional staff that are often working with little resources. The people that I had been involved with before - not so much in this University because I have been teaching here but those research librarians that I have had to engage with, for instance, at Sydney and the University of Newcastle - have been outstanding in terms of what we have netted [retrieved] from

those libraries. But also, at the same time acknowledging that there is one person there to manage all of that or whatever might be, they need to prioritise.

Such a perception bodes well for librarians' collaboration with the researchers which will definitely be extended to the e-Research/RDM space.

3. Managerial support

As contained in the following respective statements of Salvina and Nadia, support from top level institutional management and managers in libraries is viewed as very important to the RDM role.

> I have definitely a few things to say there. I will just be specific about research data management here. The first thing I think that has really helped in the places that I have worked in is very high level senior support for data management. We are talking about people like vice-chancellor, deputy vice-chancellor, and research dean kind of level people there. You don't have to explain why it is important when you have people like that. (Salvina).

> OK. I think it helped to sit down with my manager and have a clear picture of what they wanted me to do and have that as a two-way conversation so that I could have input into what I was going to do as well. That's part of the organisational structure in the sense that it's part of her role to do that. So, we have one-on-one meetings every three weeks on that. That helped me. (Nadia).

(c) International context

Researchers collaborating with international partners may need support to fulfil funder's requirements.

The comments of Mael and Salvina show that Australian researchers involved in international research partnerships or collaborations, like their colleagues, are required to fulfil international guidelines or codes and funders' requirements. This necessitates assistance from the LIP and translates to the need and impetus for the evolution or development of the RDM role.

(d) Research/disciplinary context

According to Salvina, how the individual researchers work as well as the discipline they are in affect their view of RDM. Some disciplines may tend to have more or less need of libraries than others. It follows that some disciplines especially in the sciences are more receptive to RDM than others. As Mael articulated:

> But it is also worth noting that rather than across the whole country it varies between disciplines. Some disciplines have a long history of research data management and research data sharing. We talk about disciplines that use rare assets. The other factor is that some disciplines encourage or they have long history of collaboration and other disciplines don't have as much. In some disciplines, there is a lot of co-authorship of purpose and sharing and exchange of ideas and data, and in that area it might be more natural or easy for them to do data management than in other disciplines where everyone is meant to be doing their own research independently and separately.

(e) Professional context

1. Personal initiative and professional interest

Personal initiative, and professional interest and background interplay to motivate the professionals for the e-Research/RDM role. Mael suggested that because there is no top-down incentive to be involved in RDM it takes personal initiative and strong interest in the area for librarians to be motivated to get involved. While Nadia revealed that she initiated opportunities for professional development herself with the support of her university, Sapna revealed in the following statement that Mael's passion and interest was responsible for her involvement in RDM thus:

> Sure, sure. *Mael* is the immediate starter. He was a really strong figure and coming to this point in time, absolutely, he is probably the strongest influence. You've met *Mael* and you know what a passion he has for this area.

As can be seen below Sapna spoke of the role of her organisation and its library in incentivising librarians to take on the RDM role:

> From within *our institute*[11] we get funding for doing courses or going to (what do I just call it?) like e-Research Australia, that kind of thing. So, we do get funding for that and we get a lot of support to go and extend our skills, definitely. And through the library, the little bit of work I am doing there, we have a lot of access to

[11] This is an institute within Techy that is so represented for ethical reasons.

> professional development. There's a fairly regular kind of meeting where people talk about what courses they've been doing, what type of experiences; it's excellent.

In terms of professional interest and background as motivations to take the RDM role there are individual peculiarities. For Nadia, the motivations to play a RDM role include making more information available to more people to access and re-use, RDM, professional work experience with the ANDS-funded project [engaging with the repository community] and at Grand, and doing a pilot in her first e-Research role of digitising and doing metadata for an updated media collection belonging to a school within Grand. However, for Salvina, enjoying the opportunity in the e-Research role to work with people from different professional backgrounds, having a background of some experience with special collections and historical special collections, and an interest in the management, utilisation and preservation of original materials that the university has produced including research data constituted her motivation to play an e-Research support role. Finally, Sapna was motivated into the RDM role by interests in e-Net materials from a national library, working with technical people and in project management.

2. Professional support

The national professional body of library and information professionals, ALIA (Australian Library and Information Association), was mentioned by Sapna as being very supportive to its members through "some smaller thematic groups who do all the work thing." Such support is a boost to the professional development of librarians including those in data management.

Having looked at the factors influencing the DL role, it is natural to turn to the role itself and explore the expectations of that role in terms of the responsibilities and requirements.

4.2.2 Performance components of the data librarian role.

Primarily the Kim et al.'s (2011) framework was used to code the views of e-Research experts presented in this section. The framework follows Fine and Cronshaw's (1999) model and is a hybrid job analysis framework that combines work-oriented and worker-oriented methods of job analysis. The work-oriented methods seek to describe what a worker does while the worker-oriented methods aim to identify what a worker needs to successfully perform job tasks (Morgeson, 2007, p.380). The Kim et al.'s (2011) framework includes the

two dimensions of work and worker characteristics which are discussed further in the following sub-sections.

4.2.2.1 Experts' views on work characteristics of the data librarian role.

Kim et al. (2011, p.129) explained that work characteristics refer to a worker's duties with respect to working with "people", "things" and "data."

(a) People

Examples of people include researchers/academics, and students and staff of tertiary institutions such as universities and colleges. In terms of the people-related duties, three of the five participants mentioned *organise teaching/training for researchers* and *provide consultation and advice*. Two other people-related duties, *facilitate collaborations* and *support report writing*, were mentioned by one participant apiece. All of these four duties are further clarified below.

The duty *organise teaching/training for researchers* one-on-one or in a seminar setting entails facilitating researchers processing or using computer systems to manage their data by themselves including assigning good metadata to describe them as well as storing or depositing them. Mael, who is an e-Research professional with a background in Computer Sciences, clarified that this approach is necessary because "there are not enough librarians to do it for the scientists or the researchers." Salvina, who has a Library and Information Profession background, provided more clarifications as follows:

> But, my view is that the researchers should be managing their own data and it is my job to turn them into better research data managers. I think it is their responsibility to be managing their data. Now some of that may end up in our repository and we may be able to help them if they want to publish it and share it especially. But, most data was not going to be shared or publicly available and I will never get to see it. So, it is not my responsibility; it is their responsibility.

The duty *provide consultation and advice* involves face-to-face interaction between the e-Research professional and the researchers or faculty and government bodies that are consumers of data. Sapna pointed out that this also includes talking to researchers and helping them to write reports as well as people management.

Researchers within a university or from different universities often collaborate on projects that may include sharing data but, according to Mael, "it is really hard to happen without a data librarian or a person who is in charge of the data. Sometimes we even have two people because it is so time-consuming." The relevance of the DL follows the need for a form of brokerage in order to *facilitate collaboration* among some organisations because of the issues with data ownership, access and usage.

Finally, to *support report writing* implies helping researchers to write research reports.

(b) Things

Only three instances of two duties within the "things" category were identified. They include to *work with computer systems and software* (two instances) and to *link research contexts* (one instance). Working with computer systems and software involves using computer systems to structure data and either using an in-house tool/software to manipulate and store data or providing repository services and helping people to store data in them.

Mael aptly described the DL duty *link research contexts* in the following statements:

> But, you also need to link it to published papers. So, if you publish papers based on the data, then it will be nice to describe that, put it in the description of the dataset that publications X, Y and Z used the dataset. So, the librarian will go out and do a search and try to investigate where these publications are and if they are linked then they will link them back to the dataset. So, they create a two-way link from the publication to the dataset and from the dataset to the publication, and that's a librarian's job.

(c) Data

Four data-related duties were identified. The duties *manage data* and *store data* were each mentioned by two participants. However, two other duties, *present data* and *collect data*, had one mention each.

An e-Research expert with a LIP background mentioned *collect data* and *manage data* as part of her responsibilities. However, Mael who is a non-LIP e-Research expert mentioned three components of what he felt to be the librarians' role in data management. The first part is to prepare the data for the researchers for public release which Mael clarified thus:

> They do it on behalf the data scientists or the researchers. But, of course this is not sustainable because people are very busy and the group, the collaborative group, will grow larger and larger and the amount of data coming out will be more and more.

This creates some problems for the librarians given their low numbers. Therefore, it is reasonable to include this in the training for researchers as Mael suggested (see Section 4.2.2.1a). The second part of the librarian's role in data management is the description of datasets while the third part is for the librarian to translate scientific and specialised datasets into language that laypeople can understand.

The duty *store data* entails the use of tools such as a repository or software to manipulate and store data while the duty *present data* has to do with exposing available records on data to the public through platforms such as Google or with tools such as the DOI so that people can find it.

4.2.2.2 Experts' views on worker characteristics of the data librarian role.

Worker characteristics include the requirements of "knowledge," "skills" and "ability." Kim et al. (2011, p.229) clarified that "knowledge refers to a body of information that must be memorised or mastered" while skills refer to "acquired competencies subject to education, training and improvement with practice". They also clarified that "ability refers to one or more intrinsic talents an individual possesses."

(a) Knowledge

It is a common view of the e-Research experts that it might be helpful for a support librarian to have the same domain knowledge as the researchers but it is not necessary or required. Drawing from her personal experience, Nadia claimed that what actually helps her in her role is having technical knowledge and skills such as IT and project management. Although Sapna revealed that she is in her role without a science background, she told the story of how a background in biology and genetics helped a colleague to develop a good metadata standard appropriate for data in that domain.

However, eight knowledge requirements for RDM professionals were identified from the views of the participants. The most commonly mentioned ones were *background in information profession*, *research process including the e-Research environment*, and *metadata standards*. There were two mentions for each of these three knowledge requirements that are clarified further below. In addition to these are five knowledge

requirements which were respectively mentioned once. They included *knowledge of resources in particular disciplines*, *research policy*, *current trends*, *repository management* and *managing websites*.

With regard to a background in information profession, Salvina clarified that like Librarianship other disciplines within the information profession such as Record keeping, Archives or Knowledge Management are very applicable to RDM. However, Sapna provided the following view of what needs to complement an information background:

> But, you also need to be aware of research policy - government policy, university policy - that's really quite important, current trends, repository management, and managing websites. That's a really big one and I think it is not given quite enough emphasis, and how to do research interviews. That's really important.

In view of the importance of knowledge of the research process, Mael pointed out that although knowing how the system works is helpful, understanding how researchers work and how the research process should proceed is more important. However, Nadia was particular about the relevance of knowledge of the broader e-Research environment nationally and internationally to RDM. Both Nadia and Sapna hinted of the need for the knowledge of metadata in e-Research/RDM support.

Nevertheless, Aba, an e-Researcher in History, thought that it would be useful for the librarians to know the resources in particular disciplines that they are supporting in terms of e-Research/RDM.

(b) Skills

The skill requirements for the DL role from the perspective of the e-Research experts comprise both the technical and non-technical types. Five technical skills were identified: *teaching*, *project management*, *metadata*, *information retrieval*, *documentation*, and *thinking in programming sense*. Although, they were singly mentioned by different individuals there was no suggestion that these are not important. However, the only non-technical skills identified were *communication* skills. These were mentioned in relation to advocacy and persuasion, people management and investigating and presenting the needs of researchers to solution providers. Communication skills might have been the only mentioned non-technical skills yet they were perceived as the most critical. The clarifications by Mael, Nadia and Sapna in the following respective statements point to this:

> I think, we are talking about training and communicating with scientists. Communications skills, I think, are really, really important in this area. If you cannot communicate with the scientists, you cannot work in this area as librarian. It is really that important. (Mael).

> I think communication skills are critical. In that broad sense that I've been talking about and I think the documentation skills are critical too, actually. I don't think it is critical to have technical skills or project management skills. All that has been helpful for me but I don't think they are actually critical things because in any research that communication is about finding out from researchers what they need and about translating it to people who can help them with that, the IT people who can help them build the tools. So, communication is very critical. Even though that is done in library schools it is not quite the same. (Nadia).

> I think having teaching skills and good communication skills are absolutely essential because you can be as good as you like with the technical stuff but if you can't communicate with researchers it is useless. (Sapna).

(c) Ability

The only identified component within the requirement "ability" is the ability *to investigate and collect data* as needed by researchers for their research.

In the framework of Kim et al. (2011), the worker characteristics dimension is limited to knowledge, skills and ability. However, the component "experience" discussed below was discovered from the views of e-Research experts as being helpful but not necessary.

(d) Experience

Generally, background and work experience in areas related to data management were deemed helpful while learning on the job was perceived to be more important. For instance, Nadia provided information on how her personal work experience with repositories and a national data services project helped prepare her for a RDM role although she did tasks that she had not done before in that role. Mael shared a similar experience of some librarians with whom he had worked. He said:

> We get a lot of people who come in this area who are librarians, but they don't have previous experience and a lot of the time they gain experience as we grow. IT

> [information technology] experience is not really necessary depending on your particular role in there.

For Salvina, the best way of learning is on the job and Sapna corroborated this as she claimed that her "experience came from work mainly on externally funded projects where a part of the reportable to the government as the funder is to make their research discoverable and shareable with all the scientists involved."

The performance components of the DL role provide an insight into what the DL role entails and what should be in their toolkits. Deficiencies in terms of the components of worker characteristics, especially the required knowledge and skills, may constitute a need for the training and/or development of librarians in order to play the role. The next section focuses on the training needs of the LIP e-Research experts in terms of their knowledge/skill gaps in relation to the RDM role as well as their options for addressing them.

4.2.3 Training needs of librarians for the data librarian role.

This section presents the professional development profile of the LIP who participated in the exploratory study in order to highlight their knowledge/skill gaps or needs at different times and how they filled or intended to fill them.

Table 4-1: Professional Development Profile of e-Research Experts.

E-Research Expert	Initial Gap		Current Gap	
	Gap	**Professional Development Option**	**Gap**	**Intended Professional Development Option**
Salvina	Understanding organisational background	Learning on the job; Conference and Professional network; and Training courses	Business analysis; Operational service supervision; and legal aspects	Project experience
Sapna	Coding (Metadata)	Learning on the job; Online courses	Understanding Australian higher educational environment	Learning on the job
Nadia	Knowledge of semantic web and RDF	Self-learning; Project management conference	Advanced knowledge of university's organisational and reporting structure	Conference and professional network

Table 4-1 shows that, except for Salvina's initial gap and Nadia's current gap in organisational knowledge, knowledge/skill gaps or training and development needs of the experts as well as their chosen professional development options are varied and specific to each person. However, it is clear that they all favoured learning on the job; that means utilising all options while keeping their jobs. As such, the support or role of their

organisations is a very important factor. The experts showed the roles played by their organisations to be two-fold: funding them to participate in conferences or training courses; and helping them with professional development opportunities.

However, the experts gave some advice to both prospective DLs and library managers and supervisors in terms of the recruitment and development of staff in the RDM role. Prospective DLs were advised to buddy up with an expert in the role and to interview researchers for insight into their needs. It is surprising that these experts suggested this as they did not mention it in their professional development profile. However, it is a possibility that the insight they had gained over time informed their suggestion so that they would have utilised it if they knew what they now know.

Salvina advised library managers and supervisors to look at how they are recruiting into those roles since:

> There's a whole set of skills people can bring to this and not all of them will even require you to be a librarian; so, that's an interesting one for them. I think the supervisors need to work out how…It is kind of what you are talking about, if the main way for people to learn is on the job you need to have some form of structured programme with targets for people to be able to do that. I think, people need to go out in pairs; not on their own because what happens a lot at the moment is people just get told 'Ah! RDM is now part of your job, go out and talk to people about data management.'

This is valuable advice but it assumes that the managers and supervisors are sufficiently conversant with the new role and its demands to be able to put together a structured programme. This may not always be the case so there may be the need to do some research on the role as well as staff analysis first.

The next section is devoted to the analysis and presentation of the data from the academic library employers' perspective.

4.3 The Academic Library Employers' Perspective

As factors influencing roles and training needs are seldom part of position advertisements, the discussion in this section is limited to the performance components of the DL role. Of the

analysed 43 positions 36 were mostly in the USA[12] (USA positions – UP) while the remaining seven were in Australia (Australian positions – AP). The analysis of those from the USA reveals the following four categories:

- General Non-management Positions (GNP – 14): These are specialist DL roles for all kinds of data, e.g. Data Librarian, Data Services Librarian, Research Data Librarian, etc.
- Subject-related Positions (SP – 12): These are DL roles within subject backgrounds and are focused on types of data that are of interest to subject areas, e.g. Engineering Research and Data Services Librarian, Social Sciences Data Librarian, Business/Data Librarian, etc.
- Hybrid Librarian Positions (HLP – 6): These are DL roles merged with other librarian roles, e.g. Instructional and Data Services Librarian, Data Services and Collections Librarian, Research Support and Data Services Librarian, etc.
- Management Positions (MP – 4): These are DL roles in managerial or coordinating capacity, e.g. Research Data Services Manager, Research and Data Support Coordinator, Data Librarian & Manager of the Empirical Reasoning Lab, etc.

These job titles occurred more than once:

1. Data Librarian (4): GNP (1)/AP (3)
2. Social Science Data Librarian (4): SP
3. Data Services Librarian (3): GNP
4. Research Data Librarian (2): GNP/AP
5. Digital Data Repository Specialist (2): GNP/MP
6. Data Curation Librarian (2): GNP
7. Data Management Services Librarian (2): GNP

This list reveals that both Data Librarian and Research Data Librarian are the only titles common to the USA and Australian job positions.

However, the presentation of the analysis of all the job positions in this section follows a similar path to what was done in Section 4.2.2 which is in line with the Kim et al.'s (2011) framework. The work and worker characteristics of the DL role as discovered in the job advertisements are respectively presented in the following sub-sections.

[12] Only one job position advertised on the ALA JobLIST belongs to a Canadian university, McGill University, Montreal.

4.3.1 Employers' views on work characteristics of data librarian role.

The work characteristics in the Kim et al.'s (2011) job analysis framework refer to a worker's duties in terms of "people", "thing" and "data". These in relation to the DL are shown below as they were found through the analysis of the job advertisements.

(a) People

Examples of people include researchers/academics, and students and staff of tertiary institutions such as universities and colleges.

Table 4-2: People-related Duties of the DL Role (N=43).

Duties	***Frequency**	**Percentage**
Organise training/instruction	30	69.8
Collaborate and coordinate	30	69.8
Provide RDM support	28	65.1
Serve as liaison	23	53.4
Participate in/with	18	41.9
Engage in research consultation and support	14	32.5
Engage in professional development activities	12	27.9
Lead and manage	9	20.9
Perform outreach	8	18.6
Partner or network with	7	16.27
Provide expertise	4	9.3

Note: *n=183 instances.

Table 4-2 shows the DL duties involving people which are clarified below.

Organise training/instruction

The DL is expected teach or instruct staff and students through workshops, individual meetings, classes or course-related and general library instructions. Areas of instruction may include: the access and use of different types of data including published statistics, software and other tools that support data-intensive research; information and data literacies; the use of digital research and publishing tools, and in contributing to and using data repository systems; data management best practices and standards; description skills required for identifying, describing and curating datasets; data-related information services, resources and problem-solving approaches to handle data-related reference questions; methodologies and tools. In relation to collegial training responsibility, the DL is relied upon to provide instructional support to librarians teaching data-intensive courses. While s/he is expected to plan and conduct professional development meetings for subject/area studies librarians on data management issues s/he must also lead them to provide RDM services.

Collaborate and coordinate

The DL is supposed to collaborate and coordinate with individuals and groups or teams both within the library and institution-wide. Particular librarians that s/he collaborates and coordinates with include outreach, special collections, digital resource and subject librarians, instructional technology managers and metadata specialists. This is done in order to develop and integrate a set of data services and implement data curation systems.

With the subject librarians specifically, collaboration and coordination relates to subject-specific training and data literacy efforts. Also, the DL is to collaborate and coordinate with academic staff, students and relevant units to identify, manage, describe, preserve and make research data available or support data services. Furthermore, the DL is expected to collaborate and coordinate with staff across the campus which could be in groups such as interdisciplinary or working groups, committees and teams drawn from relevant institutional units such as research offices, high performance computing, faculty, etc. In this regard the purposes could be to develop and maintain infrastructures that enhance access to data; to generate best practices in data archiving; to enable use of data in teaching; to increase faculty awareness of funder requirements for data management plans; and a variety of issues including workflows, data curation mechanism and metadata support.

Provide RDM support

The RDM support expected of the DL is considerable. Generally, s/he is expected to lead university/college support for faculty and students' RDM throughout its lifecycle but, specifically, s/he is to provide support for students and academic staff through appropriate research consultations, referrals and instruction for: the preservation activities of different types of data; electronic publishing and archiving, assisting in the development of archiving plans for the publications and data; the discovery, use and integration of library resources and services; the creation, review, cleaning and publication of data products and associated metadata products; quantitative literacy curriculum; and collection development support for the acquisition of data. Also within the jurisdiction of the DL is managing and supporting access to the library's electronic data collection, including support for data catalogue records. As well, technical support is required of him/her for data and content owners using data preservation infrastructure. Beside these, support takes a number of other forms.

First, the DL is supposed to provide advice on the use of effective data management tools and activities. Thus, s/he could assist principal investigators and researchers data management planning [DMP] (using data curation profiles, e.g. DMPTool). Also, s/he is expected to

advise and assist the assigned school faculty or department with scholarly communication, scholarly publishing, and intellectual property issues, as well as provide specialised assistance with advanced technologies for managing, publishing and archiving the creative and scholarly output of university faculty.

Second, the DL is meant to assist: academic staff with the writing or development of data management plans for grant applications as well as the strategies, best practices and services responding to a mandate for general data stewardship and making their research data discoverable; and staff and student users in the finding, use, manipulation, visualisation and analysis of data, including direct assistance in the use of statistical software or data applications. Third, the DL is supposed to oversee the gathering and management of data and content produced as a result of courses or research efforts.

Fourth, the DL is required to promote data citation standards and help researchers identify sustainable, documentable practices, and workflows; advocate for responsible but open access to data; and raise campus awareness of data literacy (data curation, management and preservation). Fifth, the DL is expected to articulate and encourage conceptual dialogue on data and informatics issues. Sixth, s/he is to keep abreast of trends and developments in the area of data science and data curation, and in the area of data consultancy and referral services.

In addition to supporting staff and students, the DL is required to serve as a resource for library colleagues for data and statistical support.

Serve as liaison

The DL may serve as a liaison primarily to one or more academic departments and programmes or, as part of a Liaison Services Department, s/he serves as a member of collegial team of subject and functional specialists committed to providing outstanding service in the areas of instruction, outreach, collections and research support. Within the liaison capacity, s/he is to assist research and library staff to identify and collect information about data collections at the organisation; identify current data management practices as well as needs of academics and students through surveys, interviews and focus groups; and support disciplinary and interdisciplinary research for the analysis of large datasets and the presentation of the results of research and analysis.

The DL is expected to be the representative of the library at committees within the organisation as well as his/her organisation at various local, regional, national and/or international data organization fora and/or meetings or consortia such as the Interuniversity Consortium for Political and Social Research (ICPSR). As such s/he is the primary contact for data management support in the libraries.

Participate in/with

In relation to identifying and supporting RDM-related projects, service initiatives and needs of faculty and students, or to improve RD services, the DL is expected to participate in: library-involved collaborative efforts; departmental, library, university and professional committees; university and library governance in terms of planning and policy-making in a shared decision making environment to support the library's strategic directions; and system wide, library-wide or cross-libraries' working groups or task forces. With other librarians or groups in related units such as departments, institutes, centres, and programmes, or as a member of a team, s/he is expected to participate in liaison activities, research support and instruction for academic departments, and data-related collections' development, evaluation and management. All of these are from the US job positions. However, the only job position from Australia indicates that a DL is expected to participate in the implementation of research data metadata store.

Engage in research consultation and support

The DL is required to engage in research consultation with and assistance to researchers, students, librarians, and project teams as an individual or a team member including weekday evening and weekend shifts, in person, by phone, email and chat. The consultation is about development of data management plans for grant applications and general data stewardship, data issues and challenges arising from the clients' research as well as services and some relevant databases. Also, the DL ought to engage in research assistance to provide leadership in the planning, implementation, delivery, and assessment of library research. In addition to providing general reference and research services, s/he needs to arrange and conduct interviews with patrons to identify their information and data needs. As a specialist in datasets and statistical analysis, s/he is expected to consult on a variety of research data issues including workflows, data curation mechanisms and metadata support as well as to make recommendations and consult about data policy and strategies.

Engage in professional development activities

The DL is expected to contribute to and be active in the local, state, regional and national meetings, conferences and workshops, review professional literature and network with professional colleagues outside of the university to stay informed about developments and trends in research support. Additionally, s/he is required to be willing to engage in scholarly activities including research and publication in order to attain tenure and promotion.

Lead and manage

Generally, the DL is expected to lead or chair the data working group or the data management and curation task force to facilitate campus-wide data activities and initiatives. However, the DL in managerial positions are expected to provide leadership and support for subject librarians with research data management responsibilities as well as supervise graduate student consultants and student employees. In a particular instance s/he is expected to hire, train, and supervise a staff of graduate assistants and undergraduate to work in the lab and support specific classes.

Perform outreach

The DL is required to perform outreach to students and academics through presentations, workshops, websites and one-to-one consulting on data management issues: to promote services, collections, databases and other resources to library patrons; to build the academics' awareness of funders' data management mandates and advice on the various options for compliance; to foster the adoption and use of data management best practices; and to engage with campus communities, providing a combination of targeted or specialised services, including instruction for dataset and statistical software users.

Partner or network with

The DL is required to engage with campus partners or stakeholders generally to maintain communication with them about data policy and strategies, and to make digital scholarly work and data openly discoverable and accessible for the long term. However, specific partnership relationships are for different purposes. For instance, the DL partners with academic staff to develop and deliver course-integrated library instruction and online learning within those courses with research and applied project components. However, s/he could

partner with campus data managers supporting research programmes, and work to understand their perspectives, practices and culture.

Also, partnership could be cultivated with library and non-library organisations sharing a common interest in data stewardship of a particular area of research. Other expected partnerships include: with curation and subject librarians for data curation outreach to campus; with academics and librarians to document and assess workflows and determine best practices for data curation; with colleagues across departments and offices to support the adoption and improvement of an institutional data repository, providing outreach and support to users of the repository service; with an integrated literacies coordinator to develop and implement training in data management for students and academic staff and with the copyright officer and other research support stakeholders to develop and implement advocacy and training programs in copyright management, use of creative commons licences and open access dissemination of research.

Provide expertise

The DL is expected to provide expertise in RDM within the library, the university and the broader RDM community. As such, s/he will provide guidance to librarians on answering advanced or unusual data-related questions from patrons and on updating and maintaining subject guides to include applicable data information sources. Also, s/he is to assist in the acquisition, cataloguing and preparation of data for users (e.g., creating metadata for available datasets).

(b) Things

Things includes technology or tools, documents, etc. Table 4-3 shows the duties involving things which are discussed below.

Table 4-3: Thing-related Duties of the DL Role (N=43).

Duties	*Frequency	Percentage
Develop data management services, programmes and tools	20	46.5
Support services and projects	12	27.9
Maintain current awareness	9	20.9
Manage RDM services	8	18.6
Support technical processes and infrastructure	8	18.6
Select, develop and manage collections	7	16.27
Oversee and manage repositories	5	11.6
Administer and implement metadata	4	9.3
Document and do editorial work	3	6.97
Engage and implement technologies	2	4.65

Note: *n=78 instances

Develop data management services, programmes and tools

The DL is required to provide leadership in developing and evolving data visualisation services according to student, academic staff and library needs, and in data curation and management services as well as support services for the documenting or description, storage and distributing or sharing of research data. In terms of tools, s/he is expected to: develop a data management plan; create online guides, videos and other forms of tutorials; create data policies, web resources and procedures of data curation and management on campus; create and edit metadata records for data; investigate and implement new technologies and research tools in support of data services initiatives; and develop, package, test and evaluate training resources for academic and library staff to support standards-based RDM practices. Finally, his/her expected roles with regard to programme include: developing best practices for data management stewardship and sustainable programmes; creating data management programmes or programmes that engage with cutting edge data management, archive, analysis or display technologies; and articulate vision and develop the supporting roadmap for the library's digital programme.

Support services and projects

Part of the expected role of the DL is to serve as a lead worker for/or to support or contribute to designated services and projects such as the digital library services and digital preservation and digital collection projects. S/he is required to provide technical support including as a webmaster for digital initiatives' websites and, also, to manage, develop and migrate digital application systems. Processing requests for data management plan support and archiving of datasets in the digital repository also comes within his/her jurisdiction. The DL is expected to manage research support projects, including budgets and documentation as required, for

instance as one of the job advertisements stated, “communicate the full findings of the project through the development and release via Open Access of a detailed project report and a manual outlining methods and return on investment”[13].

Maintain current awareness

The DL is required to maintain current awareness of the developments in the library profession and related or relevant fields such as e-Science, digital humanities, data curation and management, and e-Scholarship in all disciplines. Also, s/he is to maintain knowledge of digital trends and investigate their application in academic libraries. The DL needs to maintain awareness of current tools and methodologies for computation-centred, data-driven research, and keep abreast of data curation protocols and projects as well as technologies and systems of data publishing that allow for re-use of data. Additionally, s/he has to maintain awareness of new data and metadata requirements, practices and standards for data description, access and archiving including those adopted by government agencies and domain groups.

Manage RDM services

As expected, this responsibility is mostly found in MP position advertisements but it is also found in three GNP ones. The DL is required to identify staffing, operational and resource needs as well as identify and recommend appropriate methods for data storage and retrieval. Other expected duties in this regard include: provision of library-wide, interdepartmental coordination of the library's team-oriented research and data management support programmes; and the responsibility for planning, organizing, and coordinating the institutional library's initiatives to support comprehensive RDM, sharing, preservation and access for the university campus including an institutional digital data repository service. S/he is also to ensure the certification of an institutional digital data repository and audit its trustworthiness. Finally, s/he has to evaluate current and relevant technologies, standards, and practices in systems that are used to manage digital information in a library context.

Support technical processes and infrastructure

The DL is supposed to be involved with managing the lifecycle of digital datasets and information objects in virtual communities and archival repositories in order to maintain the

[13] This is from a Data Librarian position advertisement for the ANDS Gold Records Project at QUT Library, Australia.

integrity of and access to archived datasets. As such, s/he needs to provide technical leadership for digital assets stewardship including datasets and serve as a lead on institutional repository development, including supporting workflow for ingesting items into an institutional repository. Also, s/he is required to support the processes behind the external discovery and delivery of library content such as was listed in one of the job advertisements "APIs and RESTful web services, search engine optimisation, mobile application development, OAI harvesters and integration with campus learning management systems and social sites"[14]. The DL is also expected to incorporate appropriate design principles, information architectures, coding standards, and emerging technologies into the library's various open source web-based systems and projects as well as provide visualisation and mapping strategies for complex, often large sets of data.

Select, develop and manage collections

This collections responsibility typical of the subject librarian role is found in six SP and one HLP job advertisements. The DL is expected to assist or contribute to or provide leadership/take a leading role in the acquisition, management, implementation and access to collections of particular disciplines and, also, to select and manage electronic databases and journals.

Oversee and manage repositories

The DL is required to identify, adapt and implement appropriate repository technologies as well as to oversee, maintain, develop and enhance the use of repositories. Also expected of him/her is the supervision of repository services such as e-Prints, theses collection and other digital collections. Moreover, s/he is to lead the integration of digital repositories within an organisation with the research management systems. Furthermore, s/he has to maintain awareness of subject or disciplinary repositories of potential interest to the university community.

Administer and implement metadata

The DL is required to lead libraries' implementation and maintenance of appropriate metadata schemas, standards and domain specifications for scholarly resources including research data. S/he is to investigate a broad range of data sources for incorporation of data

[14] This is from a Digital Program and Data Management Librarian position advertisement at the University of North Carolina, Wilmington, USA.

into highly enriched data description records related to a variety of research disciplines and the use of meta-systems (e.g. metadata schemas and discipline-based ontologies) to manage/enable discovery. S/he is also required to investigate a broad range of data sources in relation to incorporating data into highly enriched data description records and development of a register of metadata schemas for RDM. The DL also needs to analyse information requirements relating to RDM by academics and assist with documentation of system specifications to meet these needs.

Document and do editorial work

The DL is expected to document data management consultation and research data-related repository activities, workflows, policies, and practices, and ensure that the data repository meets and continuously improves its level of service. S/he is also expected to compose and edit the library newsletter.

Engage and implement technologies

This is specific to HLP job advertisements and the social sciences. The DL is expected to engage technologies emerging as critical to research and teaching in business and economics including those supporting data-intensive research. It is his/her responsibility to identify and assist in the implementation of emergent technologies related to data services and research, and explore innovative services to support new research methods and data applications in the social sciences.

(c) Data

Table 4-4 presents the four duties involving data which are further described below.

Table 4-4: Data-related Duties of the DL Role (N=43).

Duties	***Frequency**	**Percentage**
Manage data	5	11.6
Audit data	3	6.97
Describe data	1	2.32
Analyse data	1	2.32

Note: *n=10 instances.

Manage data

The expectation for the DL to identify, acquire or curate and manage data is found only in GNP, SP and HLP position advertisements. Specifically, s/he is expected to participate in or to take a leading role in identifying or locating, acquiring, ingesting (into libraries' digital

repositories), managing for use and re-use, and providing access to data collections. S/he is to adhere to local policies and national and international standards and best practices when doing these. S/he is also expected to actively monitor and help to maintain the integrity of archived datasets, access to data, and the functionality of the data repository system.

Audit data

The DL is expected to participate in research data audits, curate collection of descriptions of datasets and provide documentation and access to data collections.

Describe data

The expectation of the DL to describe data and facilitate data management implies using or applying the preferred metadata schema such as ANDS RIF-CS to data collections. This was only mentioned in one AP job advertisement.

Analyse data

One SP position advertisement mentioned the responsibility of the DL for analysing data. S/he is required to "offer expertise in the use of statistical software, and work with numeric data resources and complex data file manipulations"[15].

It is clear from the foregoing summary that duties involving "people" are mentioned more (183 or over 67% of total instances of work characteristics) than those involving "things" (78 or over 28%) and "data" (10 or over 3%) which constitute the least prevalent of the three. The general idea seems to be that people, more likely to be academic staff, students and researchers than fellow professional librarians, constitute the main target of the DL's services. Duties around data, which is the main reason for these services, are significantly small because it is the primary obligation of their clientele to handle or manage their data with the DL only meant to support them. The duties involving things represent the means including data collections with which the DL supports his/her clients.

4.3.2 Employers' views on worker characteristics of the data librarian role.

The worker characteristics are the knowledge, skills and ability required for the DL role. These are presented in this section as they were found through the analysis of the job advertisements. However, it is important to mention that apart from the three components of

[15] This is from a Business/Data Librarian position advertisement at Lehigh University, Pennsylvania, USA.

the Kim et al.'s (2011) worker characteristics some related components discovered through the analysis of the job positions are also presented in this section. They include the requirements of personal traits or attributes, qualifications and experience.

(a) Knowledge

Table 4-5 shows the knowledge requirements for the DL role which are clarified below.

Table 4-5: Knowledge Requirements for the DL Role (N=43).

Knowledge	***Frequency**			**Percentage of Total**
	Required	Preferred	Total	
Technology and standards	21	5	26	60.4
Research data curation and management	17	8	25	58.1
Research and support	12	3	15	34.8
Scholarly communication	7	4	11	25.5
Data and data lifecycle	9		9	20.9
Subject background or programme area	6	1	7	16.27
Software	4	1	5	11.6
Resources	2	2	4	9.30
Tertiary sector & libraries	3		3	6.97
Digitisation and digital resources	2		2	4.65
Information literacy and management	2		2	4.65
Workplace requirements	2		2	4.65
Analysis	1		1	2.32
French		1	1	2.32

Note: *n=115 instances

Technology and standards

Knowledge requirements for the DL role involving technologies include: current or emerging technologies for curation and management of research materials including data and workflows. They also include the application of these technologies to research and teaching. This requirement also relates to cloud technology and basic understanding of a broad range of information technologies, including programming languages (e.g. Python, PHP, JavaScript, and HTML), hardware, digital humanities tools, web site design, user interface design, database development, digitisation services, and content and application hosting and development. In particular, knowledge of institutional, local and national data repositories or such content management systems as DSpace, Hydra, Fedora Commons, Solr and Blacklight were specified. Other technologies expected to be familiar to the DL include semantic web technologies and exchange protocols, web application tools such as XML, Java, APIs, user interface toolkits of major mobile platforms, OpenURL, OAI, linked open data, other Web 2.0 principles, and data applications such as GIS and data visualisation.

As it relates to standards, those reflected in the job advertisements include encoding standards such as XML and both MARC and non-MARC metadata standards or applications such as Dublin Core, METS, MODS, PREMIS, DDI.

Research data curation and management

Almost 60% of the job advertisements that included data curation and management in the DL's knowledge requirements are in the GNP category. However, this is also contained in other categories except the HLP. Aspects of this requirement include: RDM requirements throughout the research lifecycle in a university or research environment; funding agency requirements; best practices including metadata, format migration, preservation, re-use and retrieval; RDM principles, practices and systems; information management issues and solutions; concepts, related issues, challenges, trends in data curation, data management plans and data lifecycle management; and available tools for providing RDM services in an academic environment as well as development and trends in data services and tools.

Research and support

All categories of job advertisements from the USA as well as those from Australia are represented in this knowledge requirement of research support. The knowledge requirement *research and support* is expected to be found mainly in the SP category as it is part of their traditional responsibilities. However, it is surprising that it was found more in the GNP than other categories. The research process particularly in business disciplines and research methodologies in social sciences were specifically mentioned. However, also included is knowledge of research support in one or more disciplines demonstrated by academic or work experience, especially in the humanities and sciences with particular focus on the research lifecycle of data as knowledge of issues related to scientific research is also expected. Added to these is familiarity with quantitative and/or qualitative data research tools.

Scholarly communication

DLs are expected to know about scholarly communication in a university or research environment along with related issues such as copyright, Open Access, repositories, and emerging technologies, standards and trends in digital scholarship (e.g. electronic publishing, data mining, and digital preservation) and scholarly publishing.

Data and data lifecycle

The DL is not only expected to have knowledge about data but also data-related issues such as ethics, data governance, challenges and roles and actions for academic libraries. Also deemed important for him/her to know are data types, formats, retrieval, ingestion, crosswalk and use in research and teaching in an academic environment. Additionally, the DL is expected to be familiar with major data resources (e.g. ICPSR, Census, etc.) and data lifecycle concepts.

Subject background or programme area

Four SP and one GNP position advertisement featured subject background or areas needed by the DL: social sciences, design work, a relevant engineering or computational discipline, economics and government including collection development, environmental science, natural resources, ecology, or a related field. An MP position advertisement mentioned required aspects in a programme area to be concepts, pedagogy, research, and scholarly trends.

Software

Found only in the GNP and HLP categories, software knowledge requirements for the DL include: application suites, e.g. Microsoft Office applications; quantitative and qualitative data manipulation and analysis software tools, e.g. SAS, SPSS (PASWA), Stata, NVivo or R; GIS like ArcGIS; databases, e.g. SQLServer and PostGRE; data visualisation tools, e.g. Tableau; data delivery systems, e.g. Equinox; and data extraction/transformation/loading tools, e.g. OpenRefine.

Resources

Resources are included both as basic and preferred knowledge requirement for the DL role. The DL is expected to have extensive knowledge of relevant resources, for instance map and geospatial, and business and financial resources in all formats. S/he should be familiar with government documents and the market for digital resources.

Tertiary sector and libraries

As was found only in one SP and two HLP categories, the DL is expected to be familiar with current issues, trends and technologies affecting instruction, higher education, data services and academic libraries as well as library policies and statement of mission statements, goals, and objectives.

Digitisation and digital resources

The DL is expected to know digitisation standards, processes and related copyright issues, understand format migration and digital preservation and to be familiar with the market for digital resources.

Information literacy and management

The DL is required to be familiar with information literacy theory, practice and assessment as well as understand information management requirements throughout the research lifecycle in a university or research environment.

Workplace requirements

Workplace or organisational requirements for the DL are in the area of knowledge of health and safety responsibilities with a commitment to attending relevant training as well as equity or equal opportunity principles.

Analysis

Analysis is a knowledge requirement for the DL contained in an SP position advertisement that specifically refers to geospatial analysis.

French

This language requirement was contained in an HLP position advertisement from a Canadian university.

(b) Skills

Table 4-6 shows the technical and non-technical skills required for the DL role which are clarified below.

Table 4-6: Skill Requirements for the DL Role (N=43).

Skill	*Frequency			Percentage of Total
Technical	**Required**	**Preferred**	**Total**	
Project management	7	1	8	18.6
Technologies and standards	5	1	6	13.9
Teaching and instruction	1		1	2.32
Reference	1		1	2.32
Technical (general)	1		1	2.32
Software	1		1	2.32
Data	1		1	2.32
Budget management	1		1	2.32
Computer literacy		1	1	2.32
Non-technical				
Interpersonal and communication	36	1	37	86
Analytical and problem solving	13		13	30.2
Flexibility	8		8	18.6
Organisational and planning	6		6	13.9
Presentation	5	1	6	13.9
Time management	2		2	4.65
Liaison	2		2	4.65
Team and collaboration	2		2	4.65
Professionalism	1		1	2.32
Leadership and supervisory	1		1	2.32

Note: *n=99 instances

Technical Skills

Apart from an HLP position advertisement that mentioned technical skills generally the specific technical skills are discussed below.

Project management

The DL, either as a leader or a member of a group, is expected to have project management experience including project planning, execution, management, completion, and reporting. It is only the SP category that does not contain this requirement.

Technologies and standards

Technology skill requirements include operating systems, (relational) databases (e.g. MySQL) and their management and use to create dynamic web applications, and markup, programming and scripting languages used in web development such as HTML, XHTML, CSS and PHP. However, standards refer to one or more descriptive metadata standards.

Software

Software skills required of the DL are related to social sciences statistical packages and software such as SPSS, STATA, SAS, and R.

Data

Contained in an HLP source, the DL is expected to have "expertise with numeric data information sources, resources and uses for one or more disciplines and willingness/interest in adding others"[16].

Non-technical Skills

Only a few non-technical skills may require clarifications.

Interpersonal and communication

Oral and written communication with interpersonal skills required for communicating with internal and external stakeholders, or for dealing with problems while maintaining friendly and cooperative relationships, constitute the most common requirement for the DL.

Flexibility

Flexibility as a skill is in regard to coping with a continuously changing work environment.

Organisational and planning

Organisational and planning skills expected of the DL include creativity.

Time management

Time management relates to the necessity of meeting set deadlines and priorities as well as project completion.

Leadership and supervisory

It is not surprising that the only position advertisement containing a leadership requirement is in the MP category. This was mentioned as a preferred [not a basic] requirement in relation to managing, coaching and motivating staff.

(c) Ability

[16] This is from a Data Reference Services Librarian position advertisement at McGill University, Montreal Canada.

Table 4-7 shows the abilities required for the DL role as they emerged from the analysed job advertisements. Their clarifications follow.

Table 4-7: Abilities Required for the DL Role (N=43).

Ability	***Frequency**			**Percentage of Total**
	Required	Preferred	Total	
To work independently and collaboratively	23	2	25	58.1
To organise and prioritise tasks	6		6	13.9
To interact and work effectively	6		6	13.9
To meet tenure and promotion requirements	5		5	11.6
To provide reference, consultation and instruction	4	1	5	11.6
To build relationships	4		4	9.3
To interact/work with diverse groups	4		4	9.3
To lead or adapt to change	2	1	3	6.97
To take initiative or initiate	3		3	6.97
To communicate effectively	3		3	6.97
To exploit technologies	3		3	6.97
To liaise	3		3	6.97
To think or work creatively	2		2	4.65
To develop library resources	2		2	4.65
To handle data	2		2	4.65
To lift and move things	1	1	2	4.65
Abilities only mentioned once	11	2	13	30.2

Note: *n=88 instances

To work independently and collaboratively

The DL is expected to have the ability *to work independently and collaboratively* to ensure work outcomes in technical, multidisciplinary and cross-department team-based, collegial and cooperative, complex and fluid organisational; and cross-organisational environments.

To organise and prioritise tasks

The ability *to organise and prioritise tasks* refers to balancing the demands of concurrent projects, multiple tasks or workload assignments in a rapidly shifting or complex working environment.

To interact and work effectively

The ability *to interact and work effectively* entails working relationships with a diverse community including colleagues, students, academics and other staff including IT office professionals and administrators as well as the capability of the DL to make connections across the organisation.

To meet tenure and promotion requirements

Meeting tenure and promotion requirements implies that the DL should have both the desire and the potential for such. However, this requirement is peculiar to the USA position advertisements.

To provide reference, consultation and instruction

The ability of the DL to provide reference, consultation and instruction services is varied as it applies to different users such as librarians, students, staff and academics. For the academic staff, it relates to data visualisation and use of statistical software such as SPSS, Stata, SAS or R and GIS-related software or packages such as ArcGIS Desktop, qGIS or ERDAS Image in an academic library environment. However, developing and delivering training or instruction to all categories of users through workshops, tutorials and course-specific instruction is in support of a library's strategic goals and helps them to acquire technical and problem-solving skills.

To build relationships

The DL is expected to build relationships to respond to customers' needs and across a range of professional and disciplinary areas such as between the library and campus IT departments to further dataset management projects. Surprisingly, this expected requirement is not found in any SP job advertisement.

To interact/work with diverse groups

Interacting/working with diverse group points to a variety of constituents including academics, staff and students in a multicultural and collaborative environment.

To lead or adapt to change

While ability to lead change is desired the ability to adapt to change is required and means to adjust productively to and communicate about change.

To take initiative or initiate

This requirement found only in the GNP job advertisements is in relation to learning new knowledge and skills and pioneering collaborative projects and programmes such as developing policies and developing and implementing a comprehensive data management programme to support an organisation's research initiatives.

To communicate effectively

The ability to communicate effectively with academics and students orally and in writing involves data resources and making ideas clear and persuasive.

To exploit technologies

The DL is expected to have the capacity to engage with, explore and assess adoption of technology. S/he is to be able to use or exploit information systems and tools; as well as digital learning technologies to further library programmes and initiatives.

To liaise

The DL is expected to have the ability to liaise with a diverse range of stakeholders including administrative and particularly academic staff or researchers at all levels in order to conduct interviews.

To think or work creatively

The ability *to think or work creatively* has to do with the capacity to respond to the changing needs and priorities in a complex and changing academic environment as well as the development, assessment and promotion of the use of library services, technologies, and collections through a variety of outreach efforts.

To develop library resources

Developing library resources includes research guides and appropriate pedagogical materials such as instructional content and documentation to support effective instruction at different achievement levels.

To handle data

Handling data includes creating, manipulating and utilising databases as well as assembling, analysing and presenting data.

Abilities only mentioned once

Each of the abilities mentioned once is specific to one of the four categories of job advertisements from the USA or Australia. Belonging to the GNP category are the abilities *to manage projects, to travel, to sit at a computer, to understand, respond and follow directions,*

*to work under pressure, to pay close attention to details, to read/close-up work, to persuade, to effectively negotiate, to maintain confidentiality, to commit to goals and achieve established outcomes, to problem-solve, and to remain calm and compose*d. The ability *to travel* concerns campus and off-campus locations while the ability *to sit at computer* for a long period of time reflects sedentary work including keyboard use and repetitive hand motion. However, the ability *to remain calm and composed* is in relation to difficult situations or people, including employee relationships.

The SP category has only one required ability mentioned once. It is the ability *to pass a background check* which is related to the non-academic qualification requirement of eligibility to work in the USA.

The HLP category has four components in this regard which are the abilities *to safely perform, to lift and move things, to download and transform data files* and *to create and maintain web pages*. The ability *to safely perform* relates to the essential functions of the DL position with or without reasonable accommodation whereas the ability *to lift and move things* found as both required and desired abilities involves moving boxes, books and supplies of stated weights and staying in different positions for extended periods of time. However, the ability *to download and transform data files* is for meeting the various needs of users.

Two ability requirements mentioned once in the MP category include the ability *to present and share ideas* clearly and persuasively and the ability *to build consensus* and promote productive cooperation and teamwork.

The position advertisements from Australia (AP) have four ability requirements that include *to implement workplace requirements, to do quality presentations and reports*, *to rapidly acquire knowledge and new skills*, and *to undertake research and development work*. The ability *to implement workplace requirements* is in the areas of equity principles and health and safety standards. However, specifically mentioned in relation to the DL's ability *to rapidly acquire knowledge and new skills* is a working knowledge of the RIF-CS[17] record format and its application to the description of research datasets.

(d) Personal traits or attributes

Table 4-8 shows the personal traits required for the DL role as contained in the job advertisements.

[17] See List of Abbreviations and Acronyms for clarification.

Table 4-8: Personal Traits Required for the DL Role (N=43).

Personal Traits	*Frequency			Percentage of Total
	Required	Preferred	Total	
Service-oriented	6		6	13.9
Energetic	6		6	13.9
Committed	5	1	6	13.9
Motivated	5		5	11.6
Attention to detail	2		2	4.65
Innovative	2		2	4.65
Organised	2		2	4.65
Proactive	2		2	4.65
Personal traits mentioned once	11		11	25.5

Note: *n=42 instances

Personal traits mentioned once include: having *entrepreneurial spirit*, *politeness and courteousness, willingness to travel, interest*; being *out-going, intellectually curious, receptive to feedback, collaborative, forward-thinking*, and *positive*; and conforming to *ethical standards and integrity*.

A few of these personal traits may be clarified. *Willingness to travel* is in relation to working at periods outside official hours when needed and having *interest* refers to such area as emerging technologies. Being *proactive* is in terms of approach to service. Moreover, the DL is expected to be *committed* to a number of things such as services including user or customer services, professional development as well as excellence, diversity, equity and inclusion in higher education.

(e) Qualifications

Table 4-9: Qualifications Required for the DL Role (N=43).

Qualification	*Frequency			Percentage of Total
Academic	Required	Preferred	Total	
MLS/MLIS	31	2	33	76.7
Non-MLS advanced degrees	13	2	15	34.8
PhD or other/second advanced degree	2	7	9	20.9
Bachelor's degree	5	2	7	16.2
Undergraduate or graduate degree	3	3	6	13.9
Background		2	2	4.65
Certificate		2	2	4.65
Non-academic				
Eligibility	3		3	6.97

Note: *n=70 instances

Table 4-9 shows the identified required academic and non-academic qualifications. The most common and widely mentioned basic academic qualification requirement is an ALA-

accredited *MLS/MLIS* in library science, librarianship, information science or information, or its professional or international equivalent. It is a preferred requirement in two SP position advertisements. However, *advanced degrees* in social science disciplines such as business, statistics and economics, or sciences including engineering or data-intensive discipline or research areas with some years of relevant experience are mostly alternative requirements to an MLS/MLIS. Also, a *PhD* in a related field as an alternative to MLS or Master's degree in a social science or related discipline such as economics, political science, statistics, data science, etc., or an equivalent combination of education and experience in manipulating and analysing quantitative and qualitative data was featured as a basic requirement for the DL. However, a PhD or second advanced degree was a preferred requirement specified in the sciences or engineering or computational disciplines.

With the exception of the MP category all other categories have at least an entry each showing the requirement of a *bachelor's degree* qualification for the DL role. However, apart from one that specifically mentioned a professional degree from a library school, other fields have additional requirements of significant 2-4 years' or specialist experience equivalent to an advanced degree or in a library or academic computing or academic technology environment was required. Where a bachelor's degree was required as a preferred qualification in a GNP position advertisement, it was specifically mentioned in relation to scientific fields such as physics, or biological, chemical, earth, or life sciences.

An *undergraduate or graduate degree* as a basic qualification requirement for the DL was mentioned in connection with some disciplines including business, economics, statistics or data-oriented social science fields whereas it was a preferred qualification requirement in engineering or related disciplines, social sciences or sciences.

However, a *background* in computer science or experience with computational methods and techniques, coursework or specialisation in data curation, and *certification* from a Digital Curation Education Programme were all mentioned as preferred qualification requirements for the DL.

Furthermore, the non-academic qualification found in three GNP position advertisements pertains to eligibility to work in the USA through passing a criminal background check.

(f) Experience

Table 4-10 shows the areas and years of experience required for the DL role which are clarified below.

Table 4-10: Experience Requirements for the DL Role (N=43).

Experience	*Frequency			Percentage of Total
Areas of Experience	Basic	Preferred	Total	
Research support, reference and instructional services	13	12	25	58.1
Technologies and standards	9	12	21	48.8
RDM services and support	5	10	15	34.8
Professional engagement and work experience	1	14	15	34.8
Projects	10	4	14	32.5
Software	6	3	9	20.9
Information exchange, resources and management	2	4	6	13.9
Grant writing	1	5	6	13.9
Working with/managing data	4	1	5	11.6
Collaboration	3	2	5	11.6
Scholarly communications	3	2	5	11.6
Subject area	2	2	4	9.3
Collections	2	1	3	6.97
Diverse groups	2		2	4.65
Management and leadership	1	1	2	4.65
Keeping up to date		1	1	2.32
Documentation		1	1	2.32
Online information access tools and services	1		1	2.32
Years of Experience				
1-4	8	2	10	23.2
8	1		1	2.32

Note: *n=150 instances

Areas of Experience

Research support, reference and instructional services

The DL is expected to provide research support in terms of data services, grant proposal development and data management in an academic library setting. It also relates to the research environment, processes and qualitative and quantitative methods, including descriptive statistics and data analysis techniques and tools such as NVivo, Atlas.ti, SPSS, Stata, R, etc. Research support experience also extends to reference and instructional services in an academic or research library. Specifically, instructional services experience entails providing library instruction, information and/or data literacy or teaching academics, students and researchers the use of datasets and statistical software. It also involves developing and delivering training or support materials and services, including online products, in information management or a related area.

Technologies and standards

Technological experience requirements for the DL in terms of managing and/or developing repositories comprises data management, digital library, institutional repository and/or content management technologies or software such as CONTENTdm, DSpace, Drupal, Archon, Archivists' Toolkit, Fedora, etc. Other experience with technology required includes: computer and telecommunications technologies for information management and collaboration; programming tools for libraries; GIS; digital humanities tools; website design in HTML, XML, JSP, Dreamweaver or SharePoint Designer; database management in MySQL, Microsoft Server or PostgreSQL; scripting and programming languages such as PHP, Perl or Java; image creation in Adobe Photoshop and cross-walking, normalising and transforming XML using XSL. With regard to standards, the required experience include non-MARC standards such as DC, MODS, EAD, METS, TEI, etc., creating metadata and applying best practices to managed content as well as metadata issues related to the discovery of academic resources.

RDM services and support

A DL's experience with RDM services and support, besides using quantitative and qualitative data, and a wide range of data resources including social science and government datasets, and geospatial and statistical tools such as SPSS, Stata, SAS, NVivo and Atlas.ti, includes providing numeric and qualitative data services support in an academic setting and applying or advising best practices in digital preservation and storage to enhance library management and access. It also entails data management plan development, data curation in an academic environment, supporting GIS data and applications, and data information visualisation.

Professional engagement and work experience

The DL is required to have experience engaging in professional service and scholarship. Professional services include reference and public services, using tools such as statistical software, relational databases, GIS software, and scripting languages in work with datasets or in relation to data management. However, in relation to scholarship, the DL is expected to engage in professional and scholarly activities such as research and publication. Surprisingly, many of these were specified as preferred requirements.

Projects

The DL is expected to have experienced success with the use of project methodologies or transformative approaches to project management. S/he should have demonstrated experience

in designing, planning, developing, implementing, managing, timely completion, and reporting of user-centred information, research or data management projects or services.

Software

It is expected that the DL should have experience with a variety of software including server GIS technologies, Microsoft Office applications, data visualisation tools and software, and statistical software for quantitative analysis such as SAS, SPSS, Stata, R, etc.

Information exchange, resources and management

The DL has requirements regarding information in a number of areas. The basic requirements are only contained in the AP position advertisements whereas the preferred requirements are contained in three GNP and one MP categories. Experience with information exchange refers to protocols and encoding formats. Concerning resources, s/he is required to have experience creating and disseminating information resources. However, experience in information management is mentioned in the areas of the design, creation and maintenance of electronic databases and digital repositories, current digital preservation practices and tools, the research process and data life cycle, and trends in the organization and management of digital information.

Grant writing

The DL is expected to have experience with grant writing in a scientific, technical or academic organisation or experience with federal agency policies.

Working with/managing data

The DL needs to have worked with data, particularly quantitative data, and researchers, or to have manipulated or managed datasets. His/her expected experience also extends to data from government and private agencies.

Collaboration

The DL should have experience with developing collaborative working relationships or working in a collaborative or collegial research library environment, or with clientele and/or other communities.

Scholarly communications

The DL is expected to have experience supporting and participating in scholarly communication and sponsored research.

Subject area

Two SP job advertisements required experience and knowledge of current information resources and an academic background in the sciences and engineering as well as a broad knowledge of the social sciences for the DL role.

Collections

The DL is required to have experience managing and/or developing and working with digital collections in an academic library.

Diverse groups

It is expected that the DL should have experience working with, teaching, designing and delivering services to individuals of diverse backgrounds, levels of experience, races, ethnicities, genders, and perspectives in research, teaching, service and other work as well as being committed to fostering diversity.

Management and leadership

The basic requirement of management and leadership experience for the DL as contained in an AP source refers to supervision of professional staff but a preferred requirement in an MP source refers to operational and strategic planning of library resources and services.

Keeping up to date

Keeping up to date is found in a GNP source as a preferred requirement in terms of trends and issues in higher education, research and technology as well as data curation and management.

Documentation

The preferred documentation requirement for the DL is in relation to experience documenting workflows and procedures.

Online information access tools and services

A SP position advertisement required the "experience using online information access tools and services such as online catalogues, local link resolvers, abstracting and indexing (A & I) services, digital repositories, etc."[18]

Years of Experience

Generally, between 1 and 4 years' experience were required for the DL role, for instance, 2 years' minimum library experience on top of an ALA-accredited MLS or three to four years' minimum professional or relevant work experience at the Assistant Professor level, bachelor's degree and two to four years' experience working in a library, or in academic computing or academic technology, 1 year of work experience in the area of data or information visualisation or comparable education, and 1-2 years of experience providing professional services to an engineering disciplines in an academic, corporate, or research library as an alternative to a degree in engineering/computational discipline. However, as well as an MLS for a DL at an Associate Professor level a minimum professional experience of 8 years was specified. However, two years and three to four years were respectively given in two GNP sources as preferred experience requirements for the DL.

[18] This is from an Engineering Research and Data Services Librarian position advertisement at the University of Illinois at Urbana Champaign, USA.

Figure 4-1: The Interrelationships within Library Employers' Requirements and Responsibilities for the DL Role.

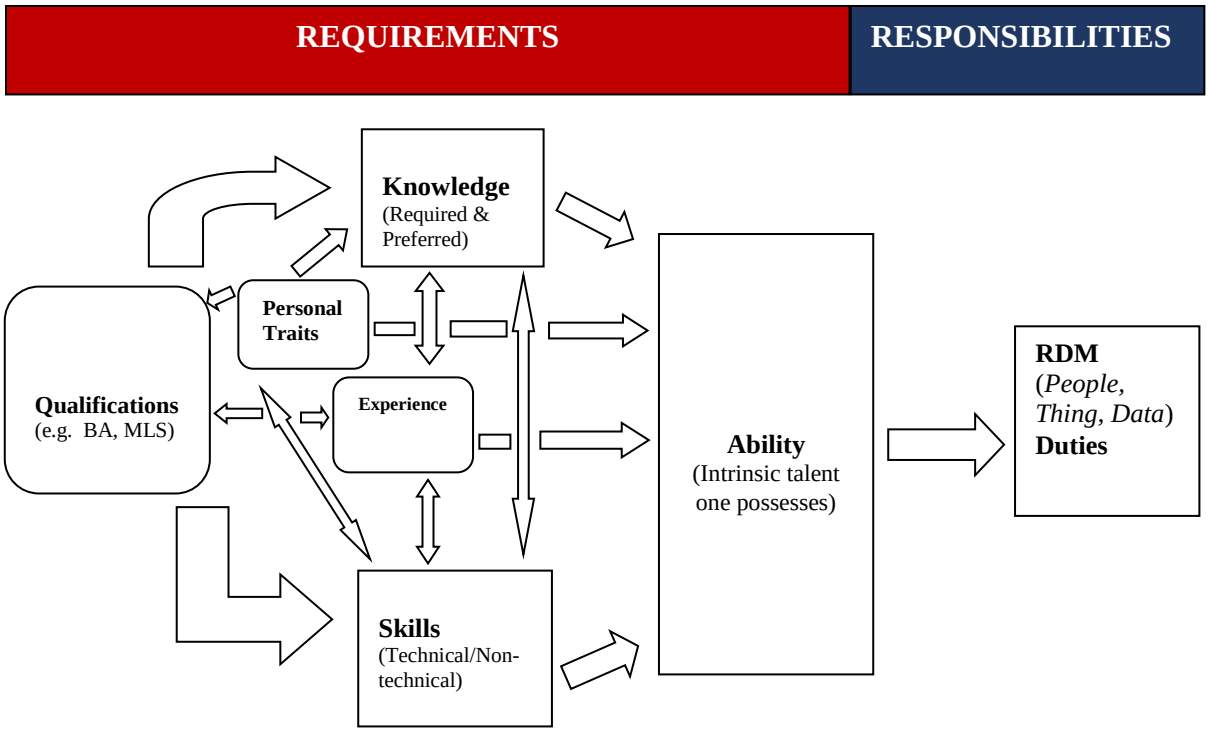


Figure 4-1 illustrates the following:

- Experience could be an alternative to, mutually complementary with, and can improve or strengthen qualifications.
- Qualifications or experience can lead to knowledge and skills.
- Knowledge and/or skills, together with personal traits and experience, which may also enhance them, provide/translate to the ability to do RDM (people, thing and data) duties.

4.4 A Synthesised View of the Perspectives

The three perspectives on the DL role being synthesised in this section belong to the literature, e-Research experts and library management employers. The perspective from the literature comes from Chapter 2 while the other two perspectives were considered earlier in Sections 4-2 and 4-3 respectively. The three main areas of this study constitute the bases for their synthesis which is aimed at providing a filter with which to discuss the findings from the main PhD interview data in Chapter 6. Each section below focuses on each of the three main areas.

4.4.1 Factors influencing the data librarian role in research organisations.

It must be noted that factors influencing roles are not usually included in job advertisements. As such only the literature and e-Research experts' views constitute the sources for considering a synthesis of these factors. Table 4-11 shows the factors within some contexts that may influence the DL role.

Table 4-11: The Factors Influencing DL Role.

Contexts	Factors	
	The Literature	**E-Research Experts**
National		
Role of government and its agencies	Incentivising of researchers by national bodies (e.g. NSF) to include dataset management in their research workflow; Funded programmes to lead the strategic direction of RDM	National research codes and RDM obligation in funded projects/programmes; National data service infrastructure
Collaborations	E-Research collaborations between libraries of different institutions and between institutions	
Organisational		
Researchers	Faculty interest; Researchers' view of libraries as trusted partners and their perception of tenure track faculty librarians as peers on campus and potential collaborators on research	Positive perception of librarians as collaborators in the research process
Academic/research libraries	Having a role in multidisciplinary research, a research support structure adaptable to new challenges, and opportunities to boost librarians' image as collaborators in research; Giving priority to e-Science within tight budgets; and Innovativeness of library management	
Administrative level support	Governance (in organisations); Administrative support is important to success in RDM	Top level support from institutional and library managements
	RDM projects in organisations	
Collaborations/ Communications	Collaborations between librarians and researchers, between libraries and the departments they serve, and between various departments in interdisciplinary subject areas	
	Communications (within organisations)	
Resources, infrastructure and services	Available resources	Availability of research infrastructure and services such as repositories, research office and HPC applications
Organisational environment	Organisational culture	
	Organisational setting	
	Politics	
	Acceptance (of RDM)	
	Role of stakeholders	
International		
Collaboration support		Funders' RDM obligation for researchers collaborating with international partners
Research		
Influence of disciplines/areas		Research discipline and areas influence researchers' views on RDM
RDM needs	Researchers' RDM needs	
Professional		
Requirements	Direct experience with data curation/management or MLS with emphasis on RDM is the required qualification found in majority of data-related positions	
Personal initiative and interest		Librarians motivated by personal initiative and professional interest
Professional support		Support by the national professional body such as ALIA
RDM jurisdiction	Library's claim	
	Presence of the required skills in an organisation, including libraries	

Table 4-11 shows that both perspectives have representative components within the national, organisational and professional contexts. However, views on international and disciplinary contexts are specific to the e-Research experts but are related directly to the researchers.

4.4.2 Performance components of the data librarian role.

To have a better understanding of the DL role it is pertinent to look at its performance components. The Kim et al.'s (2011) framework has two job analysis aspects – work and work characteristics – that are applicable to the DL role as discussed further below.

4.4.2.1 Work characteristics of the data librarian role.

The Kim et al.'s (2011) work characteristics refer to a worker's duties with respect to the categories of "people," "things," and "data." Tables 4-12 to 4-14 below show the duties of each category in relation to the Triad.

Table 4-12: People-related Duties of the DL Role within the Triad.

Duties	**Perspectives**		
	The Literature	**E-Research Experts**	**Employers**
Organise training/instruction	✓	✓	✓
Collaborate with and coordinate	✓	✓	✓
Provide consultation/advice/support in research (including analysing researchers' technology needs)	✓	✓	✓
Support data management and services	✓		✓
Perform outreach	✓		✓
Serve as liaison	✓		✓
Engage in professional development activities			✓
Support report writing		✓	
Provide expertise			✓
Ensure compliance	✓		
Facilitate access to datasets	✓		
Lead and manage			✓
Partner or network with			✓
Participate in/with			✓
Communicate with others	✓		

Table 4-13: Thing-related Duties of the DL Role within the Triad.

Duties	Perspectives		
	The Literature	**E-Research Experts**	**Employers**
Work with computers/implement IT for researchers	✓	✓	✓
Oversee and manage repositories	✓		✓
Select, develop and manage collections	✓		✓
Develop data management services, programmes and tools			✓
Support services and projects			✓
Maintain current awareness			✓
Manage RDM services			✓
Support technical processes and infrastructure			✓
Administer and implement metadata			✓
Document and do editorial work			✓
Investigate/recommend technology solutions	✓		
Maintain and manage technologies	✓		
Prepare, compile and manage documents	✓		
Manage budgets and project processes	✓		
Provide reference and information services	✓		
Assist with scholarly publications	✓		
Carry out e-Science responsibilities	✓		
Link research contexts		✓	

Table 4-14: Data-related Duties of the DL Role within the Triad.

Duties	Perspectives		
	The Literature	**E-Research Experts**	**Employers**
Audit data	✓		✓
Collect data	✓	✓	
Store data	✓	✓	
Describe/manage data	✓	✓	✓
Analyse data	✓		✓
Present data	✓	✓	

Tables 4-12 and 4-14 respectively show that only three people-related (train or instruct, collaborate with and coordinate, and consult with and advise/support in research), one thing-related (work with computers/implement IT for researchers) and one data-related (describe/manage data) duties are common to all perspectives. Some other duties either belong to one or two perspectives. It could be said that what constitutes the DL role depends on the particular perspectives or the needs of various organisations. As such, Tables 4-12 to 4-14 suggest a broad spectrum of the work characteristics for the DL role and no one DL may be expected to undertake all responsibilities.

4.4.2.2 Worker characteristics of the data librarian role.

The Kim et al.'s (2011) worker characteristics refer to the requirements for a worker's duties such as "knowledge," "skills," and "abilities." These are shown in Tables 4-15 to 4-17 as they relate to the DL role within the Triad.

(a) Knowledge

Table 4-15: Knowledge Required for the DL Role within the Triad.

Requirements	**Perspectives**		
	The Literature	**E-Research Experts**	**Employers**
Technology and standards (including metadata)	✓	✓	✓
Researchers' needs and available material or resources in particular disciplines	✓	✓	✓
Research (process and policy, and e-Research environment) and support		✓	✓
Research data and related aspects including lifecycle, curation and management (principles)	✓		✓
Terminology and methods in scientific subject domain areas (e.g. physics)	✓		
Databases	✓		
Information technology	✓		
Programming or scripting languages	✓		
Funders' data management requirements	✓		
Appropriate disciplinary data centres	✓		
Background in information profession		✓	
Current trends	✓	✓	
Repository management		✓	
Managing websites		✓	
Software			✓
Background in subject or programme areas			✓
Scholarly communication			✓
Tertiary sector and libraries			✓
Digitisation and digital resources			✓
Information literacy and management			✓
Workplace requirements			✓
Analysis			✓
French			✓

(b) Skills

Table 4-16: Skills Required for the DL Role within the Triad.

Requirement	Perspectives		
	The Literature	**E-Research Experts**	**Employers**
Technical Skills			
Teaching and instruction (e.g. data literacy)	✓	✓	✓
Project management	✓	✓	✓
Technology (including Web 2.0 and tools to curate/manage data) and standards (including metadata)	✓	✓	✓
Data (archiving and preservation services, mining, interpretation, representation, visualisation, and resources and uses)	✓		✓
Reference and data audit interviews	✓		✓
Computer literacy	✓		✓
Programming and scripting languages	✓		
Database management	✓		
Informatics	✓		
Institutional repository maintenance	✓		
Digital lab notebook applications	✓		
Licensing	✓		
RDM best practices (application to disciplines)	✓		
Research	✓		
Systems administration	✓		
Information retrieval		✓	
Documentation		✓	
Software			✓
Budget management			✓
Non-technical Skills			
Interpersonal and communication (oral and written)	✓	✓	✓
Team and collaboration	✓		✓
Administrative (leadership, management and supervisory)	✓		✓
Consultation	✓		
Data quality	✓		
Facilitation and promotion	✓		
Programming thinking		✓	
*Analytical and problem solving	✓		✓
Flexibility			✓
*Organisational and planning	✓		✓
Presentation			✓
Time management			✓
Liaison			✓
Professionalism			✓

Note: Only a literature mentioned analytical and organisational skills together.

(c) Ability

Table 4-17: Abilities Required for the DL Role within the Triad.

Requirement	Perspectives		
	The Literature	**E-Research Experts**	**Employers**
To work independently or collaboratively (in a team)	✓		✓
To organise and prioritise tasks			✓
To interact and work effectively			✓
To meet tenure and promotion requirements			✓
To provide reference, consultation and instruction services			✓
To build relationships			✓
To interact/work with diverse groups			✓
To lead or adapt to change			✓
To take initiative or initiate			✓
To communicate effectively			✓
To exploit technologies			✓
To liaise			✓
To think or work creatively			✓
To develop library resources			✓
To handle data			✓
To lift and move things			✓
To quickly learn new material	✓		
To communicate with others	✓		
To investigate and collect data		✓	

For other abilities mentioned once from the Library Employers' perspective see comments on Table 4-7.

It must be noted that some requirements found only in the Library Employers' perspective are neither included in the Kim et al.'s (2011) job analysis framework nor found in any of the other perspectives. These include experience, qualifications and personal traits or attributes – see Section 4.3.2 (d) to (f). Nonetheless, they are of no less importance than other requirements. With regard to experience, there is a difference between the e-Research Experts and Library Employers. To the former, experience is deemed helpful but not necessary whereas from the latter's perspective it is required.

However, Tables 4-18 to 4-20 depict an attempt to merge the work and worker characteristics within the Triad. The duties of each category of work characteristics (people, things and data) are aligned to the corresponding worker characteristics (knowledge, skills and abilities).

Table 4-18: The Requirements of the DL Role for the People-related Duties.

Duties	Knowledge	Skills	Ability (to)
Organise training/instruction	Information literacy and management	Teaching and instruction	Provide instruction
Collaborate with and coordinate		Team and collaboration	Work independently and collaboratively; Build consensus or relationship; Interact/work with diverse groups
Provide consultation/advice/support in research (including analysing researchers' technology needs)	Information technology; Research; Current trends	Consultation; Research	Provide consultation
Support data management and services	Research data, data lifecycle, curation and management	Programming thinking	Think or work creatively; Rapidly acquire knowledge and new skills
Perform outreach		Facilitation and promotion	Think or work creatively
Serve as liaison		Liaison	Liaise
Engage in professional development activities	Workplace requirement	Time management	Meet tenure and promotion requirements; Undertake research and development work
Support report writing		Documentation	
Provide expertise	Background in information profession	Data; RDM best practices	
Ensure compliance		RDM best practices; Facilitation and promotion	
Lead and manage	Workplace requirement	Administrative; Organising and planning	Lead or adapt to change; Organise and prioritise; Remain calm and composed; Implement workplace requirements
Partner or network with			Interact and work effectively
Participate in/with		Interpersonal and communication	
Communicate with others		Interpersonal and communication	Communicate effectively/with others

Table 4-19: The Requirements of the DL Role for Thing-related Duties.

Duties	Knowledge	Skills	Ability (to)
Work with computer/implement IT for researchers	Information technology	Computer literacy; Systems administration	Exploit technologies
Oversee and manage repositories	Repository management; Software	Institutional repository maintenance	
Select, develop and manage collections	Background in information profession; Background in subject or programme area; Databases; Digitisation and digital resources; French	Database management	Develop library resources
Develop data management services, programmes and tools	Software; Programming and scripting languages; Researchers' needs and resources	Software; Programming and scripting languages	Exploit technologies
Support services and projects	Research; Researchers' needs and resources	Research; Project mgmt.; Time mgmt..; Professionalism	Think or work creatively
Maintain current awareness	Current trends		
Manage RDM services	Background in information profession; Research	Research; Data; RDM best practices	Handle data; Take initiative or initiate
Support technical processes and infrastructure		Software; Programming and scripting languages	Exploit technologies
Administer and implement metadata	Technology and standards (metadata)	Technology and standards	
Document and do editorial work		Documentation	
Investigate/recommend technology solutions	Information technology		Quickly learn new material
Maintain and manage technologies	Information technology		
Prepare, compile and manage documents		Documentation	
Manage budgets and project processes		Budget/Project mgmt.; Documentation	Manage projects; Organise and prioritise tasks
Provide reference and information services	Background in information profession; Terminology and methods in science domain area	Reference interview; Information retrieval	Provide reference
Assist with scholarly publications	Scholarly communication; Tertiary sector and libraries; Databases	Research; Licensing	
Carry out e-Science responsibilities	Research; Technology and standards; Terminology and methods in science domain area	Research; Technology and standards	
Link research contexts	Research; Scholarly communication	Research	

Table 4-20: The Requirements of the DL Role for Data-related Duties.

Duties	Knowledge	Skills	Ability (to)
Audit data		Data audit interviews	
Collect data			Investigate and collect data
Store data	Repository management; Software; Technology and standards (metadata)	Repository management; Software; Technology and standards (metadata)	Exploit technologies
Describe/manage data			Quickly learn new material
Analyse data	Analysis	Analytical and problem solving	Problem-solve; Exploit technologies
Present data	Managing websites	Presentation	Exploit technologies; Present and share ideas

Tables 4-18 to 4-20 provide a clue on how the training needs of data librarians can be analysed. The expected responsibilities must be identified first, after which they should be mapped to the required competencies. Where these requirements are lacking in one's toolkits, they constitute his/her training needs. The next section focuses on the training needs and development options for the DL role.

4.4.3 The training needs and development of LIP for the data librarian role.

Training needs should inform the training of librarians for the DL role. As is the case with the factors influencing the DL role, training needs are not usually part of job position advertisements. However, it may well be that a prospective applicant is lacking in some requirements for a dream job position. In that sense what s/he lacks may become his/her training needs. Given this explanation, it is important to mention that only the perspectives of the literature and e-Research experts form the basis of discussion in this section.

Both the literature and the professional development profiles of the e-Research experts (see Table 4-1 in Section 4.2.3) indicate that training needs of professionals are varied and specific to both institutions and individuals. However, they are mostly typical of the knowledge and skills required for the data management and curation role which firstly must be identified in order to be addressed. Kim et al. (2011) employed a mixture of focus group and interviews along with internship work activity logs to identify what aspiring eScience professionals would need for their role. Bresnahan and Johnson (2013) surveyed some subject librarians on a list of training topics related to research data. On the other hand the training needs of the e-Research experts were explored through interviews. Whatever method serves best in a given environment or that suits investigators seems preferable.

The preferred training option is understood to be the same in the literature as in the views of e-Research experts. Bresnahan and Johnson (2013) indicated that their research participants preferred training formats such as one-day workshops, panel sessions, practical handouts, and informal discussions. On the other hand, the e-Research experts preferred learning on the job, conferences and professional networks, project experience, self-directed learning and training courses. All of these options from both perspectives can be summed up as learning on the job. This implies keeping their jobs while trying to improve themselves. This is more like one of the positions clarified by Corrall (2012) which is training professionals to work in digital or data curation and not training specialists. It appears that this position favours employed or experienced librarians in the field while the option of pursuing a specialist career in a data curation role will suit novice librarians just starting their career.

4.5 Chapter Summary

The three sources of data complementary to the data from the main phase of this study were considered in this chapter. They include the perspectives of the literature, the e-Research experts and the library employers. Specifically, since a review of the literature was presented in Chapter 2, only the last two were separately presented in this chapter to provide enough details that will facilitate understanding a synthesis of these done towards the end of this chapter. Each of these two perspectives was presented based on the three main areas of this study that are also the focus of the research questions. The three main areas are the factors influencing the DL role, the performance components of the DL role and the training needs of LIP for the DL role and their options for meeting them.

A synthesis of these perspectives reveals a number of things. In terms of the factors influencing the DL role it is evident that both the literature and the e-Research experts' perspectives have components within the national, organisational and professional contexts. Also, the international and disciplinary perspectives are the unique views of the e-Research experts and directly related to the researchers. However, they are of no less importance than other contexts.

With regard to the performance components of the DL role, the work and worker characteristics of that role from all three perspectives were first presented separately before being mapped together in order to provide a guide to analysing training needs.

Finally, the training needs of librarians from both contexts of the literature and the e-Research experts were discovered to be both varied and specific to institutions and

individuals, and must be identified first. However, the options for meeting the training needs for the DL role in both perspectives fall within the learning on the job category through different options. The implication is that formal training in data curation programmes at library schools was ruled out.

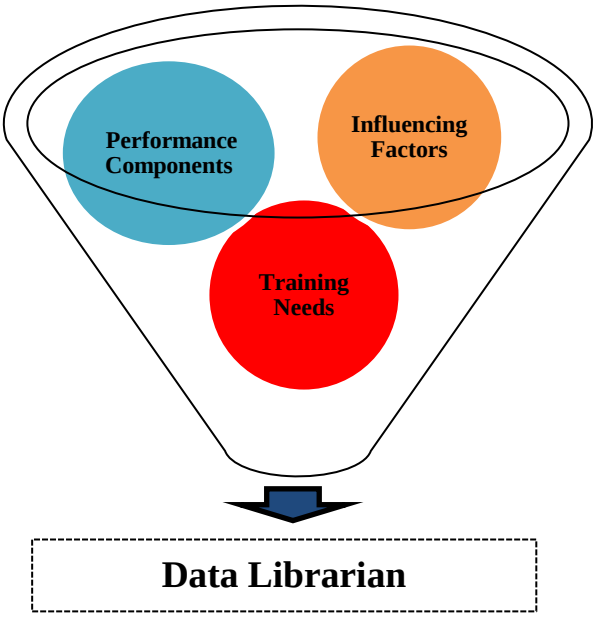
CHAPTER 5: DATA ANALYSIS AND PRESENTATION

5.1 Introduction

A total of 25 people from the chosen research organisations (ROs) participated in the main data collection for the study[19]. There are four categories of participants altogether: university librarians (ULs); library and information professionals (LIPs) such as Crown Research Institute (CRI) library managers and librarians as well as academic librarians from the universities; institutional repository managers (IRMs) from the universities; and e-Researchers (ERs).

In this chapter, I present the analysis of the interview data collected in Phase 3 based on the participants' responses to questions focused on the three main areas of this study related to the DL role. As shown in Figure 5-1, these areas are influencing factors, performance components and training needs with the options of the LIP for meeting them.

Figure 5-1: Areas of the Study for Data Analysis and Presentation.



5.2 The Factors Influencing the Role of the Data Librarian

This section focuses on the responses of the participants to the questions around research question 1: *What factors may influence the DL role in New Zealand ROs?* These responses reveal several identifiable and considerable factors from a number of contexts that can be

[19] For detailed information on the profile of research participants see Sections 3.3.6.3 and 3.3.7.

grouped into the four main categories that are discussed below: national context, research context, motivational (to play the RDM role of the DL) context and organisational context.

5.2.1 National context.

The national context refers to factors associated with New Zealand as a national entity mostly represented by its national government. This context comprises mainly two blocs of factors in terms of the perceived gaps around the roles expected at national level and the efforts/expected efforts by professional and research bodies, consortia and interest groups in relation to these gaps. These are to be discussed individually.

5.2.1.1 The roles expected of the New Zealand Government.

a) E-Research and RDM leadership role

More than half of each category of research participants expected a national leadership or direction for e-Research and RDM in terms of putting a policy framework, funding and service infrastructure in place. In relation to the countries they referenced such as the USA, UK and Australia the participants saw New Zealand as being left behind. This is exemplified in the following comments of some participants.

> Leadership needs to come from the government like in Australia e.g. provision of backlog of money for projects and infrastructure; New Zealand seems far behind. (Aala).

> The thing that will effect a change would be when New Zealand does go the same route as the United States and the UK and say that publicly funded data must be publicly available because if they are going that road then at the government level they are saying this information has to be made publicly available, therefore, we have a funding strength for it because it isn't a negligible cost. (Brady).

That the mandate appears an effective driver may have underlined the understanding by some research participants of the need for RDM policy as a first step towards an e-Research/RDM role in the research organisations (see Section 5.2.2.2).

However, it may be wrong to assume that the New Zealand Government is passive about e-Research and RDM. Various government organisations and agencies such as the Ministry of Business, Innovation and Employment (MBIE), Archives New Zealand, National Library and Statistics New Zealand were mentioned as starting discussions or doing something about

managing datasets. However, Riley said that there does not seem to be much communication between the different government organisations.

Also, there are some government projects and initiatives around e-Research and RDM. These include NeSI (National e-Science Infrastructure), Lincoln Hub, National Science Challenge (NSC) and NZGOAL (New Zealand Government Open Access and Licensing). However, it must be noted as Georgia pointed out that NeSI is all about high performance computing (HPC). About this, Hoku argued that it amounts to neglecting the cultural side of RDM support services within its remit and the exclusion of the different workflows and processes beside the scientific. The Lincoln Hub is a collaboration between Lincoln University, DairyNZ and three Crown Research Institutes (CRI) that may boost research in designated areas. Eden provided the insight that NSC requires researchers that receive its grant to comply with NZGOAL requirements with regard to Open Access.

Moreover, as good and incentivising to do research as these may be, the efforts of government organisations/agencies as well as the projects and initiatives are clearly seen, as depicted in the comments below, as an uncoordinated bottom-up approach that seems not to have adequately filled the gap or doused the expectation for national leadership in RDM from the government.

> But, this should be both; you need the top-down and bottom-up. I think there is a lot of bottom-up in New Zealand. I think people are trying to make the changes that are necessary. They are hearing what the researchers are needing but I don't see the national support. (Georgia).

> I think New Zealand has a very fragmented approach. I think at the national level there is no leadership coming out of the government or the higher ed (*education*), tertiary education commission, or the Ministry of Education around building and supporting the use of e-Research infrastructure. It may well be that that is because they are going to need additional or don't want to put money into it. (Hoku).

b) A change in the funding model

However, the government appears to have inadvertently encouraged the fragmented approach to research efforts through its Performance Based Research Fund[20] (PBRF) model that

[20] According to Nathan (2014), the PBRF is a funding model for New Zealand research institutions established by the government in 2003 based on three criteria: quality of individual researchers (60%); research degree

research participants suggested should be changed. Georgia and Baron were of the opinion that the model engenders competition and divisiveness since it does not provide a cooperative view of RDM that would have encouraged collaboration, sharing of ideas and exchange of resources that can boost RDM. A cooperative model would have allowed for synergy, economy and maximisation of available resources within a collaborating group. Further, Phoebe said the PBRF is old-fashioned and incapable of capturing disruptive cycles of modern research. The inevitable result of the overall picture, in Daisy's expression below, is a negative impact on researchers in terms of RDM.

> At the moment, because we focus on PBRF for this purpose, PBRF currently doesn't recognise datasets at all. So, at the moment we are not putting in any effort about importing any information datasets that researchers might have published. At the moment actually my impression is that a lot of, well most researchers are not publishing datasets.

5.2.1.2 The role of professional and research bodies, consortia and interest groups.

The perceived gap around a national or centralised e-Research/RDM direction have elicited some activities which could be part of making "the changes that are necessary" (Georgia as cited above) as well as the anticipation of some roles by professional and research bodies, consortia and interest groups.

The only and commonly mentioned professional body was LIANZA (Library and Information Association of New Zealand Aotearoa). Sofia expected LIANZA to play an advocacy role in the area of its interests and also to be able to play an advisory role to the Library School at Victoria University of Wellington through an advisory or steering committee in terms of putting together lectures for the up-skilling of librarians in areas such as e-Research. Also, both Riley and Maru expected LIANZA to play a leadership role in RDM to the extent of offering RDM courses for librarians. However, these expectations would be more realistic if e-Research and RDM were within LIANZA's radar. On the contrary, there is reason to suggest that it is not. Some participants expressed disappointment that LIANZA is failing to meet these expectations. This has led to some efforts to fill the perceived gap created by the failure. The following comments confirm this.

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completions (25%); and external research income (15%). RDM is yet to be required as part of researchers' reports.

> I am not saying anything I don't know. Interesting enough we have, I know somebody on the NEC [National Executive Council], LIANZA Committee organising the NEC Conference. So, I suggested to her that it will be great to see some speakers in that area, data management area. But, at the moment I am not seeing that; I am not seeing leadership in that area. So, potentially I think it's what is useful to have that kind of leadership. (Riley).

> I'd like to see LIANZA, the professional body, doing more in this area; you know we are running the same old workshops on customer relationships and marketing and publications. I'd like to see them do some more serious issues around e-Research, data management and all these kind of things. I think if those things were offered they would definitely be taken up because I think they are big knowledge gaps. But, at the moment because we don't really see that coming through the formal education or through special interest groups; there is no special interest group through LIANZA then we kind of are having to do it ourselves[21]. (Charlotte).

Daisy's comment below suggests that this alleged failure of LIANZA is due to their scale of operation that might need to be changed.

> I don't know whether that answers it at all but I would almost think that organisations like CONZUL (*the Council of New Zealand University Librarians*) and LIANZA even though normally they work on that broad scale of things, the overarching structural side, I would almost rather see them take on the small projects. You know, pick something really small, pick a few librarians to run it and just get something happening rather than trying to come with some [big projects that no one is willing to participate in].

Different research bodies are also thought to have policy codes around data. Two such bodies are contained in Brady's comment below.

> The Royal Society has a policy code for scientists and researchers. The Health Research Council has a code but I am not aware that there is a New Zealand code. So, the different research bodies have professional codes.

[21] This is a reference to the Data Literacy 101 course.

However, it happens that these research bodies are mostly in the science domain and none of them is the equivalent of any of the national research bodies in other countries such as the USA and the UK that may be required to cater for all disciplines. Hoku suggested in the following comments that to assume such a role will require the availability of national funding and infrastructure as in Australia.

> Along with the Australian environment while I was there it's a slightly different approach in so much as with the global financial crisis the Australian federal government threw a lot of money at the higher education sector generally and that's where projects came out; the ARROW (*Australian Research Repositories Online to the World*) project which I was involved in, a few other e-Research projects including ANDS were developed from that fund which was available and that then provided the necessary infrastructure which has allowed the National Health and Medical Research Council and the Australian Research Council to mandate an open access to publicly funded research outputs.

Universities New Zealand which is the national body of the vice-chancellors of the universities across New Zealand, and Science New Zealand on whose board the CEOs of the CRIs sit, are the major consortia at the senior management level for the universities and CRIs respectively. By their very high position they are believed to have a voice that the government cannot ignore if they choose to make statements on anything. As a result they are at least expected to play an advocacy role. However, Hoku mentioned that CONZUL, a sub-committee of Universities New Zealand, assigned one of their members to lead the development of CONZUL position papers and policy statements around what the government and the universities should be doing. In addition to this, CONZUL articulated the minimum metadata standards for describing data in the university libraries. On the part of Science New Zealand, there is no information on any role that they are playing yet in this regard. In summary, all consortia seem to be found wanting in terms of their expected advocacy role which could have steered the government in the right direction. This is captured by Georgia in her comments below.

> I don't know why they (*CONZUL*) are sitting on their hands; it seems to me they are not advocating in a coherent and clear way that the government can hear the message. I mean I was listening on the radio the other day and I was hearing Peter Gluckman who is the National Science Advisor [Chief Science Advisor] to John Key [the Prime

> Minister of New Zealand] and he was saying how there was a lack of good advice to government ministers about complex research issues. I think it is exactly the same for these sorts of issues.

The government needs such advice or advocacy in clear language that will help position it to meet real and critical needs. The comment of the Chief Science Advisor implies that the government is expecting some good advice especially from interest areas that may not be in its radar. To have a government that is willing to listen is an opportunity that must be taken.

Like the professional and research bodies, and consortia, relevant interest groups are believed to be able to play some roles in this regard. Particularly mentioned are the CRI data management interest group, New Zealand Data Futures Forum and Lincoln Hub. However, it must be noted that consortia and interest groups thrive on collaboration. However, whatever advantages that collaboration may have there is an inherent undermining element that should be considered and addressed at a top management level such as Universities New Zealand or its CONZUL sub-committee and Science New Zealand. The particular case of the CRI the data management group contained in Brady's comments below provides insight into such problems.

> In terms of the power of any of those groups, no they don't have a lot of power. We can make decisions collectively but we will then each, individually, have to come back to our organisations to get them to agree to it or not; endorse any statements that's being made in terms of influencing the science policy. The rule for New Zealand as a country, no, that will have to come through each individual CRI but there is Science New Zealand which is the umbrella under which all this is done and all the CRI, the CEOs sit on the board of Science New Zealand and they do make statements.

5.2.2 Research context.

Within the research context are factors involving research endeavours that relate either directly or indirectly to the researchers. Such factors include the research disciplines/areas or community, research needs and interests of researchers as well as policies such as RDM and Open Access mandates. These are to be discussed in this section.

5.2.2.1 Researchers as drivers.

Researchers constitute a major sub-set of the academic/research libraries' clientele to whose needs they must respond. Library services are normally built around the needs of the service community or else those services are either irrelevant or misdirected and will be a waste of the scarce resources. Such needs are discerned either from the requests of the researchers or articulated through library surveys. Therefore, it follows that where there is a genuine desire and enthusiasm or very clear need being expressed by academics for assistance with e-Research/RDM support the libraries will be prompted to acquire/develop the relevant services, tools or resources, and even reposition their staff by training where it is required, for meeting those needs. However, a lack of interest and enthusiasm for RDM on the part of researchers is a great disincentive for the LIP to build any support for it unless there is a mandate to do so. This is clearly understood from Hoku's comments below.

> Then, of course, the other side of it is the skills and the role around helping researchers manage their datasets. But, my view is that those services there are some standard generic tools and services that we can provide researchers but it needs to be very much research-driven unless there are mandates that we have to [provide those services]. It is up to the researcher to determine where the research dataset should be preserved, to what level it is going to be curated, to what level it is going to be made accessible to other people. We can then provide the tools that help them to describe that in a consistent way so that other people can find them.

This statement by Hoku should not be understood to mean that policy mandate is an alternative to researchers' interest and need for RDM support. Policy is only a recognition of existing needs and a formal empowerment to institutionalise the articulated response to them. It is an institutional motivation or justification or backing to render such services alongside the researchers' desire or interest. This is evident from Georgia's comments below:

> …we've met researchers, researchers have expressed interest in support but it needs to be mandated at a high level so that it's built into the services.

However, where the interest is low or non-existent some of the ways for getting researchers involved could be advocacy and mandates for RDM.

5.2.2.2 Mandate for RDM.

A view common to participants from both the universities and the CRI as well as the LIP and e-Researchers is the fact that mandates from funding bodies, publishers and the research community will give an impetus to RDM. While it is true that some researchers who understand the benefits and rationale for Open Access, data preservation and such-like may readily embrace RDM, Sabir argued that those highly driven by what they need to do to get their research grants would need such a push to get them interested in it. Funding is always a driver as whoever holds the fund pulls the strings. So, RDM can be slotted into the funding process to great effect. If funders and journal publishers will include RDM requirement in their processes many researchers will be compelled to comply. Moreover, as most researchers are sensitive to practices within the general research community they are more likely to welcome RDM if it becomes a norm in the community. In all, leadership and example by the government is necessary as well as advocacy role played by various relevant bodies. The following comments from Riley imply that a positive development is taking place in New Zealand but the central government needs to be more proactive in this respect by taking leadership.

> Yeah, I think, especially overseas and I'd think we are starting to see it as normal in New Zealand. There are the funders; so, we have several rules pitched with some various organisations including the government, MSI, MBIE, the ministry, and as part of that we are starting to see the requirements in terms of data management; so, having a data management plan and planks…And not only that it is required but that apportioned funding is made available for that process. Until that happens I don't think you just can do it; well, yeah, because it is just the other thing you need to do. So, when the requirement isn't in place I think there will be more of the push into the motivation to do it. Then, meanwhile as an organisation there's need to hugely support that, and perhaps when that happens the funding to do that as well.

5.2.2.3 Disciplines or research areas.

Although the e-Research/RDM area may indicate a cross-disciplinary outlook, the needs most researchers may have are supposed to be in the areas of their research interests and disciplinary expertise. It is the view of Hoku that the scope of their RDM support needs and advocacy for that may vary by disciplines and individual researchers and their research areas. For instance, those domains in the area of science that have an established tradition and experience in managing and sharing datasets may have little need for or may depend less on

the library than the disciplines in the humanities and social sciences where there is no expertise or any understanding or experience whatsoever. Respectively, Jabneh, Georgia and Daisy had similar views that disciplines have some peculiarities in terms of their information model, the nature of their research outputs including research data that they generate and the best practices in handling them. Perhaps this is one of the reasons as shown below that Lyn thought it sensible to make use of subject/liaison librarians in that support role. According to her:

> What a researcher in sciences might need would be probably completely different from something like a research from Law Faculty or something like that. So, to a certain extent being able to work broadly; as much as possible one has broad understanding and may be work closely with the subject specialist like subject librarian to help deliver on that.

5.2.3 Motivation to play the data librarian role.

The responses of the participants show that the motivation to play the DL role is at both institutional and individual levels. However, a common ground between the two levels is that the DL role is within the jurisdiction of libraries and the professional remit of LIPs in ROs. The motivations to play the DL role at these two levels are discussed below.

5.2.3.1 Institutional level.

The institutional level has to do with the academic or research library as an institution or establishment within a RO playing a longstanding role towards a given or clearly defined institutional mission backed by policy statements. As such there are two identifiable sources of motivation at the institutional level.

a) The role is within the remit of libraries in ROs.

All university librarians and two CRI LIPs (Dacia and Maru) indicated that the RDM role is within the remit of libraries in ROs and the principles of Open Access and open research. Underlying this view is the fact that librarians fit into the research architecture or ecology of ROs. As such, the role does not ask librarians to do something that is outside their remit but rather to provide services in a new way. Such an understanding is needed to be recognised by all in the library, filtering down from management to the frontline staff if relevant services are to be rendered to the researchers. This is important as the libraries should be strategically

positioned for and seen to be adding values to the research process in their organisations. It is believed that the existing skill levels of Librarianship could be transferred to the RDM area.

However, there are attendant challenges to the view that academic/research libraries have a role in the e-Research/RDM area for the leadership of such libraries. First, Hoku viewed this challenge as articulating the role and convincing the staff about it. Aala asserted succinctly that:

> University librarians ought to lead their libraries in this direction and recognise opportunities to do this.

Similarly, the understanding of the libraries' capabilities to undertake RDM also needs to be sold to the entire RO community. Each library needs to convince its community about its RDM capabilities and role. This is another challenge as pointed out below by Brady:

> Ideally, it will be good to promote that the library staff could do this, that they are used to managing data. But, I don't know that that would happen. There are rather a lot of political issues to deal with before we could get anywhere near that.

In other words there needs to be buy-in both by the researchers and the senior management at the institutional level in the research organisations[22].

b) Recognition of RDM policy as a first step in e-Research support

All categories of research participants in the study made statements indicating that a RDM policy framework is seen as a fundamental driver of the RDM support role. The following are a few examples:

> Yeah, I don't think that I can start if the academic staff don't ask me for a while for it or not until we have a mandate or something from the university. (Lily).

> We will start with RDM policy and I am confident we can do that with what we've got. (Ngaio).

However, libraries are thought to have the expertise for developing RDM policy as is the case in all case institutions where participants reported efforts in that direction. Either the library is being mandated by the organisation or it is taking the initiative to develop one.

[22] Leadership RDM buy-in at both library and institutional levels is discussed in Section 5.2.4.1.

5.2.3.2 Individual level.

The individual level refers to LIP working in libraries within research organisations. At the individual level there is a general aspect as well as a specific aspect. The former refers to all librarians in terms of their professional background, requirements, goals and experience while the latter refers to specific librarians who should have specific professional interests and requisite personal qualities to work in the area.

a) The motivation for all academic librarians

By their background and training librarians have the expertise in the field of managing information and Riley viewed data as just another information field. In the same way that they have successfully advocated for other services within their information management capabilities, librarians can awaken the enthusiasm or interest of researchers in RDM where it does not exist as Baron claimed:

> Librarians often work from passion and advocacy of things. In terms of data archiving, there is no great enthusiasm and scientists don't seem to have the interest.

According to Riley librarians already understand the value of information over time and understand archival issues and the ownership element within that. Thus, they are quite well strategically positioned to take on data as within their information management remit.

b) The motivation for individual librarians

Although RDM is seen as being within information management it appears that, rather than categories of librarians such as reference, subject or digital librarians, it is individual librarians with a certain personal manner and qualities, and professional experience that are better suited for a RDM role. Some descriptions provided by Daisy and Eden include motivation based on Open Access, a good temperament for challenges, willingness to do something scary and make it less scary, opportunity to liaise with researchers, having people skills and working with people around information organisation, and enjoying working with large amounts of information (*information geek*). Eden specifically stated:

> I think the field of librarians, archivists and records managers tends to attract people who are geeky to begin with. But, I mean if you are the kind of person who is an information geek you really just enjoy working with data and working with systems and helping people organise things and you think that's fun; this is a perfect job.

However, it is important to note that a number of LIP participants from both the universities and CRIs including Lyn, Maru and Sofia emphasised that there needs to be an interest or curiosity or real desire in the area of e-Research and RDM in order to play that role. For instance, Maru said:

> I am purely guessing here, I would imagine that the motivation would be that they are interested in working in that kind of area and either they have or are wanting to develop that kind of skills set.

Nevertheless, in terms of professional experience, librarians with cataloguing and liaison experience were favoured for the role. In other words, these are expected to apply or transfer their skills to the new area.

5.2.4 Organisational context.

The organisational context refers to the factors within the research organisations that may influence the role of the DL. They are buy-in at library and institutional leadership levels, the status of research support arrangements, existing collaborations and challenges that each research organisation has. An elaboration of each of these follows below.

5.2.4.1 Buy-in by both library and institutional leadership.

To lead an organisation in a new direction is a challenge for leadership and Jabal believed that sometimes it may take a little bit of risk and courage to try something new. To drive people and make things happen will always come down to leadership. Many research participants felt that leadership at both the library and organisational levels should be driving the e-Research and RDM agenda in ROs. Where there is a clear engagement by senior management of an organisation it could lead to development of policy that sets the tone for everyone to go in the chosen direction, or it could lead to the development of support services by the library. It may well mean that a head librarian with RDM vision could start ahead of the organisational leadership and hope to convince them by actions. One of the case institutions, UN3, showcases this. This university has no e-Research strategy yet the library developed a data management plan for insertion into a workflow and all the subject librarians were trained with an internally developed programme called Data Literacy 101 to position them for the e-Research/RDM support role.

Another university provides evidence of the positive influences of having support from senior management. This is captured from a participant's comments of below.

> At the moment the library's role in the RDM support is developing. There is a clear recognition amongst leadership here at *UN1* that the library does have a role to play in RDM because we, traditionally the library is the, I don't know if 'guardian' is the right word or 'gatekeeper,' but we are the organisation on campus that deals the most with information management. (Eden).

In this RO two librarians were appointed to support RDM and a draft RDM policy was before the Research Committee for approval at the time of data collection.

5.2.4.2 The nature of research support in the research organisations.

The nature of research support in each RO can be gauged from its research support framework which comprises the staffing, infrastructure, existing policies and status of RDM support. These are represented in Tables 5-1 and 5-2 respectively for the universities and CRIs that constitute the case institutions.

Table 5-1: The Research Support Framework in the Universities.

Institution	Staffing	Infrastructure	Policies/e-Research Advisory Body	RDM Support
UN1	A small team of 4, mostly part-time, provide different parts of traditional services but jointly provide the research system training support	About to move from institutional repository to Symplectic Elements	There is an Open Access policy but the data management policy circulated for feedback was before the Research Committee	Two positions (Advisor Digital Access and Records and Research Data Analyst) were dedicated to support data management
UN2	Liaison librarians have been used since 1997	Symplectic Elements and institutional repository	Draft policy at infancy and university policy around data focuses only on safety and accessibility; Had an ineffective e-Research Committee 2009-2012	There is low level attention to e-Research and ongoing discussions about RDM appeared to be more on the technical side
UN3	A team of 4 divisions of subject/liaison librarians managed by the Information Services Manager support research, teaching and learning while the Research Services Librarian supports them with building new tools and services	An open institutional repository and a restricted repository for researchers' outputs	No university e-Research strategy; Has an e-Research Advisory Group (part of the Research Committee but more of an interest group than policy making/enforcing body)	Data management plan was developed for insertion into a workflow; Subject librarians were trained with an in-house programme 'Data Literacy 101'
UN4	2 Academic Support Librarians respectively for Research and Learning/Teaching manage a team of 20 (19 subject librarians and 1 Special Collections Librarian) to directly support a wide range of subjects and faculties	1 open institutional repository and 1 restricted repository for staff and student members and about to move from DSpace to a new repository software	The e-Research Working Group developed a Capability Plan and a data management policy was planned to be used as from 2014	e-Research was not yet fully embraced in the university but a lot of efforts were on-going

Table 5-2: The Research Support Framework in the CRIs.

Institution	Staffing	Infrastructure	Policies/e-Research Advisory Body	RDM Support
CRI1	The only formal research support staff are a research director with a few staff around science reporting. As a result about 5 *knowledge advisors informally fill the gap	Just started an institutional repository	Not aware that any RDM policy existed	Library did not do RDM as efforts around data were at the science end of things
CRI2	The Information and Services group manages the library records and intranet functions.	Share Point portal	Had Information management policy but RDM policy was being put together	No emphasis on information governance but discussions ongoing
CRI3	The Information Services group (1 of 10 GNS support groups) looks after the library services and IT to provide support for the research output and needs of scientists	Uses a bibliographic database for research outputs	There were policies and procedures regarding research outputs	Research outputs seemed to be within the remit of records management rather than the library
CRI4	Knowledge & Collections team (1 archivist, 2 *knowledge navigators and 1 information advisor) directly support scientists	An in-house database that stores all the digital versions of outputs	Filling out RDM plan implemented only recently	A newly developed role devoted to support data but researching involving librarians/advisors
CRI5	Library team oversees library records and resource management while knowledge navigators do the frontline role	Share Point, E-Brida and some other databases	RDM was not a priority yet	No RDM support yet

Note: *These are equivalent to subject librarians in the universities.
CRI6 is not included in the column institution because only a researcher from there participated in the research and it was the LIP from the case institutions that were primed to provide the required information.

The research support framework is observed to have influence over the DL role in some ways. Firstly, for both the universities and CRIs, subject librarians or their equivalents are preferred over other categories of librarians to play this role. This shows a link with the staff arrangement in place[23]. Secondly, all universities and CRI1 have institutional repositories which Hoku saw as having the potential for managing research data. Here is his comment:

> Like Australia New Zealand university libraries all provide repositories. In fact we all have DSpace repositories, so, the essential infrastructure that will allow for the

[23] See Tables 5.15 and 5.16 in Section 5.3.2.2 regarding the approaches to e-Research/RDM.

deposit and making openly accessible research outputs and also information about research data is in place. It will involve very little money to actually start mandating or strongly suggesting or awarding points to people who did make things more available.

Thirdly, there is no mention of e-Research advisory bodies in the CRIs as in three of the universities. Although deemed by Baron to be ineffective and 'dead' in his university it was indicated to be functional in the other universities. Having such an advisory body in place could serve as a catalyst to the RDM role and efforts. For instance, in UN4 it is driving and boosting the e-Research/RDM agenda. The universities are apparently ahead of the CRIs in terms of RDM support. Although they are not on the same level of efforts at the moment that it is on the radar of the CRIs gives some hope for RDM in the near future.

5.2.4.3 Collaborations.

Three main types of collaborations that the ROs are involved with to be discussed in this section are: between librarians and the researchers; between the library and other organisational units; and between the library and other organisations.

a) Collaboration of librarians with the researchers

Tables 5-3 and 5-4 show the collaborations of the librarians with the researchers in the university and CRI case ROs respectively.

Table 5-3: Collaboration of Librarians with the Researchers in the Universities.

Institution	Opportunities to Promote Library Services/Projects	Areas of Collaboration	Researchers' Perception of Librarians	
			Librarians	**Researchers**
UN1	Intranet; Departmental newsletters and meetings; Relationships with researchers; and Providing good service that researchers could tell others about		Much of the time researchers did not realise librarians have expertise in the particular area (*they need*)	Librarians had expertise; particularly important as their involvement in projects would lead to a better outcome than currently
UN2	Leaflets; Emails	PBRF; Researchers' needs; Training for beginning academics; Information/publicity about books and research reports; and Directions about information management and research publicity	Academic audits rated librarians highly and as being available and useful	
UN3	Departmental, divisional and university committees' meetings; Formal and informal notifications/publications of services; and Individual relationships with researchers	PBRF; Education of academics, e.g. e-Research issues; Support for researchers in particular disciplines or areas; and Advice on data curation and management best practices	Relationship with researchers, especially emerging academics, described as being very good	Librarians seen as being proactive and good potential colleagues to involve in a project
UN4	Formal meetings with faculties and schools or departments; Newsletters; Librarians' membership of committees; and Formal report of the UL to University Council/Acad. Board	Raising awareness; Training and workshops on areas of need; Research consultation and access to resources; and support through special collections/digitisation programme	Staff and students surveys indicated high satisfaction with subject librarians' performance; Relationships with academics seen as very good	Librarians play important roles that many researchers do not realise

Table 5-4: Collaboration of Librarians with the Researchers in the CRI.

Institution	Opportunities to Promote Library Services/Projects	Areas of Collaboration	Researchers' Perception of Librarians	
			Librarians	Researchers
CRI1	Meeting invitations	Requests and delivery of information resources; and Pre-project surveys	Majority of the feedback was favourable to knowledge advisors	
CRI2	Working with research groups	Access to information resources; Training on searches and use of tools e.g. EndNote; and Research projects (occasionally)	The library seen rather rigidly as library with the librarian providing information and related services; The longer employed scientists seemed to value librarians more than newer ones	Scientists did not tend to see librarians as collaborators in research unless there was a major shift in their disposition
CRI3	Face-to-face conversations; Intranet; Emails; Flyers; Seminars; and One-on-one training	Reference support and assistance; and Scientists' information needs	It was thought that the scientists perceived the librarian as a useful professional	
CRI4		Provision and support for new tools	Scientists appreciated what librarians did for them	Scientists intended to bring librarians into research collaboration as having better understanding of scholarly publications than the scientists
CRI5	Intranet; Speaking at science meetings; One-on-one training; and Site visits of the knowledge navigators for services and training	Documents/research output management platform (Share Point)		
CRI6				It was thought that they did not have the knowledge and skills for information management in science domains

The tables show that formal meetings and intranets, more than other means, are used for promoting services and projects. Areas of collaboration are varied but PBRF and training of researchers feature more for the universities while information resources (access, request and delivery) are more obtainable in the CRIs. However, it is only in UN3 that advice on data curation and management best practices was reported.

In terms of perception of librarians as collaborators in the research process by the researchers, it is encouraging to note that more of the researchers especially from the universities believed that librarians have the expertise or potential to be involved in projects to create better

outcomes[24]. However, if many researchers do not realise or do not tend to see them as research collaborators then more and better advocacy and promotion may be required on their part in order to be visible and convincing to the researchers. However, it is hoped, as in Maru's comments below, that the existing collaboration in general research support can be furthered in the area of e-Research and RDM.

> We've had, even though it's early days, we have quite a long process of talking to people, finding out about publishing cycles and what kinds of releasing internal review processes there were and the people we've talked to have tended to buy in a lot more than the people that we didn't talk to. I guess that's really normal but the people we approached in that were really willing to engage and I would imagine that the same kind of thing would happen with e-Research and data; that we would have quite a few people just because they know what's going on in our approach that they would engage.

b) Collaboration between the library and other organisational units

Table 5-5 depicts the collaborations in the ROs between the library and other units of each RO.

[24] This is a boost to the new mission of librarians proposed by Lankes (2011) which was referenced in Chapter 1.

Table 5-5: Collaboration between the Library and other Organisational Units.

Institution	Organisational Units	Areas/Purpose of Collaboration
Universities		
UN1	ITS; Research Office; and Human Ethics Committee	Respectively for Provision of secure storage, easy collaboration facilities, version control, backups, etc.; Creation of data management plan; and Data publication over concerns about confidentiality or privacy
UN2	ITS and Research Office	For the systems and infrastructure, and the drive to do something respectively
UN3	Many units of ITS (At the highest level the University Librarian met with the ITS Director every couple of months)	Projects e.g. storage (the University Librarian collaborates with many other units to link them up)
UN4	Faculties; Research centre; ITS; and Research Office	Respectively for the Needs of individual units of faculties; Sponsorship of collection and space for them in the library; and Research support
CRI		
CRI1	IT; Science teams, Legal team; Communications team; Reporting team; and Records Manager	Librarian worked with representatives of IT and Science teams in a project team that talked with Legal and Communications team; and worked with Reporting team
CRI2	Various teams of ITS (infrastructure; applications support; software development; project, etc.)	Various projects e.g. upgrading Share Point
CRI3	IT	Technical issues with PC
CRI4	Science teams	Building the reference library and output library
CRI5	IT	Leading or supporting a project in which the library was involved

The library collaborates commonly with the Research office in the universities only but collaborates mostly with the ITS (Information Technology Services) unit within both the universities and CRI. The most identified area of collaboration is projects and, secondly, system-related issues. It is important to note that only one university, UN1, indicated the creation of data management plans and data publications as areas of collaboration. However, a closer look at these collaborations does not indicate that there is a clear vision as to why there should be very strong links between the different service units at the strategic level. The implication is that much of the collaboration was only ad hoc. However, Georgia thought that it should be different when she said

> So, you are dependent on relationship building and having a good relationship with somebody so you can do something and it shouldn't be like that, it should be more infrastructural.

c) Collaborations between research organisations

Collaborations in which the ROs are involved are of four types. First and specific to the CRI are international collaborations. For instance, collaboration within the Australian Libraries in the Emergency Sector (ALIES) is done in order to share resources. Moreover, a CRI sought information from international university libraries about building a repository while another CRI collaborated with overseas institutions in an online hub for sharing information.

The other three types of collaboration between ROs are within New Zealand and are either among the universities or among the CRI or between the universities and the CRI. The only mentioned collaboration among the universities is at the top management level by way of an association of the vice-chancellors of the universities across New Zealand called Universities New Zealand. A sub-committee of Universities New Zealand that is related to the university libraries is CONZUL[25] which is expected to represent the interests of the library sector.

The collaborations among the CRI are both at the management and special interest group levels. Brady hinted of Science New Zealand[26] as a collaboration platform of various CRI leaders for making statements regarding their sector. Furthermore, Sofia talked about a consortium of CRI library managers who liaise on issues such as sharing costs of database subscriptions. Riley spoke about the data management interest group made up of people from diverse backgrounds such as scientists, librarians and records keepers that meet on a regular basis (in January each year) to have discussions. However, there is not much information about their impact.

According to the submissions of the participants, the collaborations between the universities and the CRI varied over time. Brady provided the information regarding the past. In 2004 when the universities and the CRI got some tertiary funding they formed one consortium for access to Web of Science and ScienceDirect. However, by the time of first renewal around 2007 it was clear that because the two blocs of ROs are so different they could no longer stay in the same consortium. Two collaborations were mentioned for the present period. First, Daisy and Riley mentioned the Lincoln Hub which brings together Lincoln University, DairyNZ and three CRI - AgResearch, Landcare and Plant & Food - to collaborate on land related research and draw support from the work of about nine hundred (900) scientists. The second collaboration mentioned by Sofia is that of GNS (Institute of Geological and Nuclear

[25] CONZUL with other consortia, research and professional bodies, and interest groups was discussed in Section 5.2.1.2.
[26] The CEOs of CRI sit on the board of Science New Zealand.

Sciences Limited) with the universities in terms of geothermal or groundwater programmes for summer students.

d) The organisational challenges

Many research participants highlighted some challenges within the organisations that require addressing if RDM role is to thrive. Some of them involve the librarians and others involve the researchers, the required infrastructure and frameworks, and the management. While some can be addressed by the library management others can only be addressed by institutional leadership.

Those that have to do with librarians include staff numbers, knowledge/skill gaps, funding and the time and method for addressing the perceived gaps. Although the CRI libraries are research libraries they are also a kind of special library that typically have low staff numbers. These and UN1 have a low number of staff so that if the existing staff are required to up-skill they will struggle with loads of time and work. Funding is also required for training/developing them or hiring new staff. Moreover, there is the need for change management in order to reposition them to work in a new area. Except funding that is the responsibility of institutional management the library management has other responsibilities regarding staff.

In terms of the researchers, some participants highlighted the challenge of their lack of interest and apprehensions regarding ownership around data. Therefore, the provision of a conducive environment by the institutional leadership may be needed such as funding for technological infrastructure and services as well as policy incentives backed by advocacy. Thus, institutional buy-in at management level as discussed in Section 5.2.4.1 is required within the ROs to motivate researchers to engage in RDM. To achieve institutional management buy-in may require advocacy on the part of library management.

5.3 Performance Components of the Research Support Librarian and Data Librarian Roles

This section focuses on the analysis of the participants' responses to the questions around and also partly answer research question 2: *What are the performance components of the DL role in New Zealand ROs and how are these different from those of the research support librarian (RSL) role?* The analysis of their responses to these questions is to be presented regarding the RSL role and DL role respectively.

5.3.1 Research support librarian role.

The RSL normally support the needs of researchers. These translate to specific responsibilities for which they should have the requisite background, knowledge base and skills to deal with. As such the relevance of their existence is tied to being able to meet these researchers' needs.

5.3.1.1 Researchers' needs.

Research support services are meant to be tailored towards the actual research needs of the researchers. This demands a healthy collaboration with trust between RSLs on the one hand and the researchers on the other. While researchers should be made aware of the capabilities of RSLs as well as the services available for them (whether through advocacy or promotions) the RSLs in turn need to understand the needs of researchers as well as how they want these to be met. Table 5-6 shows the needs of researchers as understood by the LIP participants.

Table 5-6: Researchers' Needs as Understood by the LIP Participants (N=12).

Needs	**Description**	***Frequency**	**Percentage**
Information resources	Help to access- obtain published and unpublished information (occasionally data) or validate, verify or gain permission for re-use of resources	4	19.04
Advice	About publishing, RDM best practices	4	19.04
Access	Access to information resources including full text journals, indexing databases, restricted specialist resources	2	9.52
Funding	Help to access funding	2	9.52
Time	Help that saves the time of researchers	2	9.52
Searches	Searches for literature or what is being/has been done in terms of intellectual property and scientific research	2	9.52
Training	Training on how to search, use tools	1	4.76
Research project	Work as a team member	1	4.76
Bibliometrics	Help to figure out researchers' h-index or impact factor	1	4.76
Mentoring	Supporting apprenticeship programmes for emerging academics	1	4.76
Support	Internet	1	4.76

Note: *n=21 instances

Needs involving information resources and advice are more prominent and indicate that they have more needs within the pre-research and post-research phases than during the research phase of the research cycle. However, it is important, as Lyn highlighted in her following comments, that in order to confirm that their understanding is correct RSL may need to find out from researchers what their actual needs are.

> Yeah. I think, for that I have some assumptions that I have but that's part of what we are doing in the project (*on the needs of researchers*) we are running at the moment. It is actually to identify that very thing because I think we assume a whole lot and we don't actually do a whole lot of finding out.

5.3.1.2 Handling of obscure requests.

Most needs of researchers come to the RSL as requests with the expectation of a successful outcome. The LIP research participants were specifically asked how they had handled obscure requests that they could not readily meet because of their lack of the required experience, knowledge base or skills. Their responses fall into either of four categories and each category has at least an LIP participant from the university and CRI blocs of case institutions respectively.

a) Reference interview/research

A number of the LIP participants alluded to information searching skills as what gave them the confidence to try and find out any solicited information. To facilitate the search it is important to understand what the researcher really needs. As noted by Daisy, this is where it becomes important that the librarian is able to engage the researcher in a reference interview in order to properly diagnose his/her need. It is when the need is established that where and how to search become clear. Then, research is carried out to find out before the librarian can get back to the researcher to meet his/her needs.

b) Collegial approach

Some LIP have had to resort to asking colleagues when they do not know the answer or do not have a tool that will help them to answer some obscure queries. Such colleagues range from managers to professional friends or teammates. This appears to be done mostly on informal basis but in one of the universities, UN3, there is an formal structure for doing this as Charlotte's comments below reveal.

> Well, I suppose because we've employed the Portfolio Librarian (Research) she's been an excellent advisor to the liaison team because she really has developed, she's been kind of in that role, not in that role but working in the area for about 8 years now. So, she is kind of our go-to-problem-solver expert and all of us, we all use that and that's what the portfolio librarians are for. They basically spend their time keeping up to date, really keeping abreast and then transmitting that knowledge and

also dealing with troubleshooting as questions arise. So, yeah, we are using her quite extensively.

So, it is after asking his/her colleagues that the RSL gets back to the researchers with the answers to their requests.

c) Connecting them up

Sometimes when it becomes clear that the requests are not within the remit of RSLs looking beyond the library becomes the next option. This may necessitate either connecting them with or working out within the research support team the right person that can help the researchers to meet their research needs. It may also require the RSL to work with the researchers to find out the appropriate answer to their particular needs. However, this approach implies that the RSL should have the knowledge of the capabilities within other support units in the organisation and maintain contact with them so that they can easily contact them when needed.

d) Advising researchers about the lack of capacity to help them

Advising researchers about the lack of capacity to help them is usually the last option to take when it is evident that the library does not have the capacity to help researchers in a particular situation and the RSL does not know anyone or any unit in the organisation that can help. The researchers may then be courteously advised about that. This may appear challenging as it requires some people skills such as good customer management to handle the situation.

It is safe to conclude that there was no mention of a prescriptive approach in the LIP participants' handling of obscure requests. Rather, the above approaches suggest pragmatism is preferred over inference as needs are different and a combination of different factors might interplay in whether the staff are able to meet them.

5.3.1.3 Performance components of research support librarian role.

The performance components of the RSL role as found in the responses of the LIP participants are articulated based on the Kim et al.'s (2011) job analysis framework[27]. However, the framework has two parts: work characteristics and worker characteristics. The former refers to a worker's responsibilities or duties with respect to working with "people,"

[27] This has been fully discussed in Section 2.3.2.2.

"things" and "data" while the latter comprises the competences of "knowledge," "skills" and "ability" required to carry out those duties.

5.3.1.3.1 Responsibilities of research support librarian.

The views of LIP participants regarding the responsibilities within the RSL role involving people, things and data as they emerged from the findings are discussed in this section.

a) People

The responsibilities involving people include the duties towards people such as academics or researchers, students and staff. Table 5-7 outlines the duties of the RSL role involving people.

Table 5-7: People-related Duties of the RSL Role (N=12).

Duties	Descriptions	*Frequency	Percentage
Provide support/advice	Publishing; Reference service interaction; Better searches; Data management best practices; Where to find research or a digital repository to deposit data; Funding; Up-skilling or awareness of other library staff regarding involvement in support; Internet; Alert services; Helping people understand the Privacy Act and access information; Use of tools e.g. citation tools, readcube storage, etc.	8	66.6
Organise training/education	End-user education or training/inductions/advocacy on use of tools e.g. EndNote, literature searches, bibliographic management, bibliometrics, database searching, reference management, research reports	7	58.3
Assist in research project	Become a partner in research projects to validate or verify or gain permission to re-use resources; to identify tools, information, facilities or other support services to connect with; do specialist services depending on the project	2	16.6
Help with research needs	Identify research needs including obtaining or delivery of documents, book purchases and reference search	2	16.6

Note: *n=19 instances

Provide support/advice and *organise training/education* are the most common duties. However, it must be noted from Table 5-6 that *advice* is also popular in terms of what LIP participants understood to be the researchers' needs whereas *training* presents a different picture. This further reinforces the importance of finding out from researchers what their needs are in order to bridge any gaps between the understanding of RSLs and the actual needs of the researchers.

b) Things

Responsibilities involving 'things' include duties requiring things such as tools or technology, resources, documents, etc. Table 5-8 shows the duties of the RSL role involving things.

Table 5-8: Thing-related Duties of the RSL Role (N=12).

Duties	Descriptions	*Frequency	Percentage
Work with databases	Management; Support; Assessment; Manipulation to generate information, informetrics or metadata e.g. SQLShare, Science Direct, Liberty 5	6	50
Provide document services	Literature searches; Reference lists; Document supply/delivery; Guides	5	41.6
Provide access	Making information accessible through tools such as catalogues or metadata; Providing access to online information or library print information	3	25
Guide on things	Identifying where to publish e.g. high impact journals	1	8.3
Apply metadata		1	8.3
Staying current with things	With both information and tools	1	8.3
Troubleshoot with technology	Troubleshooting	1	8.3
Assist with collection development	Acquisition of journals and books	1	8.3

Note: *n=19 instances

It is evident from Table 5-8 that the most common duties are those involving *work with databases* and *provide document services*. The picture agrees with the high occurring and related *information resources* needs in Table 5-6.

c) Data

There was no indication of any data-related duties except as an expressed intention in Brady's comments below:

> The only input we would have at the moment would be if they ask for help in sourcing already published datasets or already available datasets. I have helped input into identifying a system with setting some principles for access to some data, so, in that instance if you collect data for a purpose then you can't re-use it for another purpose without the appropriate ethics approval. But, if such a thing is administered as data that you can re-use and it's identifying that; what was administered as data and what wasn't. Also, I have done some work on identifying data ownership. So, information that CRI2 holds we don't necessarily own; they are under different

contracts for services. In some cases we own it. In some cases we are only the current hosting manager of that information but we are not the owner. (LIP9)

The absence of data-related duties underlines two things. First, RDM is yet to gain momentum in New Zealand. Second, RDM is pictured as the primary responsibility of researchers whom the LIP are only meant to support.

5.3.1.3.2 Requirements of research support librarian.

The views of the LIP participants regarding the requirements for the responsibilities within the RSL role such as knowledge, skills and ability as they emerged from the findings are discussed in this section.

a) Knowledge

The knowledge requirements for the RSL role as shown in Table 5-9 comprise nine areas with their descriptions as they emerged from the findings.

Table 5-9: Knowledge Requirements for the RSL Role (N=12).

Requirements	**Description**	***Frequency**	**Percentage**
Knowledge/Understanding			
Background in information professions	E.g. traditional Librarianship, Records Management, Information/Knowledge Management, Archival Studies	5	41.6
Research	Research broadly, research cycle and e-Research; How to do data gathering; and Data management,	3	25
Publication	Process or cycle of publishing and what to do with/after publication	2	16.6
Collection and systems	Library collection, records and database systems	2	16.6
Background in computers	Computer basics	1	8.3
Research profiling tools	E.g. ResearchGate, ResearcherID, etc.	1	8.3
Technology	Current technology and issues in libraries around repositories, metadata	1	8.3
Tertiary education sector	The different arising needs in terms of supporting students and other clients in research, learning and teaching	1	8.3
Rights	Copyrights and compliance issues	1	8.3

Note: *n=17 instances

Table 5-9 shows that a background in any of the information professions is a fundamental requirement hence it is the most mentioned. Research comes second which is understandable because the RSL work in a research environment to support researchers' needs. Thus understanding the main business of their clientele should be a top priority. Moreover,

knowledge of the library collection and database, and the publication process and cycle that are joint third in popularity are needed by RSL in their support role.

b) Skills

The technical and non-technical skill requirements for the RSL role are shown in Table 5-10 with their descriptions as they emerged from the findings.

Table 5-10: Skill Requirements for the RSL Role (N=12).

Skills	Description	*Frequency	Percentage
Technical			
Research	Includes searching databases and the internet, accessing information pathways to find information and knowing how to evaluate results and synthesise information	5	41.6
Training, Facilitation and Promotion		3	25
Metadata	Cataloguing and applying metadata scripts	2	16.6
Publication support	Metrics, post-publication support or tracking what happens to research publications	2	16.6
IT	Working with computer systems, languages and tools or software, organising and presenting information	2	16.6
Reference interview		1	8.3
Non-technical			
People	Setting up good networks; Ability to read body language or build and nurture relationships; Liaison; Customer service; Communication; Social skills;	5	41.6
Personal	Good work ethic; Time management	3	25

Note: *n=23 instances

Table 5-10 shows that the topmost technical and non-technical skills are research and people skills respectively. These are requirements based on where and with whom they work. Training, facilitation and promotion as well as personal skills that come next appear to be complementary requirements.

c) Ability

Unlike knowledge and skills, there are only three mentions of the abilities required for the RSL role: to work with research tools; the ability to work quickly; and the ability to synthesise large quantities of information. The minimal mentions may be due to the nature of ability as overlapping with skills. As such some people may not see the difference between the two and instead may choose to focus on skills only.

d) Qualification and experience

The requirements qualification and experience are not included in the Kim et al.'s (2011) framework but they were mentioned by the LIP participants hence they are highlighted here. All components of these requirements as shown in Table 5-11 were singly mentioned by different participants.

Table 5-11: Qualification and Experience Requirements for the RSL Role.

Qualification	**Experience**
Library and Information Studies or similar background	Understanding/appreciation of tertiary environment
A postgraduate degree	Teaching
	Computers, computer software and information organisation
	e-Research arena
	Collection development, management and evaluation

5.3.2 Data librarian role.

The DL role does not exist in a vacuum but rather to support e-Research/RDM efforts of the researchers. As a result, the context of understanding researchers' needs is fundamental to functioning in that role. Within this context, what is understood to be the role of the library by LIP especially those in management positions influences their support services approach which may translate to the duties and requirements of the DL role.

5.3.2.1 Researchers' context for the role.

This section presents some information about the researchers that participated in this study that provides an insight into the context of the researchers who constitute the beneficiaries of the DL role.

a) The Researchers' profiles

Table 5-12 presents the profile of the researchers from the New Zealand ROs that participated in this study.

Table 5-12: Researcher Participants' Research Profile.

Researcher (Institution)	Qualifications/ Specialisations	Research Interests	Experience in Research Area
Sabir (UN1)	PhD, Computer Sciences (Architectures for distributed visualisation and grid computing)	Visualisation; E-Research/HPC space: use of technology and the barriers, and also bringing people with non-computing background into communities	12 years overall but about 7 years for the use of technology interest
Dabir (UN3)	PhD, Computer Science (Access control in distributed systems)	E-Research technology; Computer security and access control; Cloud computing and data storage	12 years for distributed access control but 4 years for the more recent interests
Jabal (UN4)	PhD, Computer Sciences	Computer systems modelling; Design of distributed or networked systems; grid computing; E-Research	Since the 1980s
Dae (CR12)	PhD, Biological Sciences (Human Genetics & Epigenetics)	Biomarkers for the treatment of obesity and Type 2 diabetes	4 years but broad interest in human health and obesity is longer
Arana (CRI4)	B.Com (Management Information System)	How spatial information can be used in forestry business in New Zealand	Many years
Jabneh (CRI6)	PhD, Physical Geography (Landslide in Post-geomorphology)	Understanding environmental systems and providing solutions for managing them better	12 years

Table 5-12 shows that while half of the researchers are from the universities the other half are from the CRIs. Although those from the universities have the same qualifications in the same domain (PhD in Computer Sciences) they have different specialisations and research interests. Meanwhile, their counterparts from the CRI have different specialisations and research interests. However, they are all from science disciplines with their experience in their respective research areas ranging from four to over twelve years.

b) Researcher participants' e-Research/RDM profile

Table 5-13 shows the researchers' e-Research/data management profile in terms of their involvement, the data they generate and how they manage them.

Table 5-13: Researchers' e-Research/Data Management Profile.

Researcher (Institution)	e-Research Involvement	Data Generated from Research	Way of Managing Data
Sabir (UN1)	His involvement is mostly at strategic and governance level and he has been part of the New Zealand e-Research community since 2006 as well as the group looking at e-Research 2020	Experimental results; and Software	Data managed in a very ad hoc way rather than structured way especially by his research students
Dabir (UN3)	Projects that have got e-Research significance e.g. access control projects; and HPC advocacy in relation to NeSI	Data files that relate to models of Geography (three dimensional models of landscape)	Storage options: Multiple copies of files in folder structures for projects stored in Syncplicity at Otago, Auckland Pan Cluster, hard disks of some computers with formal local synchronisation, and personal external hard disk drive backups; Sharing options: NeSI data fabric, Dropbox or Google Drive Management: With personally created index files
*Jabal (UN4)	No longer active in research but very much in management position e.g. in steering groups	Models of computer systems and networks and the codes for simulations with their parameters	
Dae (CRI2)	Mining publicly available databases to generate data and using specific statistical packages to analyse and share it collaboratively	Genomic data	Files in folders and sub-folders are stored in workstations
Arana (CRI4)	Not much involved but currently working on how to integrate datasets from different sources	Spatial data; Forestry informatics; Bioinformatics; Research interviews & transcripts	Data is stored on local Nexus and core datasets are stored with ESRI's Schema and ArcSDE while backup is on individual basis
Jabneh (CRI6)	Collecting a lots of data, analysing that to model systems for managing them better (current role)	Environmental data	Data is collected according to standards by adequately trained people. Then metadata is applied and the procedures and methods are documented. Next, data is archived and published. So, the structure is collection, curation and management, archiving and delivery

*This researcher was in a senior management position and because he was no longer active in research he could not provide any information on the way he managed data.

From Table 5-13 it is observed that not all the researchers are actively involved in e-Research. Furthermore, the data generated from their research as well as how they manage them are quite varied.

c) Researchers' RDM challenges, needs and expected roles for libraries

Table 5-14 shows the researchers' challenges with data management, their research needs as well as their expectations in terms of the role for libraries.

Table 5-14: Researchers' RDM Challenges, Needs and Expected Roles for Libraries.

Researchers (Institution)	**Data Management Challenges**	**Research Needs within Research Cycle**	**Expected RDM Role for Libraries**
Sabir (UN1)	Managing working datasets especially across institutional boundaries; Generated data becoming a lot bigger than initial calculations	**PR**: Training on data management plan for researchers/PhD students and how to manage their research data as part of the project; **AR**: Data preservation and availability	Involvement of librarians in research projects; Working with Research Office and ITS to coordinate/champion data storage
Dabir (UN3)	No server infrastructure to verify the storage; Storage of artefacts in such a way that people can access them	**PR**: Access to datasets from various sources likely to be used for analysis; **DR**: Version control; Disciplined process to managing intermediate data files that will not be stored forever; How to manage and organise the mix between people of same/different institutions and countries in a collaboration; **AR**: Storage of datasets (artefacts) as potential for re-use; DOIs for datasets including resources connected to a dissertation to make them citeable and accessible	Managing long-term access and storage of digital artefacts
Jabal (UN4)	How to store simulation codes with their parameters	*See the next column*	Storing software versions as a big continuum with their simulation codes/parameters; Linking all the aspects of a researcher's context to research that existed when the publication was created
Dae (CRI2)	Accessing their data externally	**PR:** List of public repositories of data **DR**: *See also the last column*; **AR:** Enough storage for the raw data	Data registry (a central repository of works held); Big data (database and repository) searching; Standard formats for datasets; Searchable electronic holdings for curated (experiment) records
Arana (CRI4)	Getting disks (space); Yet to develop data management plan for disposal and retention in collaboration with Digital Curation Centre	**PR**: Data management plan **DR:** Critical datasets generated and saved; **AR**: Strategic Level: Managing the collaborative processes for secure storage and management of data; Comprehensive Level: to make data searchable and discoverable	Custodianship of datasets; Data management plan; Catalogue; Discovery (Web) tools for visualisation
*Jabneh (CRI6)		**PR**: Project management system; Data management plan	Information management should be part of the curriculum of science disciplines which LIP can then support in collaboration with academics; Integration of different standards

*Researcher believes that he has no data management challenges

From Table 5-14 it is clear that the data management challenges revolve more around storage than access. While research needs are varied and cut across all phases of research they are more prevalent in pre-research (PR) and after or post-research phases (AR) than around during the research (DR) phase. In more of the cases each researcher's expected RDM role for libraries is observed to be influenced by his/her data management challenges and research needs.

However, subjecting the last three columns of Table 5-14 to a filter reveals the specific research needs of the researchers. They are storage, management of datasets, data preservation and access, version control, information management, data catalogue, experiment records, discovery (Web) tools, implementing DOIs, supporting research projects, training on data management plans, and data registries.

5.3.2.2 Approach to the RDM role in the research organisations.

This section focuses on the existing or intended approaches to e-Research/RDM support in relation to the various ROs. These are summarised respectively for the universities and CRI in Tables 5-15 and 5-16.

Table 5-15: E-Research/RDM Support Approach in the Universities.

Research Institution	**Approach**
UN1	The capabilities are developed in two staff, an Advisor for Digital Access and a Records and Research Data Analyst, to support e-Research and data management as a result of the size of the organisation and the limited number of staff. The intention is to collaborate with ITS and the Research Office in e-Research/RDM support.
UN2	There is an e-Research Librarian position that has not been involved in any sort of data management. So, the first priority is to use subject/liaison librarians who may work with cataloguing staff around the role. The intention is to figure out the core competences needed and find ways to train and develop them.
UN3	The intention is to embed the role with subject librarian responsibilities, re-write their job description to reflect that as they would continue to be supported by a research portfolio librarian. They have been trained with an in-house developed programme titled 'Data Literacy 101' to develop their capabilities. A Lib Guide has been developed as well as a data management plan which will be implemented once it is officially adopted.
UN4	The approach is to up-skill subject/liaison librarians for the role while metadata librarians would also provide assistance with metadata services. An e-Research working group (WG) with a director has responsibility for e-Research policy across the University and together with ITS the director leads e-Research across the organisation. The WG has developed a capability plan with some 8 action points that was to be adopted in the organisation and aims to boost the capability of both the support units (including the library) and the academics. Two new positions have emerged in the ITS in this regard. One is the Capability Builder who articulates the skill needs for each support unit. The other is e-Research Specialist who will function in a pre-project consultation arrangement. A Virtual Support Unit (VSU) with representatives from different support units is being put in place and the subject librarians would work within that.

Table 5-16: E-Research/RDM Support Approach in the CRI.

S/N	Research Institution	Approach
1	CRI1	It is anticipated that the library may be part of the project team. Depending on what might be needed the knowledge advisors' team is said to have the attitudinal disposition to get any skills set that may be required. Recruiting is also being considered if it is additionally required.
2	CRI2	The intention is to begin with an information audit, identify existing datasets and apply standard metadata to them. Next is to consider the technology used for their collection and storage in view of a possible future path to them given no available fund for their management beyond the project's lifecycle. Up-skilling of any staff to be deployed would depend on the skills set they have but the first step is to give them a good understanding of information governance and information access principles.
3	CRI3	The first step is to ensure there is evidence for the need for that support by doing a project. Then there will be a proposal to the human resources unit for policy positioning, gap analysis, and internal lobbying for buy-in against the priorities of senior management.
4	CRI4	If there are no additional resources allocated to RDM the activities will have to be re-prioritised. The logical first step is to start with the available skills. So, a staff member with some background in data management may be deployed while there would be an effort made toobtain resources to cover her other tasks. The knowledge and collection unit is about to recruit an Information & Data Services Advisor that will partly be involved with data support.
5	CRI5	It is believed that some of the skills required for RDM support are held by the Records Manager and both the library team and the knowledge navigators' team (Subject librarian equivalents) who work closely with the scientists except that RDM is not a priority currently.

It is generally observed that the approaches are closely related to the existing research support framework in the various ROs (see Tables 5-1 and 5-2). However, the approaches highlight a number of issues discussed below.

a) Librarians for the DL role

Apart from CRI2 and CRI3 all other ROs clearly indicated who they intend to play the DL role. Of these, apart from UN1 where two people were appointed to the role the rest suggest that it is conceived as a part or embedded role. A specialist individual role was only mentioned in two cases with regard to the present and in future. The following comments are insightful:

> Now, if we went down the track of all the whole range of research support services that we are doing then I think we might just need a specialist role for a while to help gear us up, whether that was just a short-term role and then as a project, perhaps, and then there's a transference of skills and we keep running from there. That's one you

> could use a specialist role. But, it will depend on how much the library is required to do. (Ngaio).
>
> Yeah, our intention is to carry on using the liaison librarians and we've actually just re-written their job descriptions to reflect that, an increased role in support of research because it is something we know is going to grow but I can't see us creating unique jobs like data librarians or something like that, not at this stage anyway. (Charlotte).

However, more of the ROs whether universities (UN3, UN2 and UN4) or CRI (CRI1 and CRI5) tend to favour a team or group role to be played specifically by subject librarians or their equivalents in the CRI. Some of the reasons that the LIP/UL participants gave in defence of their choice can be summarised as follows:

1. It is in line with the existing support structure that has been set up; so, there is the logic but also some advantages of utilising it.
2. The subject librarians have been the library's interface with the researchers and, so, have built up relationships with them, and have a deep understanding about them and their needs in addition to earning their trust.
3. There is the danger that if you only have an individual specialist role knowledge and expertise would be concentrated in an individual who may leave the organisation and there may not be real knowledge and skill transfer.
4. No one person can attempt to provide all the required services across all disciplines but subject librarians already have subject knowledge and can comfortably handle the nuances of disciplines which is critical.

Of these, it must be noted that the first reason is the main reason given that it is a more convenient and an easier course to take. Altering the status quo will always involve the challenges of change management that many people may prefer not to face. Trying something different from the status quo is a challenge for leadership as one of the e-Researcher participants rightly observed in the comments below:

> And it will boil down to its leadership. It always boils down to leadership, right; going to take a little bit of a risk; going to try something. (Jabal).

The fact that three out of the four universities in this study favour subject librarians to play the DL role confirms this. Comments from a University Librarian and another participant from the only university that has a different RDM support approach are seen as a

confirmation that their position is informed by the fact that there is no provision for subject librarians in their support arrangement due to the following reasons mentioned by some participants.

> *UN1* doesn't operate with the concept of liaison librarian (but collegial approach) and is focused on land, urban issues, etc. (Phoebe).

> The capabilities are developed in a few librarians due to the size of the organisation and the limited number of staff available with time to add these skills to their roles. (Rewa).

With regard to the second point, building and maintaining relationships is a matter of personal ability rather than a position that may require it. Regarding the third point, the individual specialist role does not necessarily imply working in isolation. A person in such a role can work with subject librarians and also train them if the organisation includes that in his/her job description. In terms of the fourth point, both the LIP and e-Researcher participants are in agreement that a domain knowledge requirement in library support is helpful but not necessary. A LIP participant provided a personal example thus:

> I mean, I was an Information Librarian for Chemical Engineering and I knew nothing about Chemical Engineering. So, I've worked without domain experience/expertise but I can say that they do also provide a big short-cut if you didn't have some familiarity even if it is just informal, yeah. (Daisy).

b) Understanding about library's e-Research/RDM involvement

The approaches are a product of how LIP and UL participants understand the role of their libraries in e-Research/RDM. The role is viewed to be at the institutional level in three main ways as:

1. A developing support role that is more aimed at educational, advisory and facilitating services;
2. The provision of access to tools and information needs;
3. A revision and extension of skills of librarianship rather than many new skills as the new tasks build on a tradition of duties already existing.

Therefore, being conceptualised at the institutional level, it is understandable why a group rather than the specialist individual role is preferred.

c) The perspective of researchers

Any approach that is not tailored to the actual context of the service base in terms of actual needs may be a waste of resources. Understanding the clientele in terms of their needs is critical. Tables 5-12 to 5-14 provide insight into the kind of information that the library needs in order to articulate, plan and position itself for better services.

d) Suggestions for research data services in New Zealand

> So, there are some things that everybody in the rest of the world are doing and New Zealand is still lagging around. Mandating the accessibility to publicly funded research outputs, that doesn't necessarily involve a big amount of money; it is a bit of stick. Like Australia New Zealand university libraries all provide repositories. In fact we all have DSpace repositories, so, the essential infrastructure that will allow for the deposit and making openly accessible research outputs and also information about research data is in place. It will involve very little money to actually start mandating or strongly suggesting or awarding points to people who did make things more available. (Hoku).

Hoku's comment above suggests that the use of institutional repositories could be extended to research data services. However, other participants such as Georgia, Daisy and Jafari showed reservations about such intention due to their concerns about funding and the capacity to maintain such services. Georgia did not want her organisation to have a data repository but she encouraged academics/researchers to publish their data in subject-specific repositories elsewhere. In Jafari's related view institutional repositories should not be used to support e-Research/RDM. Instead data should be deposited somewhere else but its surrogates in the form of metadata should be stored in an institutional repository and linked to the research publications. Meanwhile, Daisy suggested that, because of the lack of capacity for maintenance, New Zealand should not build a research data service like ANDS in Australia but could approach Australia about being part of ANDS by contributing financially to it. She further suggested changing ANDS name to Research Data Australasia in that respect.

5.3.2.3 Performance components of the data librarian role.

As was done in the case of RSLs the two aspects of responsibilities and requirements are considered for the DL role in line with the Kim et al.'s (2011) job analysis framework[28]. The

[28] The Kim et al.'s (2011) framework has been discussed in Section 2.3.2.2.

responsibilities and requirements respectively refer to the Kim et al.'s (2011) work and worker characteristics. However, the views analysed here are those of both the LIP (12) and the UL (4) participants.

5.3.2.3.1 Responsibilities of the data librarian role.

a) People

Responsibilities involving people include the duties towards people such as academics or researchers, students and staff. Table 5-17 shows the DL role duties involving people.

Table 5-17: People-related Duties of the DL Role (N=16).

Responsibilities	Descriptions	*Frequency	Percentage
Provide advice on data management	Advice and support around best practices in terms of data planning, creation, structuring/organisation, indexing, description, curation and (lifecycle content) management; Assisting with metadata	5	31.25
Liaise with	With academics to provide them with tools for managing datasets or finding information platforms to manage or evaluate information such as looking for the impact of research; Connecting academics with other support units; Liaising with researchers to identify and collect information about data	5	31.25
Organise training	Letting people know what they need to know and helping them to find it; Training in data management planning, metadata standards for research data	4	25
Help with research needs	Helping researchers meet their needs including information and data discovery and compliance type of issues	4	25

Note: *n=18 instances

In Table 5-17 the duties to *provide advice on data management* and *liaise with* respectively are slightly more common than the joint second place responsibilities to *organise training* and *help with research needs* respectively. In summary, duties with people have more instances than other types of duties and this is taken to mean that their primary responsibilities are with the clientele around which revolve other types of duties.

b) Things

Table 5-18: Thing-related Duties of the DL Role (N=16).

Responsibilities	Descriptions	*Frequency	Percentage
Assist with tools	Data management plan; Referencing (EndNote); and Finding (indexes, abstracts, citation reports, etc.); Developing training resources	5	31.25
Apply metadata standards	Using or applying or providing it for creating/managing metadata records for dataset description	4	25
Manage systems	Management of systems including institutional repository	2	12.5

Note: *n=11 instances

Responsibilities involving things refer to duties requiring tools or technology, resources, documents, etc. Table 5-18 shows the DL role duties with things. As the table depicts, the category *assist with tools* is the most common and corresponds with *liaise with* of the people category in Table 5-17 above. Similarly the second highest category of responsibilities *apply metadata standards* also correlates with *provide advice on data management* in the people category in Table 5-17. However, an e-Research participant, Dabir, believed that the DL role requires experience with tools in terms of what has worked and what has not worked.

c) Data

There was no direct data responsibility besides supporting researchers with tools in terms of data-related needs. This may be related to the understanding that the library's role is limited to educational and advisory functions (see Section 5.3.2.2b). Charlotte's comment below clarifies this:

> Well, I think we would have a definite position on what we think our role is. We certainly wouldn't want to get involved in everything; we don't want to get in the business of storing data but I suppose we will see our role as providing that research data advice; so, educating the researchers, telling them how they should be managing their data, looking at data management plans and which we have created.

However, an e-Researcher participant, Jabneh, was of the view that the DL role requires experience with RDM in different domains.

5.3.2.3.2 Requirements of the DL role.

The requirements refer to the Kim et al.'s (2011) worker characteristics and comprise the knowledge, skills and ability required in a role. These are to be discussed in relation to the DL role.

a) Knowledge

Table 5-19 shows that *technical* knowledge and *research/scholarly publication* with a bias towards data constitute the most common knowledge requirements for the DL role. The observation that there is no mention of domain knowledge as a requirement further strengthens the fact that, although it could be helpful, it is not deemed necessary for the DL role.

Table 5-19: Knowledge Requirements for the DL Role (N=16).

Requirements (Knowledge/Understanding**)**	**Description**	***Frequency**	**Percentage**
Technical	Different technology platforms, tools, systems, digital environment	6	37.5
Research/scholarly publication	Scholarly process; Research/data lifecycle; Copyright and intellectual property	5	31.25
Metadata		2	12.5
Background in information literacy, liaison		1	6.25
Science and statistics		1	6.25
Researchers	Needs	1	6.25
Data	How to handle, store and manage data	1	6.25

Note: *n=17 instances

The views provided by the researchers that participated in the study tend to confirm many of these requirements. The researchers believed that the DL role requires: knowledge or understanding of databases; metadata; data lifecycle, storage and management, types and issues involved; computer literacy; and data collection, types and problems relating to that as well as a background in standards and information technology, particularly information architecture. A synthesis of both contexts of the LIP and the researchers is needed for articulating LIP services that are more relevant to the researchers.

b) Skills

Table 5-20 shows both the technical and non-technical skills required for the DL role as they emerged from the study.

Table 5-20: Skill Requirements for the DL Role (N=16).

Requirement	**Description**	***Frequency**	**Percentage**
Technical			
Citation tools	Metadata schemas and catalogue application and management; Implementing DOIs for datasets	3	18.75
Keeping up to date	Research landscape	2	12.5
Research/Searching		2	12.5
Training and Data literacy	Presentation and facilitation	2	12.5
Data	Curation and management; Helping researchers manage datasets	2	12.5
Database	Management	1	6.25
Project management		1	6.25
Non-technical			
People	Communication, interpersonal and interaction	4	25

Note: *n=17 instances

At first sight, Table 5-20 above may suggest that by their frequency technical skills are either more important or needed than non-technical skills but it must be noted that people skills are the most mentioned. Thus it is critical to the role since all other skills will be irrelevant if there is first no effective engagement with researchers which can only be built and sustained by people skills.

However, e-Researchers' perspectives on the skill requirements of the DL role mostly features the technical skills that confirm many requirements in Table 5-21. They include: keeping up to date with the research landscape in relation to people, policy and technology; digital data curation, management and preservation; and searching skills. The only non-technical skills mentioned are skills for networking with people.

c) Ability

Ability for the DL role was mentioned in five main areas as shown in Table 5-21 with their descriptions.

Table 5-21: Ability Requirements for the DL Role (N=16).

Ability	**Description**	***Frequency**	**Percentage**
To communicate	Engage with scientists one-to-one or one-to-many; Demonstrate and promote services to researchers	2	12.5
To relate	Build and maintain relationships	2	12.5
To use technology	Use or be flexible with technology platforms	2	12.5
To liaise	Liaise with clusters of academics	1	6.25
To catalogue	Catalogue or apply appropriate metadata	1	6.25

Note: *n=8 instances

There is a connection between the abilities in Table 5-21 and the responsibilities discussed in the last section. For instance, while the abilities *to communicate, to relate* and *to liaise* relate to the people category the abilities *to use technology* and *to catalogue* or apply metadata relate to the things category.

5.4 Training Needs for the RDM Role

This section provides the analysis of the responses of the research participants which provide the answer to research question 3: *what is the nature of the training needs of the librarian and information professionals and the preferred ways for meeting them in order to play the DL role in New Zealand ROs?* First, the professional development profile of the LIP participants is presented. Next are the perceptions of the training needs for the DL role.

Lastly, the training and development options as well as their challenges for the DL role are outlined.

5.4.1 Professional development profile of LIP participants.

The LIP participants provided information that constitute their professional development profiles. Table 5-22 shows their knowledge/skill gaps at the beginning of their role and options for meeting them whereas Table 5-23 shows their knowledge/skill gaps at the time they were interviewed and their intended options for meeting them.

Table 5-22: Initial Gaps and the Options Used for Professional Development.

LIP Participant (Institution)	**Initial Gap (IG)**	**Professional Development Options**
Daisy (UN1)	Data management	Reading (journal and website) articles, e-Research conferences and making contacts, talking to people, following Twitter feeds
Eden (UN1)	How to apply archival training/skills to RDM	Talking to researchers about their needs; e-Research conference and online (DCC) resources
**Rewa (UNI)		
Baron (UN2)	Computer skills	Computer acquisition and online reading
Charlotte (UN3)	e-Research	e-Research conferences and in-house training programme
*Georgia (UN3)		
Lyn (UN4)	Strategic understanding of the tertiary institution environment; E-Research; Kinds of relationships to form with different people	Official project (research support strategy writing)
Maru (CRI1)	Subscriptions (budget, foreign currency) and inter-loans	Managerial mentoring
Brady (CRI2)	Technical aspects of information security governance	Certificate course in information security management from ISACA
Sofia (CRI3)	Historical knowledge of the collections and specialised cataloguing skills	Collegial (remote) support
Dacia (CRI4)	Webinars, websites	Has not yet been filled as the exact role of the library is undecided
Riley (CRI5)	Organisational culture and records management	Managerial support

Note: *The interview with this participant ended earlier than the scheduled time because she had another appointment so that she was unable to address a few questions including this aspect. **This person was not interviewed but provided some information as answers to some questions complementary to the interview with his colleagues.

Table 5-23: Current Gaps and the Options Intended for Professional Development.

LIP Participant (Institution)	**Current Gap (CG)**	**Professional Development Options**
Daisy (UN1)	Technical background for data management	Using search in databases or professional network to get relevant resources
Eden (UN1)	Staying current (only a temporary gap)	Collegial support
**Rewa (UNI)		
Baron (UN2)	Metadata and funding aspects of research support	(*He only provided a clue to formal education*)
Charlotte (UN3)	Higher level of e-Research expertise	Collegial support (going to the UL or the RSL and PD meeting)
*Georgia (UN3)		
Lyn (UN4)	Understanding the needs of researchers in the organisation	Official project (to find out researchers' needs)
Maru (CRI1)	Upgrading knowledge in copyright, cataloguing, project management and implementing library systems/databases	Professional reading; Training opportunities and getting funding; Collegial support; and Researching clients' needs
Brady (CRI2)	Development of a repository	Bringing external parties to help while she manages the project
Sofia (CRI3)	Serials, acquisitions and managing library budget (although her role doesn't require these)	Managerial support; Webinars
Dacia (CRI4)	*No information*	*No information*
Riley (CRI5)	Data management	Free online courses, Reading; Connecting with data managers in CRI; Getting support for training and funding in any available university course

Note: Same as notes on Table 5-22

Although most of them did not plan to use the professional development options for the current gaps, it must be noted generally that both initial and current options are similar. However, Table 5-24 shows that all the organisations have some role, directly or indirectly, in the training and development of the LIP in terms of providing the opportunities, resources or sponsorship. The general idea is that there is support from all the ROs based on relevance of training/development to organisational goals or priorities.

Table 5-24: The Role of ROs in LIP Participants' Professional Development.

Research Organisation	Role (Actual or Expected)
Universities	
UN1	There is available funding for conferences and time for self-guided reading
UN2	If formal education is the option for an area deemed beneficial the organisation would sponsor it
UN3	The organisation has a strong staff development policy and supports CPD requests
UN4	There is a budget for staff development when needed. Some staff have been sponsored to attend conferences
CRI	
CRI1	The organisation has management (mentoring) support
CRI2	The organisation paid for a ISACA course and granted leave for the course staff attended
CRI3	There is support upon any strong case for training or development that is of benefit to the organisation
CRI4	There is sponsorship support in areas of priority
CRI5	Provision of opportunities for induction courses and funding for training

5.4.2 Perceptions of the training needs for the data librarian role.

A UL participant, Phoebe, described the skills needed for the DL role as "not so much gaps which are not known but an exploration with aspects such as data curation and management (starting with small data), understanding what needs to be done with HPC, data literacy of staff and students among other related competences." Two LIP participants provided similar views. While Rewa viewed the knowledge and skill requirements as a revision and extension of skills from the traditional duties of librarians rather than many new skills Eden saw it as a case of figuring how to apply the information and the skills developed in her archival training and career to this sort of work. Thus, the LIPs clearly believe that the DL role is a new area for doing their work another or in a new way. In other words they already have the necessary background that may require upgrading or up-skilling in order to play the new role. One of the e-Researcher participants provided a view that confirms this:

> Having said that, any organisation the size of the university should be prepared to invest in staff development; that should be the step they are taking. But, I don't think it is happening fast but I don't think you are looking at the whole set of re-education of your library staff. (Jabal).

Table 5-25 shows areas or components that need to be included in the training for the DL role. The views on the two sides of LIP/UL and the e-Researchers are presented.

Table 5-25: Training Needs for the Data Librarian Role.

Area or Component	**E-Researchers' Views**	**LIP/UL's Views**
Research	Understanding of the research environment	Understanding of research and research cycles
	Research project management	Understanding of e-Research
Technology	Engagement with (ever-changing) technologies	Understanding what needs to be done with HPC
	Technology basics	Understanding of available tools
Information management	Information management and informatics	Understanding of information governance and access principles or (international or existing) standards
	Domain basics	
	Understanding interchange standards	
Research data	Data collection and its purpose	Research data
	Business analysis	Research data curation/management
	Machine discovery	Data literacy
Metadata	Metadata	Metadata standards
Organisational knowledge		Policies that govern various aspects in the organisation
Customer relationship		Customer training

From Table 5-25 it is interesting to observe that there is agreement on most of the main areas of training, although there are differences in their elements. Only organisational knowledge and customer relationship are specific to LIP/UL participants.

5.4.3 Training and development options for the data librarian role.

Table 5-26 below shows the views of both the e-Researcher and the LIP/UL participants on the training and development options for the DL role.

Table 5-26: Training and Development Options for the Data Librarian Role.

Main Option	Option Types	
	E-Researchers' Views	**LIP/UL's Views**
Personal opportunities		Self-development opportunities e.g. with experts such as librarians and other professionals in the field; getting exposed to other support services in the area; conducting some research with technology for hands-on experience; and personal reading
		Talking to researchers about how they use data, the practices they use to manage data, what sort of tools or programmes they use, etc.
Organisational opportunities	Formal learning process that may require some courses or training programme may be in a university	Organisational support for training which may be in-house, bringing in an expert (alone or in partnership with other libraries) to deliver it or sponsorship for courses or programmes either through formal education or professional meetings e.g. conferences and workshops
	Learning on the job through projects and conferences	Learning on the job
	Courses to do exchanges with other libraries and places doing it	
		Professional collegial or peer support for anyone new to a role
		Pilot data management project to learn on

Some level of agreement within organisational opportunities suggest that there is a common expectation that organisations should play an active role in the training of LIP for the DL role. Table 5-24 shows that there are not likely to be many problems with this expectation. However, the professional development profile of the LIP (see Tables 5-22 and 5-23) discussed in section 5.4.1 gives an insight into personal opportunity options that some of them used and why the options are specific to them.

5.4.4 The challenges of training and development for the data librarian role.

The challenges of training and development for the DL role as observed by some UL/LIP participants are in three main areas which can also be linked with the contextual factors discussed in Section 5.2. They include:

1. Lack of formal opportunities in New Zealand for preparing data librarians

From the national context this is a gap mentioned in the comment below by a participant in relation to the professional education of DL:

> I mean we have a problem with having adequately trained librarians. As you said, there isn't a qualification in New Zealand which would prepare somebody for a role like that. I mean I've done self-training and now we are training people in-house and I know a lot of libraries are doing that but that would be the gap that is missing. (Georgia).

This challenge becomes more apparent when a library is faced with having no opportunity to take people who are already doing other tasks to develop them into this kind of role. Many librarians are so busy that they would not want additional responsibilities. The only alternative will be to hire those who are trained with the expertise that is suited for this role. It becomes critical then that where such people are not available any institution of higher learning running information profession programmes should take such expertise into consideration. Moreover, leadership of libraries may have to look for interim measures to ensure that they develop capabilities in their staff in order to play the DL role. The Data Literacy 101 at UN1 is a typical example of this.

2. Convincing librarians to buy into the DL role

Two participants, Hoku and Riley, from the university and CRI blocs respectively pointed out the challenge to articulate the changing role of librarianship in terms of how the core skills set is relevant for moving into the phase of data-centric research support. Therefore, getting the LIP to recognise that this is important and part of their tasks that they need to be convinced to focus on is a key challenge for university librarians and CRI library managers. This obviously will require leadership and change management through vision, explanation and training in order to motivate their staff to play the DL role.

3. The likely demands of the DL role on existing staff

Some libraries may have good staff that are very keen and willing to take on new challenges. However, as is always the case, Ngaio emphasised that there is more to do than most libraries have the resources for. However, Maru highlighted this fact in relation to the staff in terms of their number and time especially in typical CRI libraries. Hence, the main challenge is being mindful not to overstretch the existing staff by making them take additional responsibilities or making sure that they feel competent to handle them. Managing the demands well will be a sure advantage in playing the DL role.

4. Lack of policy incentive

This point touches on all contexts influencing the DL role. It was observed that "At policy level, policy position for researchers is not in place in New Zealand" (UL4). RDM policy, national or institutional, is an incentive to all stakeholders including libraries, LIPs and researchers to get involved in RDM. It follows that library involvement in RDM will naturally lead to the evolution of the DL role. Therefore, its absence is a disincentive whether in a country or in the organisations as it will become more difficult to get researchers to do RDM.

5.5 Chapter Summary

In this chapter, I presented the analysis of data comprising the responses of the research participants to the extent that they provide answers to the research questions.

With regard to research question 1, there are four main contexts to the factors that may influence the DL role. First, there are national context factors that relate to the perceived gap around the national-level RDM leadership role and the efforts by professional and research bodies, consortia and interest groups to fill the void. Second, there is the research context that is embodied by factors involving researchers, RDM policy mandates and the disciplines as drivers to RDM efforts. Third, the motivation context points to the drivers both at institutional and individual levels for playing the DL role. Finally, there is the organisational context comprising factors involving RDM buy-in at institutional and library levels, the nature of the research support as well as various collaborations in which the research organisations are involved. These contexts constitute the environment within which the DL role is situated and require due comprehensive consideration.

In terms of research question 2, it was shown that the RSL and DL roles have similar performance components in terms of their responsibilities and requirements. However, the uniqueness of the DL role stems from the support regarding data and data management. Further, more than half of the ROs, more of the universities but also the CRI, favour subject librarians or their equivalents in the CRI to play the DL role for different reasons but mostly because of the convenience and perceived advantages of using the existing support service. The specialist individual DL role can only exist short-term currently for the purpose of training subject librarians or in the future when the responsibility or the need for it grows.

Concerning research question 3 it was noted that the professional development profile of the LIP participants and, together with the UL participants, their perceptions about the training needs for the DL role are at the background of their views on training needs and the preferred

ways for meeting them. However, the LIP/UL and e-Researcher participants are in agreement on most of the main training areas or components. In terms of the training and development options, the main options divide into personal and organisational opportunities but the views of the LIP/UL and the e-Researcher participants are only similar with regard to some components of the organisational opportunities.

CHAPTER 6: DISCUSSION

6.1 Introduction

The study set out to explore the role of the DL in New Zealand ROs (universities and CRIs) in terms of research data management (RDM). It attempted to answer the following questions:

1. What factors may influence the data librarian role in New Zealand ROs?
2. What are the performance components of the data librarian role in New Zealand ROs and how are these different from those of the RSL role?
3. What is the nature of the training needs of the library and information professionals and what are their options for meeting them in order to play the data librarian role in New Zealand ROs?

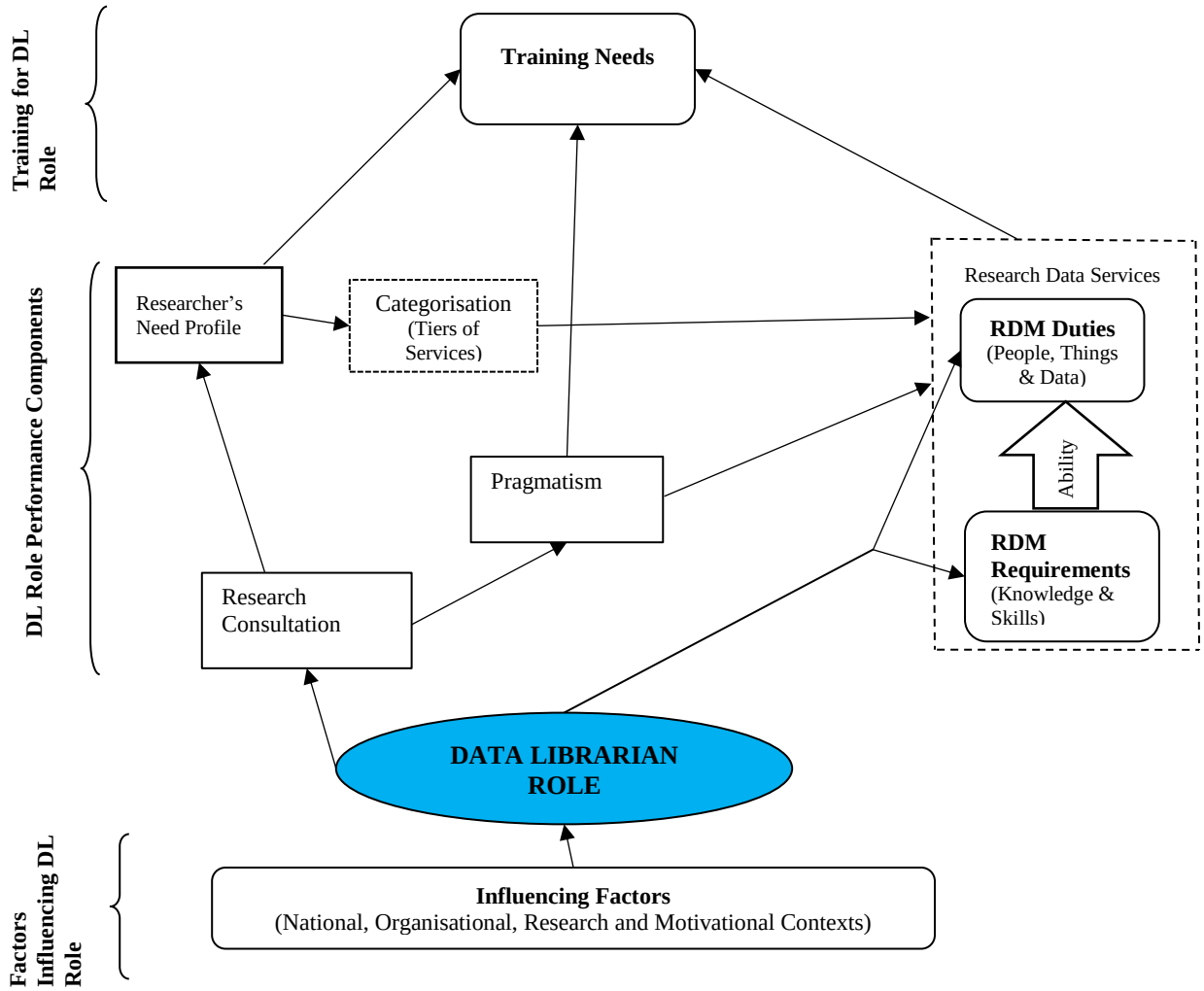
The research approach adopted by the study is the constructivist philosophy combined with case research and a conceptual model drawn from Abbott's (1988) theory, *The System of Professions*. The preceding chapter on data analysis and presentation showcased the findings which provide answers to Questions 1, 3 and partly 2.

This chapter seeks to discuss these findings in the light of a model, the Data Librarian Role Blueprint (the Blueprint), that emerged from the study. The components are described first. This is followed by a discussion of the interrelationships among the main areas of the study and a summary of the model. Next, there is a detailed discussion of the main aspects of the study around which the model is built. Specifically, the discussion of the DL role performance components provides the complete answer to research question 2. Where necessary, the discussions draw from the Triad (perspectives of the literature, experts and employers) presented in Chapter 4 to strengthen or complement the findings. The discussion also extends to other aspects of the study as well as issues related to the model and a demonstration of its fit.

6.2 Data Librarian Role Blueprint

The main aspects of the study around which the Blueprint is built are the influencing factors on the DL role, the DL role dimensions and the training needs for the DL role (see Figure 6-1).

Figure 6-1: Data Librarian Role Blueprint.



The components of the Blueprint are influencing factors, training needs, RDM duties, RDM requirements, research consultation, research data services (RDS), researcher's need profile, pragmatism and categorisation. These are aspects of the DL role which involve supporting the e-Research/RDM activities of clients including academics and researchers. Each of them is discussed below.

6.2.1 Influencing factors.

Influencing factors are the circumstances, facts, people, things, environment, etc. that may either enhance or hamper the DL role in a research organisation. Four contexts of influencing factors were identified in the findings from the study: the national, organisational, research and motivational contexts. These are placed right at the base of the model underneath the DL

role in order to underpin it. Thus, the DL role is shown to be situated within these factors prevailing around a RO. As such, these influencing factors constitute a basic and indispensable consideration that determines the complexion or configuration of the role in any given environment.

6.2.2 Research consultation.

Research consultation describes a discussion or meeting between a DL and researcher(s) in relation to their research needs or requests. The findings show that librarians engage in research consultations with the researchers to address their numerous and varied needs.

Librarians develop and work with some tools such as classification and metadata schemes to describe contents of documents/resources including data. They also work with other tools such as data management planning tools, library guides, indexes and abstracts among other reference tools. However, they do not have any diagnostic classification system or dictionary of professionally legitimate problems in place that could facilitate research consultations.

6.2.3 Categorisation.

Categorisation refers to the analysis and mapping of the researcher's needs to the Reznik-Zellen et al.'s (2012) 'tiers of services' in order for the client to be amenable to RDS from a DL. Although librarians may find some ways to understand the needs of the researchers, the information provided by the participants does not suggest that they do so in any formal ways. However, it is felt that some sort of classification is still needed to facilitate RDS. This is the reason for including the component categorisation in the model. It is an adaptation of Reznik-Zellen et al.'s (2012) tiers of services.

6.2.4 Pragmatism.

Pragmatism means a practical approach to obscure problems/needs of researchers by the librarian based on his/her level of knowledge/skill as well as the opportunities and resources available within his/her service environment.

The findings show that the LIP participants handled obscure research requests from the researchers in a number of pragmatic ways other than inference. They comprise reference interview/research, collegial consultation, connecting researchers (referrals) with contacts or possible sources for further help, and advising researchers about the lack of capacity to help them. The last approach is normally adopted as a last resort. According to Shay (2008), "in general, librarians are curious people" (p. 59) and "the job of a librarian is to help patrons

find answers" (p. 61) within the limits of his/her capabilities and environment. Therefore, s/he may search, consult and do referrals to satisfy the needs of researchers rather than trying to 'infer' answers to their requests. Abbott's (1988) the System of Professions suggested that the practitioners of a profession may infer prescriptions with predictable outcomes in order to gain competitive advantage over possible interlopers of certain tasks from other professions. However, there was nothing said by the LIPs that suggest that was true of them.

6.2.5 Researcher's needs profile.

Researcher's needs profile refers to a summarised description of what is understood by a DL through research consultation to be a researcher's needs or requests. It is the picture generated about the researcher's needs that require RDS. In other words, through research consultation the researchers' needs are met by RDS.

6.2.6 Research data services.

RDS are the services provided by DLs in response to their clients' RDM needs or problems for which they are expected to have the requisite knowledge and skills. RDS involve the two performance components of the DL role that define it. They include RDM duties and RDM requirements.

6.2.7 RDM duties.

RDM duties refer to e-Research/RDM support tasks involving one or a combination of people, things and data. People may be academics/researchers, students, staff, librarians, etc. Things refer to tools such as computers, data management planning tool, metadata schemes, etc. Data may involve data resources in different formats that may be needed for or generated from research.

6.2.8 RDM requirements.

RDM requirements are competences required for the e-Research/RDM support tasks such as knowledge, skills and ability. While knowledge refers to a body of information to be learnt skills refer to the know-how of applying knowledge to accomplish a task. Either or both of knowledge and skills provide the ability to accomplish given tasks.

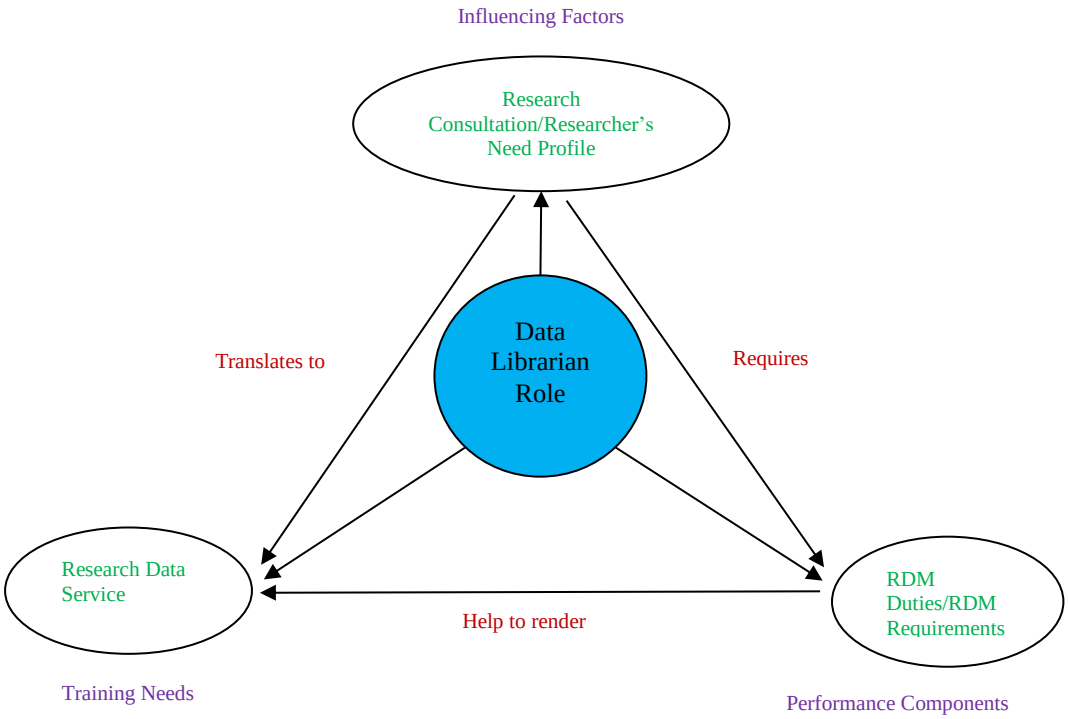
6.2.9 Training needs.

Training needs refer to the gaps in the requirements for the DL role in relation to RDS which they are expected to fill with appropriate training. Researchers' need profiles and RDS are seen to constitute the basis for discovering the training needs of librarians for the DL role.

6.2.10 Main areas of the study.

The main areas of the study around which the Blueprint was developed are related to one another. They are influencing factors, performance components and training needs for the DL role. Within the model, there are relationships between five components. As shown in Figure 6-2, the components comprise research consultation, researcher's need profile, and RDS as well as the two performance components (RDM duties and RDM requirements) within it.

Figure 6-2: The Relationships among the Main Areas of the Study.



Driving the relationships are researchers' needs which belong to the research context of factors influencing the DL role. Researchers are seen to be the drivers of RDM through their research areas, interests and needs. The researchers' needs determine and translate to RDS which require the performance components of RDM duties and RDM requirements in order to be addressed. While the performance components are part of the DL role dimensions,

within the research data service context they help to reveal the requirements that a prospective DL may be lacking. These are his/her training needs.

However, there are a few other relationships between the main aspects of the study that are not easily seen from the model. For instance, the decision on the type and design of training to address the identified training needs depends on organisational factors such as organisational and library leadership RDM buy-in.

6.2.11 Summary of the components of the model.

The Blueprint as illustrated in Figure 6-1 shows that the influencing factors on the DL role are at the base of the model like a foundation of a building. Thus, the DL role is situated directly on top of the influencing factors. Just above the role is research consultation which is the core and starting point of his/her activities in the role. A product of research consultation is the researcher's need profile that could be subjected to categorisation in preparation for RDS. However, obscure problems emerging from research consultations need to be dealt with pragmatically.

However, both the categorised researcher's need profile and pragmatically assessed needs are addressed through RDS. These translate to the duties of the DL for which s/he requires the ability from relevant knowledge and skills. It is what s/he lacks in terms of knowledge and skills within the background of the categorised researcher's need profile and pragmatically assessed needs that shows what his/her training needs may be.

The next sections are devoted to a detailed discussion of the main areas and other areas of the study as well as issues with and the fit of the Blueprint.

6.3 Influencing Factors

Influencing factors are the circumstances, facts, people, things, environment, etc. that may either enhance or hamper the DL role in a RO. The study identified some factors influencing the DL role which fall into four contexts: national, organisational, research and motivational categories. The national context comprises factors such as lack of national leadership or direction in e-Research/RDM, the perception of the PBRF model as well as the activities of professional and research bodies, consortia and interest groups which stem from the lack of an e-Research/RDM leadership role.

The organisational context comprises the following factors: RDM buy-in by both library and institutional leadership, the nature of research support in the research organisations,

collaborations and organisational challenges. Within the research context are such influencing factors as researchers being RDM drivers, a mandate for RDM and the discipline/research areas of researchers.

Finally, factors from the motivational context occur at individual and institutional levels. At the institutional level RDM was seen to be within the remit of academic/research libraries and there was a recognition of RDM policy as a first step to e-Research support. However, the individual level has two aspects. On a general note, the motivation of librarians stems from the understanding that RDM is within their remit. However, in terms of individual librarians, motivation comes from professional interest, background and experience.

The literature component of the Triad also has four contexts of factors influencing the DL role. Broadly, three of these are exactly the same as those identified in the study: national, organisational and research contexts. The only different context is professional context instead of the motivational context. However, the elements within each context, despite having the same name in both the findings and Triad, are different. Some of these are specific to the USA. A few examples are the researchers' view of tenure track faculty librarians as peers on campus and potential collaborators on research (Brandt, 2007) and the incentivising of researchers by national bodies such as the National Science Foundation (NSF) to consider dataset management as an important component of their research workflow (Newton et al., 2011).

Moreover, there are elements within the contexts in the findings that are also found in the Triad. They comprise faculty interest in (researchers as drivers of) RDM, institutional RDM support at the administrative level and collaborations between librarians and researchers, and between libraries of different organisations. Thus it is clear that there could be many factors within a particular context influencing the DL role in any given environment.

However, a closer look at the elements within the contexts from the findings reveal some relationships between the contexts in terms of how they may influence each other and affect the DL role. These are discussed further below.

6.3.1 The Interrelationships within factors influencing the data librarian role.

The influencing factors are interrelated and each relationship may directly or indirectly have a positive or negative influence on the DL role as shown in Table 6-1.

Table 6-1: Relationships within the Factors Influencing the DL Role.

_____ Positive Influences _____

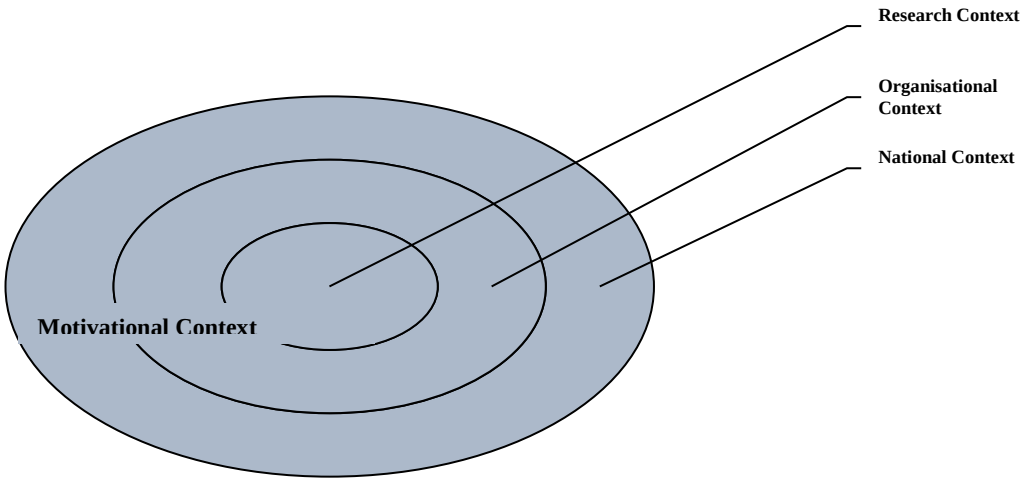
Negative Influences

Matrix Entities	**National Context**	**Research Context**	**Organisational Context**	**Motivation Context**
National Context		Gap-filling role of research bodies, consortia and interest groups		
Research Context			Scope of RDM needs and advocacy for RDM vary according to researchers' disciplines and research areas; RDM should be driven by researchers	RDM mandate from funders, publishers and research communities compels researchers
Organisational Context	Lack of government e-Research/RDM leadership role; Old-fashioned PBRF model			RDM is within the remit of academic libraries and librarians; The recognition that RDM policy is a primary driver; Having some librarians with RDM interest or related background or requisite qualities that can take up RDM role; Library and institutional RDM buy-in; Nature of research support; Collaborations
Motivational Context	Perceived inertia by national professional body (LIANZA)		Organisational challenges	

Generally, the nature of their influence is of two types as it relates to the impact of these factors on RDM which may or may not encourage the existence of the DL role. The top-right-down side of Table 6-1 above embodies factors across all contexts that directly or indirectly have or could have a positive influence on RDM and/or the DL role. The bottom-left-up side of the table features factors from contexts other than the research context that present a contrary picture.

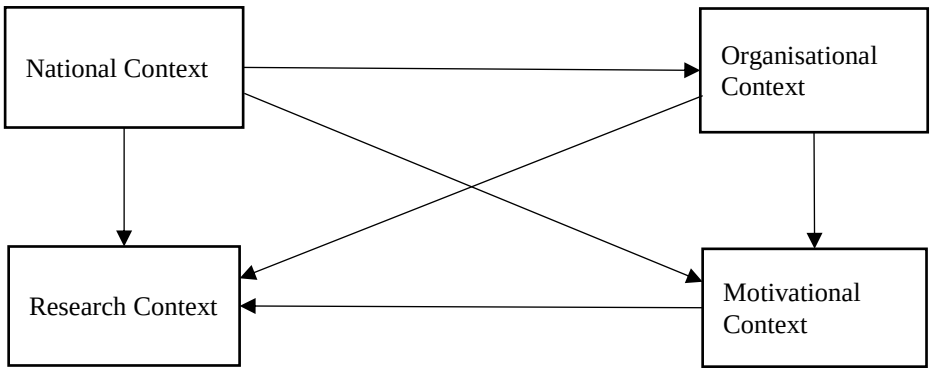
With regard to the influence of the factors on one another, it is clear from Figure 6-3 that the research context is the pivot of these factors via researchers and their needs while the motivation for RDM comes from the organisational and national contexts. These form the inner and outer layers revolving around it respectively.

Figure 6-3: The Pivot of the Influencing Factors on the Data Librarian Role.



Altogether, as depicted in Figure 6-4, there are six identifiable relationships which are discussed under the type of influence each has on the DL role. However, organisational challenges fall under the organisational context vs motivational context relationship and belong to the side of the table with negative influences. Moreover, they could turn positive if addressed. This is part of the reason that it is discussed under the appropriate relationship heading alongside other relationships with positive influences. It is also to avoid discussing that relationship heading under both positive and negative influences.

Figure 6-4: Direction of Influence among the Contextual Factors.



6.3.2 Positive influences on the data librarian role.

Four pairs of contextual factors fall into the category of those that may have positive influences on the DL role.

a) National Context Vs. Research Context

The national context affects the research context in some ways. Research bodies, consortia and interest groups were reported to be involved in some activities as a result of the lack of e-Research/RDM leadership or national direction in New Zealand. The leadership role involves putting a RDM policy framework, funding and service infrastructure in place for researchers in order to incentivise them to do RDM as in the USA, the UK and Australia. In relation to RDM policy, research bodies such as the Royal Society and Health Research Council were reported to have their separate code of ethics for scientists and researchers involving RDM. Without any doubt, this can boost research, although its effect is limited to the areas on which these research bodies focus. Similarly, CONZUL is a consortium reported to have articulated the minimum metadata standards for describing data in the university libraries. This is a tool that could be useful for the DL role in terms of supporting researchers in RDM.

Also, the interest groups such as CRIs' data management group, New Zealand Data Futures Forum and Lincoln Hub were reported to be working on promoting RDM. All of these pockets of development may not have as substantial impact as a national direction in RDM but they are, nonetheless, positive for RDM which enhances the DL role.

b) Organisational Context Vs. Research Context

Many researchers are found in research organisations. It follows that the scope of the need for RDM and/or advocacy for it are dependent on the researchers' disciplines, research areas and interests. Most of the core sciences have a long tradition of RDM and, as such, may need little or no advocacy and help with RDM. Their RDM needs and interest are on a level that is different from those in the humanities or social sciences who may require more advocacy to adopt it. The main idea being conveyed here is that in research organisations where there is a genuine interest, or the need to be assisted with RDM is clearly being expressed by the researchers, the DL role will very easily and readily evolve.

In other words, researchers are the drivers or otherwise of RDM by way of their interest and needs or apathy. This view offered by Hoku, a research participant and a university librarian, was also held by Bresnahan and Johnson (2013, p. 2) who asserted that "researcher needs drive the types of support libraries must provide." If RDM is to thrive, researchers need to be motivated or incentivised. The challenge is on the part of stakeholders including the government, research organisations and academic/research libraries.

c) Motivational Context Vs. Research Context

As a researcher who participated in this research (Sabir) argued, some researchers are highly-driven by what they need to do to get their research grants. Thus, they need that push to get them involved in RDM. This is where a RDM mandate from funders, publishers and research communities becomes very important as they have a compelling influence on researchers. Jones (2012) noted that research funders and journal data policies are now including requirements for data management and data sharing.

However, Erway (2013, p. 13) included these requirements in the elements of the conversation that needs to be had among university-wide RDM stakeholders under the question "what requirements are imposed by others?" Invariably, such requirements are a boost to RDM that will in turn enhance the emergence of the DL role.

d) Organisational Context Vs. Motivational Context

More of the factors within the organisational context have the potential to serve as the motivation to practice RDM and promote the DL role. These are: RDM being seen to be within the remit of academic libraries and librarians; the recognition that RDM policy is a primary driver; some librarians having an interest in RDM or a related background or requisite qualities; the existence of library and institutional leadership RDM buy-in; the nature of research support that could be adapted for RDM; and various collaborations

within/outside the research organisations that could be beneficial to RDM. Each of these needs elaboration.

Heidorn (2011, p. 663) advanced a number of arguments for libraries to curate digital research data including that "curation of data is within the libraries' mission, and libraries are among the only institutions with the capacity to curate many data types." Therefore, a recognition that RDM is within the remit of academic libraries and their librarians is a conceptual positioning that is positive for the DL role.

In terms of policy as a primary driver of RDM, nothing more needs to be added to Higgins' (2012, p. 20) comment that:

> Data management is best facilitated by a series of documented policies, strategies and procedures, and may not in fact be viable without them. Policies at organisational level or research funder level, underpin the activities required, ensuring that they are embedded into a research organisation or university's workflow. A high-level policy environment can be critical in ensuring that digital curation is given the support it requires through strategic and financial planning.

Furthermore, it is of great advantage to have librarians with an interest in RDM or a related background or requisite qualities. This is because less time and money may be required to prepare such staff for the DL role. Someone with an interest does not need any persuasion in the area of his/her interest. S/he only needs motivation by way of relevant resources/tools as well as administrative and training support to get started. Personal initiative and professional interest featured prominently within the experts' component of the Triad.

The library and institutional leaderships' RDM buy-in was a factor with positive influence on RDM that was also found in the experts' component of the Triad. However, regarding the institutional leadership, Soehner et al. (2010, p. 9) proffered that "without faculty and institutional engagement, libraries will find themselves preaching about the importance of data curation, preservation, and access without making an impact."

However, the nature of the research support in place is important in relation to starting an involvement with RDM. This is seen from the findings in terms of having a bearing on the intended support approach. For instance, a majority of the research organisations chose to use their subject librarians or their equivalents for the DL role. Also, Hoku was of the view that only a little needs to be done including mandating RDM for repositories to be used to manage

research data. This echoes Wong (2009) and Henty (2008) who revealed that institutional repositories are currently being utilised to actively support the e-Research lifecycle.

In terms of collaborations, the findings reveal that different types of collaborations in which the research organisations are involved can have positive RDM outcomes and aid the institutionalisation of the DL role. The first is collaboration between librarians and researchers in the research organisations which could be extended to the area of RDM. The experts within the Triad reported that their researchers have a positive perception of librarians as collaborators in the research process. Such researchers would readily engage with the librarians for RDM purposes. Also, there is evidence from the literature to corroborate this. Brandt (2007, p. 367) provided the example of Purdue University Libraries: "a common question is, 'How do you get started in these collaborations?' It helps that Purdue librarians are tenure track faculty and are seen as peers on campus."

The second type of collaboration mentioned in the findings is that between the library and other units of research organisations such as research offices, ITS, faculties, research centres, human ethics committees, and science and legal teams. Erway (2013) was of the view that there is a need for conversation among the major university-wide RDM stakeholders, including some of these units, to make sure that their university realises the perceived benefits from funding mandates. This collaboration is very important as every stakeholder has an important part to play in the space where a DL role exists.

The last type of collaboration found is that between the libraries of research organisations or between the research organisations. The latter is of three types: collaborations among the universities, among the CRIs and between the universities and the CRIs. These are mainly consortia and interest groups. Notable among them are CONZUL, RNZ (the CONZUL equivalent for the CRIs) and the Lincoln Hub[29]. The expectation is that CONZUL and RNZ should be able to work together to exert some influence on the government regarding RDM in the way that ARL does in the USA or the research library community does in Canada and Australia (Higgins, 2012).

Apart from the above aspects, there is one element within the organisational context that could influence RDM and affect the DL role either positively or negatively depending on whether it is addressed. It is the organisational challenges in relation to librarians, the

[29] These were discussed in detail in Section 5.2.1.2.

researchers, the management, and the required infrastructure and framework. Those that involve librarians comprise low staff numbers, knowledge/skill gaps, and funding, time and method for training/developing or hiring of librarians. In relation to the researchers, there could be a lack of interest in RDM and apprehensions regarding data ownership. Some of these challenges may not be within the jurisdiction of the library to address but, at least, they require RDM buy-in, strategic initiatives and advocacy on the part of library management. These requirements are more important in cases where uninterested institutional leadership needs to be won over in order to provide the necessary funding and technical and policy infrastructure for RDM.

6.3.3 Negative influences on the data librarian role.

Two pairs of factors that may have negative influences on the DL role are discussed below.

a) National Context Vs. Organisational Context

The perception of the lack of a national e-Research/RDM leadership role results from the non-existence of any national focus or centralised approach in terms of putting a policy framework, funding and service infrastructure in place for e-Research/RDM. The non-existence of these, particularly a policy framework, is a disincentive on the part of researchers to not do RDM which in turn frustrates and hinders or delays the emergence and thriving of the DL role in the ROs. Higgins' statement in the previous section shows the need for a national RDM policy in New Zealand. Also, all categories of the research participants recognised putting RDM policy in place as a first step in e-Research/RDM support[30].

Generally, a policy is an official empowerment, mandate or justification for entities to work towards a given goal. It is also a yardstick for appraising actions. Such policies will normally specify mandates, responsibilities, reasons, expectations, and parameters and requirements such as a budget. In other words policies do not only bring the desired things into being but they also facilitate their operation. These advantages of a policy may be the reason why it must be in place as an incentive to RDM efforts. Where a RDM policy is in place researchers will be mandated to do RDM[31] and the authorities will be compelled to provide the required resources. This will naturally intensify the need for the DL role.

The literature shows that in different places the library community has played a key role in influencing national data policy in line with Lewis' (2010) Pyramid. For instance, Corrall

[30] See Section 5.2.3.1b for detailed information on this.
[31] See also Section 5.2.2.1 in relation to researchers' drivers.

(2012, p. 111) reported that "librarians in the USA have worked through the ARL (*Association of Research Libraries*) to influence national developments in research data management." Higgins (2012) also provided information about similar developments in terms of strong representation of the research library community on the Government's Research Data Strategy Working Group and the Steering Committee of the ANDS in Canada and Australia respectively. Sapna from the experts' component of the Triad mentioned that ANDS, set up by the Australian Government with funding up to 2015, has been pivotal in supporting and raising the profile of data librarianship and digital librarianship in Australia.

Therefore, a national policy framework, funding and service infrastructure for research, and RDM in particular, should constitute a major area for advocacy by CONZUL, a committee of Universities New Zealand. When in place, a national research (data management) policy, funding and service infrastructure will have a positive impact on the researchers and RDM within the research organisations as well across the country. This will boost the DL role a great deal.

b) National Context Vs. Motivational Context

The LIPs that participated in this research expected LIANZA (Library and Information Association of New Zealand Aotearoa) to play some roles in RDM but were disappointed by their perception of its inertia. Their expectations are that LIANZA should act as a lobbying force for advocacy, advise the Library School at Victoria University of Wellington through an advisory or steering committee with respect to developing lectures for the up-skilling of librarians in areas such as e-Research, and play a RDM leadership role to the extent of offering RDM courses for librarians.

Professional associations at different levels play vital roles in the areas of their interest as well as the development of their profession. Thomas, Satpathi, and Satpathi (2010) discussed the role of library associations in professional development within the context of emerging challenges in academic librarianship. While admitting that self-education and self-motivation are helpful, the authors pointed out that what the majority of professionals require is external assistance which needs to come from professional associations. Although these authors focused on a case study of the Indian Association of Special Libraries and Information Centres (IASLIC), they discussed the activities of IFLA (International Federation of Library Associations and Institutions), ALA (American Library Association) and CILIP (Chartered Institute of Library and Information Professionals) in the education and training of

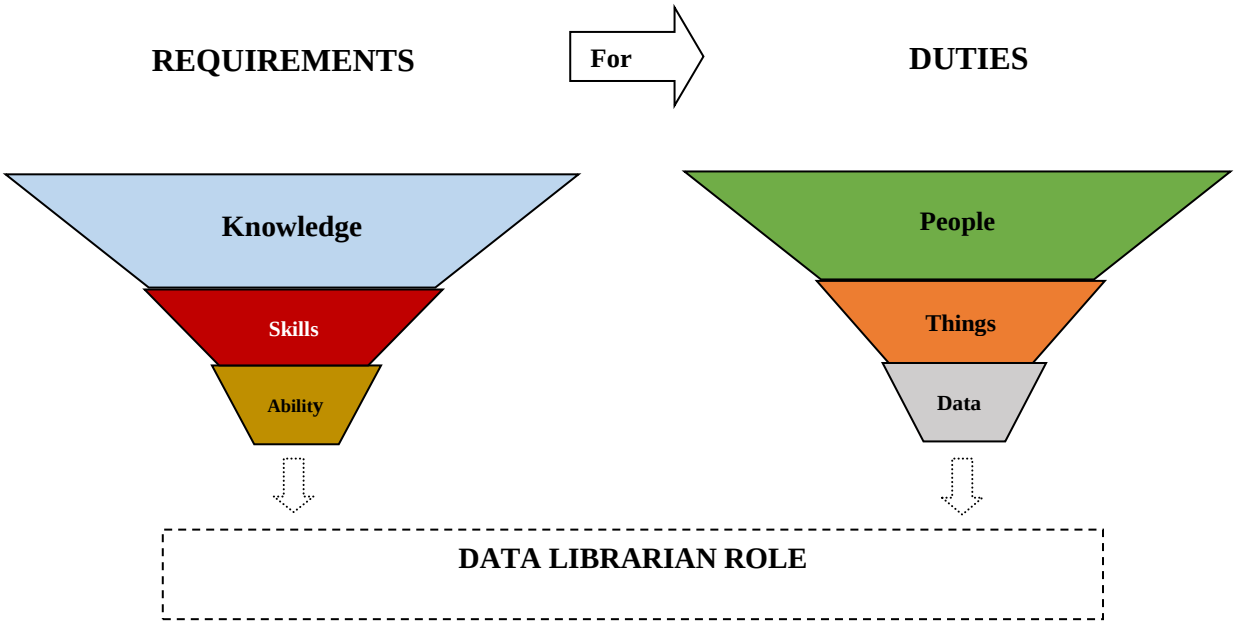
professionals. These activities comprise: publications; production of continuing education resources; provision of continuing education in a variety of venues and formats; development of competency statements; organising of conferences, training programmes, courses, workshops, and seminars; executive briefings/masterclasses; and webcasts.

However, in the case study IASLIC organised training programmes, seminars and workshops, and study circles. LIANZA may borrow some of these options that may be novel in addition to the usual options and decide on the best way to be involved in RDM for the benefit of librarians in New Zealand. The educational roles of a library professional association such as LIANZA can be summed up as the accreditation of formal programmes in librarianship, and the certification and continuing education of librarians which Lynch (1987) discussed.

6.4 Performance Components

Based on the Kim et al.'s (2011) job analysis framework, the DL role has both work characteristics and worker characteristics that respectively refer to the performance components of duties and requirements as can be seen from Figure 6-5.

Figure 6-5: The Performance Components of the Data Librarian Role.



Below, the performance components of the DL role are separately discussed in detail. Next, they are compared with those of the RSL in order to fully answer research question 2: *What are the dimensions of the DL role in New Zealand ROs and how are these different from*

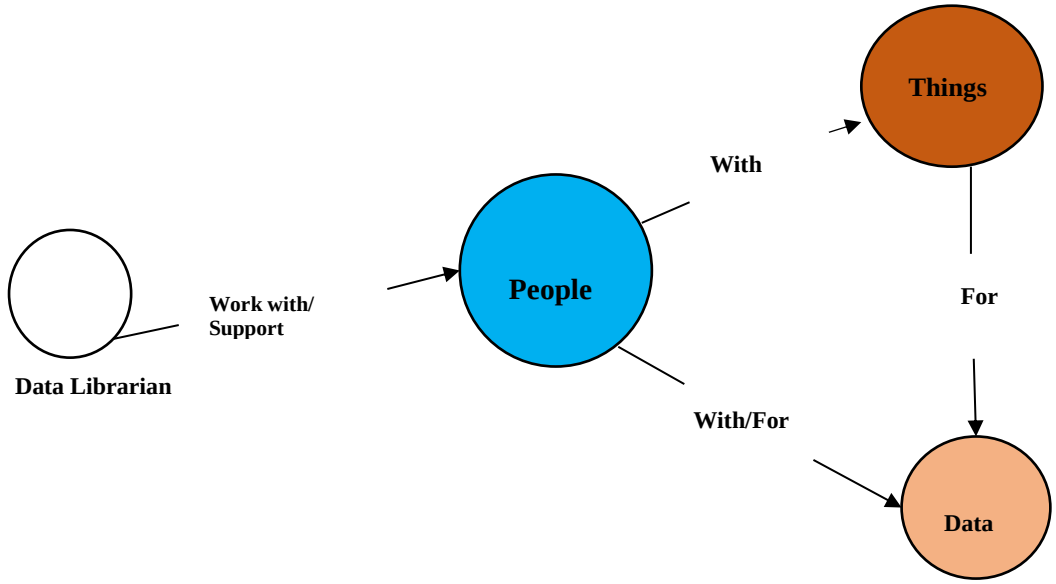
those of the research support librarian? Finally, the kinds of librarians preferred for the DL role are discussed.

6.4.1 The duties of the data librarian role.

The work characteristics refer to a worker's responsibilities or duties respectively involving people, things and data. The findings show more people-related duties than thing-related duties. However, there were no direct data responsibilities besides supporting researchers with tools in terms of data-related needs. The same pattern is also discovered within the experts and employers' components of the Triad. However, the Triad has elements within data duties such as *audit data*, *collect data*, *store data*, *describe/manage data*, *analyse data*, and *present data*. The pattern of having more people-related duties than other types of duties was also reported by Addom, Kim and Stanton (2011, p. 631).

Therefore, the general idea is that people such as colleagues, academics or researchers and students constitute the major focus or target of the services of the DL role. While data-related duties represent the goal and, in some particular instances, the means for meeting the research needs of their clientele, thing-related duties only constitute the means for meeting those data needs. Figure 6-6 depicts the relationships within the DL duties.

Figure 6-6: Relationships within Data Librarian Duties.



Researchers need data which are part of the scientific record for obvious reasons. Lynch (2009, p. 178) claimed that RDM hinges on the purposes of the scientific record:

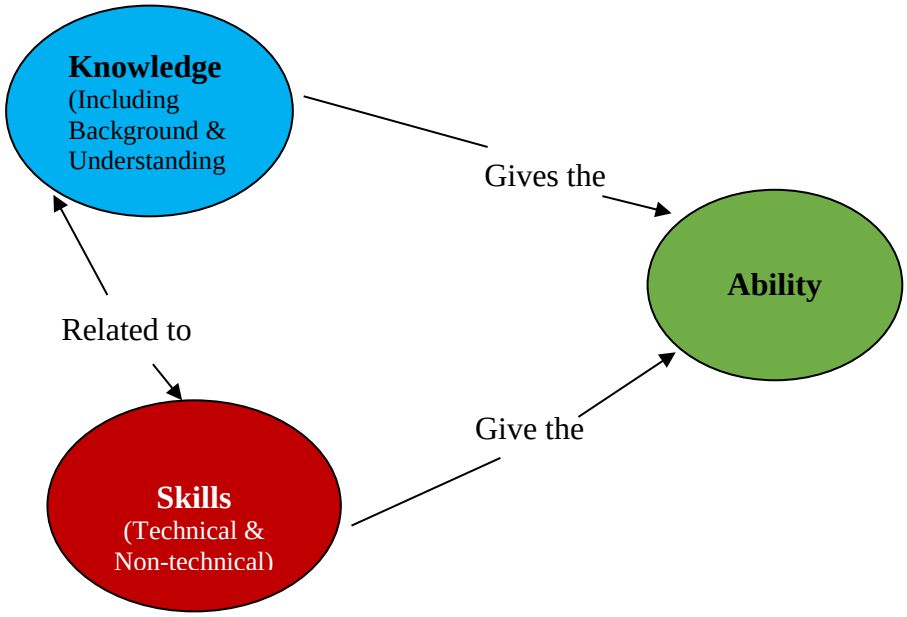
- to communicate findings, hypotheses and insights from one person to another, across space and across time;
- to be a vehicle for building up communities;
- to be a vehicle for a form of large-scale collaboration across space and time;
- to establish precedence for ideas and results; and
- to enhance reproducibility which is tied to trustworthiness, collaboration and building upon the work of others.

Moreover, the capture, dissemination, stewardship and preservation of digital data constitute critical issues in the development and sustainability of e-Research (Carlson et al., 2011, p. 630).

6.4.2 The requirements of the data librarian role.

The worker characteristics refer respectively to a worker's requirements including knowledge, skills and ability. Since supporting e-Research/RDM is believed to be within the remit of libraries, during data collection it was taken for granted that librarians have the requisite background from their professional education and experience. As such, their qualifications were not investigated. Otherwise, knowledge and skills are normally acquired through qualifications and/or experience as could be seen within the Triad. Depicting the findings, Figure 6-7 underlines the importance of knowledge and skills which are related as they provide the ability to carry out the different types of RDM duties.

Figure 6-7: Relationships within Data Librarian Requirements.



This brings a new understanding about ability that is different from its original meaning clarified by Kim et al. (2011, p. 129) as "one or more intrinsic talents an individual possesses." Instead, from the findings of this study ability is understood to mean having the power or capacity to do something through the acquired knowledge and/or skills. For instance, *technical* knowledge gives the ability *to use technology*. Likewise, knowledge of *metadata* and possession of metadata skills within *citation tools* combine to produce the ability *to catalogue*. Furthermore, *people* skills give the DL the ability *to relate* and *to communicate* with the academics or researchers but together with a *background in information literacy* and *liaison* they extend the ability *to communicate* to include teaching data literacy to the researchers.

Similar examples are also found within the Triad. A few of them are worth mentioning. First, possessing knowledge of *information technology* with *computer literacy* and *system administration* skills provide the ability *to exploit technologies*. Second, knowledge of *information literacy* together with *teaching* skills leads to the ability *to provide instruction*. Third, having a *background in an information profession*, and *reference interview* and *information retrieval* skills provide the ability *to provide reference* services. Finally, possessing knowledge of *analysis* and *analytical and problem solving* skills lead to the ability *to problem-solve*. This new understanding is very much in tandem with one of the definitions

of ability as found in *Chambers 21st Century Dictionary* (2007) "the power, skill or knowledge to do something".

However, it is worth noting that, although it is the only non-technical skill mentioned in the findings, people skills, specifically interpersonal and communication skills, were discovered to be a common skill requirement for the DL role. Interestingly, interpersonal and communication skills constitute a common denominator within the Triad. In the employers' component of the Triad, they are the most common required skills (86%) while the e-Research experts mentioned them as the most critical skill requirement. One of the e-Research experts succinctly described these skills thus:

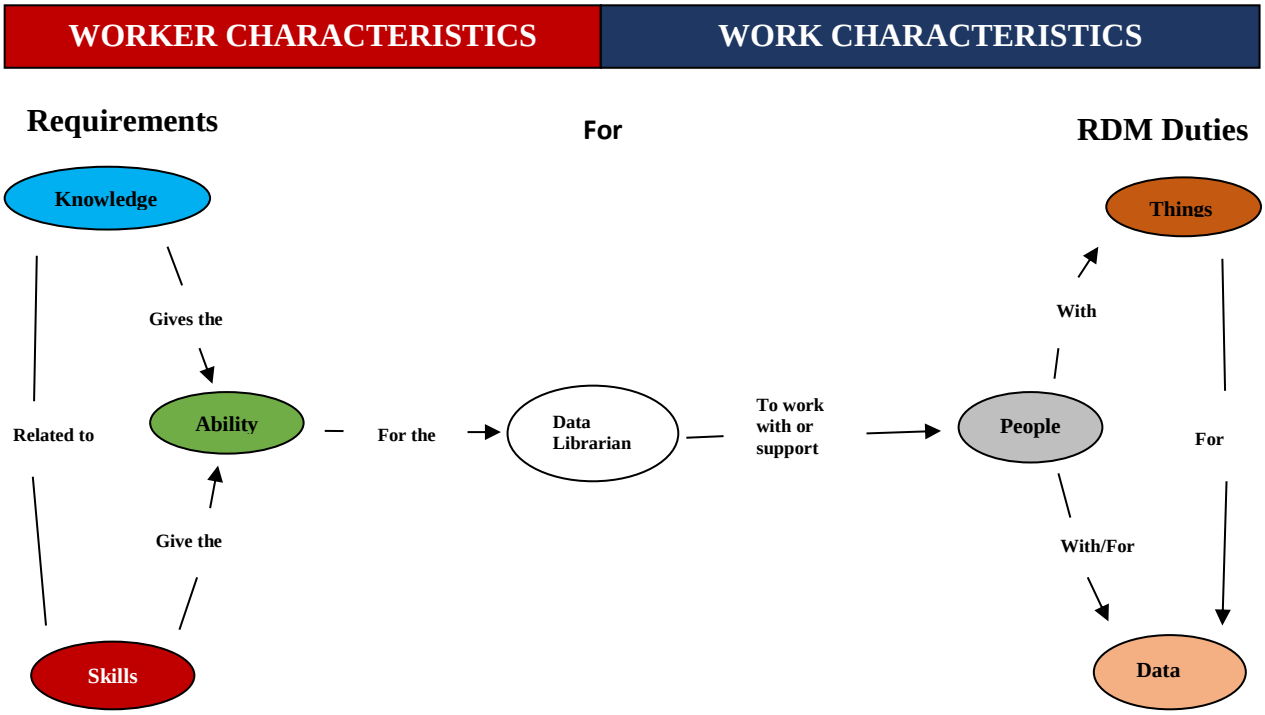
> I think, we are talking about training and communicating with scientists. Communication skills, I think, are really, really important in this area. If you cannot communicate with the scientists, you cannot work in this area as a librarian. It is really that important. (Mael).

Drawing on their background in librarianship and work experience in the field of e-Research, Simons and Searle (2014) included 'high level communication skills' in their discussion of the core set of skills and knowledge required within the generalist e-Research support role. They provided the insight that librarians need communication skills because in their roles they interact with a wide range of people both within and outside their organisations so their positions may require persuasion, negotiation, advocacy, providing training sessions, giving webinars, presenting or speaking at meetings such as conferences, describing things, and translating information such as user requirements between two groups. In other words, the ability of the librarians to play the DL role is also related to having interpersonal and communication skills.

6.4.3 The relationship between the data librarian duties and requirements.

Figure 6-8 represents the relationship between the DL duties and requirements. This is a fusion of Figure 6-6 and Figure 6-7. Thus, these requirements are needed for responding to the RDM duties.

Figure 6-8: The Relationship between Data Librarian Duties and Requirements.



However, it must also be noted from the diagram that ability is where duties and requirements connect directly. Therefore, RDM duties require the DL to have the ability to render RDS for which s/he must possess the relevant knowledge and skills such as emerged from this study. For instance, *technical* knowledge gives the ability *to use technology* which is helpful in the responsibility to *manage systems*. Also, knowledge of *metadata* and possession of *metadata* skills will translate to the ability *to catalogue* which is relevant for the responsibility to *apply metadata standards*. Similarly, within the Triad, the knowledge of *information literacy* together with *teaching* skills leads to the ability *to provide instruction* which helps in the responsibility to *train or instruct*. Also, a *background in the information profession* with *liaison* skills provides the ability *to liaise* which helps to *serve as a liaison*.

6.4.4 Comparison between the performance components of the research support librarian and data librarian roles.

The comparison of the performance components of the RSL and DL roles is drawn from a look at the elements of their duties and requirements from Tables 5-7 to 5-11 in Section 5.3.1.3 and Tables 5-18 to 5-22 in Section 5.3.2.3 respectively. Table 6-2 shows the dimensions of their duties in juxtaposition while Table 6-3 shows the juxtaposed dimensions of their requirements.

Table 6-2: The Duties of Research Support Librarians and Data Librarians.

Duties	Research Support Librarian	Data Librarian
People-related	Training/Education Research project Research needs Support/Advice Reference service	Training Research needs Liaison Data management
Thing-related	Metadata Databases Technology Guides Staying current Document services Access Collection development	Metadata standards Systems Tools
Data-related	No direct data responsibility except willingness to help with sourcing of published/available datasets if requested	No direct data responsibility except advising or supporting researchers with tools for data-related needs.

Table 6-3: The Requirements of Research Support Librarians and Data Librarians.

Requirements	Research Support Librarian	Data Librarian
Knowledge	**Knowledge/Understanding:** Background in information professions; Computer Research Publication Research profiling tools Technology Tertiary education sector Collection and systems Rights	**Knowledge/Understanding:** Background in information literacy; Liaison Research/Scholarly publication Researchers (needs) Technical Science and Statistics Data Metadata
Skills	**Technical:** Training, facilitation and promotion Research Metadata IT Reference interview **Non-technical:** People Personal	**Technical:** Training/Data literacy Research/Searching Citation tools Databases Keeping up to date Project management Data **Non-technical:** People
Ability	Work with research tools Work quickly Synthesise lots of information	Communicate Relate Liaise Use technology Catalogue

It must be observed that the dimensions of the RSL role apply more to research generally while those of the DL, especially in the people and thing (duties) categories, revolve around datasets and their management. As such, the research support environment is a general

background that is relevant for the DL role. However, a closer look at the duties and requirements of both reveals three things to be discussed in this section.

First, there are some elements of particular categories that appear in the two roles. With the categories in parentheses, these are *training* (people and skills), *research needs* (people), *metadata* (things), *research* and [scholarly] *publication* (knowledge), and *research* [and searching] and *people* (skills).

Second, there are elements of some categories of the DL role that correspond or can be mapped to some elements of the same or different categories of the RSL role (in parentheses). In the ability category the elements *communicate, relate* and *liaise* correspond to *people* (skills), *use technology* corresponds to *work with research tools* (ability) and *catalogue* is the same as *catalogue* (things). In terms of the knowledge category the elements *information literacy* and *liaison* point to specialisations within *background in information professions* (knowledge). Also, *researchers* [needs] relate to *research needs* (people), *support/advice* (people), *reference services* (people), *reference interview* (skills), *research profiling tools* (knowledge), and *document services* (thing). In addition, *technical knowledge* embodies *computer* and *technology* (knowledge), *IT* (skills) and *databases* (things). Lastly, *scholarly publication* can include the aspects of *rights* (knowledge) and *publication support* (skills).

Considering the skills category, *keeping up to date* within the research landscape includes *staying current with research tools* (things). Meanwhile *database* skills are required for working with *databases* (things) and *project management* is applicable to *research projects* (people). For the people category, *liaison* can be linked to *people* (skills). However, in terms of the thing category, while systems include *computer* (knowledge), and *databases* and *technology* (things), there are different kinds of tools of which *guides* (things) are one.

Finally, the observation which fully answers research question 2 is about the elements that are specific to the DL role. They include *data* (knowledge and skills), *data management* (people), *data literacy* (skills), and *science and statistics* (knowledge). Moreover, although *citation tools* include metadata schemas and catalogue application and management, generally, the implementation of DOI for datasets is specific to the DL role. Overall, the support service aspect in data and RDM is a major difference between the specific DL role and the more general RSL role. Also, the requirements for qualifications and experience were found only in the RSL role. Although they are not part of the Kim et al.'s (2011) framework, they are worth reporting on.

6.4.5 Librarians for the data librarian role.

As presented in Section 5.3.2.2a, the findings reveal that the majority of the research organisations felt that the DL role should be a team or group role embedded into the role of subject librarians or their equivalents in the CRI. Some factors gleaned from the findings are responsible for this position on the embedded subject librarian model. First, the role was conceived to be at the institutional rather than individual level. Second, it may be more economical and logical to use the existing support service structure. Third, as the library's interface with the researchers, the subject librarians have longstanding relationships with and understand the needs of researchers and have earned their trust so it makes sense to extend this relationship to the aspect of RDM. Fourth, there is the danger of no real transfer of knowledge and skills in case someone with specialist skills leaves the organisation. Finally, there is no one encyclopaedic person with enough background in all subject areas to comfortably handle the nuances of disciplines for which the subject librarians are suited.

However, it must be re-emphasised as discussed in Section 5.3.2.2a that the convenience and logic of using the existing support service structure is the main reason for the choice of subject librarians for the DL role. This view is also supported by the literature. The works of Cox et al. (2012), Bresnahan and Johnson (2013), and Johnson and Bresnahan (2015) focused on the scholarly communication and research data training needs and upskilling of liaison/subject librarians for RDM. Newton et al. (2011) reported on Purdue University's model of librarian roles in institutional repository dataset collecting. The report revealed that the e-Data Task Force was made up of five main subject librarians with background in the areas of the data they collected and two additional subject librarians. Also, within the general framework of re-skilling subject/liaison librarians for research, Auckland's (2012) research showcased in the findings of its second work package a considerable skills gap in nine key areas of RDM considered for future involvement by subject librarians.

However, embedding e-Research/RDM support into the subject librarian role is not the only option available. Although Cox et al. (2012) focused on subject librarians they admitted that:

> Within LIS teams, one person might see RDM as about IL [information literacy] another about metadata. Another person might play an expert role, keeping others abreast of wider developments. While all RDM activities align in some ways to existing roles [of liaison librarians], some do not do so in a simple way.

In other words a team of people with different backgrounds than or including subject librarians can also be made to play this role. However, the findings of this study include two conditions within which a specialist individual DL role can exist in New Zealand ROs. The first condition is where the DL is brought short-term to train staff on RDM. The second condition is when there is an increased role of supporting RDM and there is the need to create unique jobs for it such as the DL position. The Employers' component of the Triad contains four categories of specialist individual positions in the USA[32].

From the above, it is clear that there are various options for choosing what works best in a given environment.

However, this choice depends on either of two positions one takes on the training of librarians for RDM that Corrall (2012, p. 126) discussed. This was highlighted earlier in this thesis. One position is training library professionals to work in digital or data curation while the second is training digital or data professionals (experts). Library managers who favour the first position are likely to up-skill their existing staff, whether subject librarians or not. This translates to either an embedded team/group role or an embedded specialist role such as Subject-related or Hybrid Librarian Positions that were mentioned above. Those who favour digital or data professionals or experts are likely to hire data librarians in the mould of the General Non-management and Management Positions also mentioned above. Such staff can work in collaboration with subject librarians and/or any other category that may be needed.

6.5 Training Needs

The training of librarians or re-skilling or up-skilling for the DL role is a key to positioning them for the role. It entails an understanding of the duties and requirements of the role as discussed in the last section (6.3.2) and weighing the toolkits of the prospective librarians against them. Any gaps discovered in that regard constitute their training needs. The following parts of this section discuss the findings on the training needs for the DL role, the options preferred by the participants for addressing them as well as how these relate to Lindsay's (2013) The Professional Learning Iceberg[33].

6.5.1 Training needs for the data librarian role.

Since the services of librarians are patron-driven it is of great importance that their needs should be a major consideration for the librarians' training. Research question 3 is *what is the*

[32] See Section 4.3 for details on them.
[33] The Professional Learning Iceberg is discussed in Section 6.5.3.

nature of the training needs of the librarians/information specialists and what are the preferred ways for meeting them in order to play the data librarian role in New Zealand research organisations? The views of the participants about the training needs for the DL role have been triangulated. The participants include the LIPs and ULs on the one hand and the e-Researchers on the other hand. Eight main areas of training needs were identified together with their elements:

1. Research (understanding the research space including research cycles, research project management and e-Research)
2. Technology (understanding basics around technology, available tools, what needs to be done with HPC, and engaging with ever-changing technologies)
3. Information management (understanding of information governance and access principles or [international or existing] standards, basics around domains, information management and informatics, and understanding interchange standards)
4. Research data (research data, data collection and its purpose, research data curation and management, data literacy, machine discovery, and business analysis)
5. Metadata (metadata standards)
6. Organisational knowledge (including policies that govern various aspects of the organisation)
7. Customer relationship (including customer training)
8. Interpersonal and communication skills

Although they were not specifically mentioned by the participants as a training need but because they were deemed a critical skill requirement, interpersonal and communication skills were added to this list.

Similarly, information from the e-Research experts within the Triad reveals that their needs are varied and specific to each person. However, only *metadata* and *organisational knowledge* correspond with the findings listed above. Other training needs mentioned by the experts are *knowledge of the Semantic Web and RDF*, *business analysis*, *operational service supervision*, *legal aspects*, and *understanding the Australian higher educational environment*. In terms of the literature, potential training needs are mostly discussed in the form of recommended courses or topics, areas of required competences and elements to be included in the training of librarians for a role in RDM (Cox et al., 2012; Kim et al., 2011; Paris, 1996).

The various training needs mentioned in the above discussion were identified through interviews with experts and a literature review. However, from the literature other ways that they could be identified include interviews with focus groups and internship (Kim et al., 2011) and surveys (Auckland, 2012; Bresnahan and Johnson, 2013). It follows that any method that may be considered suitable and workable in the relevant environment should be employed. However, a comparative view shows that surveys are mostly relevant where a set of required competences for a role are already known so that the participants are evaluated on that.

Nevertheless, identifying training needs is the first step in the up-skilling for the DL role but the next step is picking the appropriate training mode from available options. The next section focuses on the options preferred or suggested for training for the DL role.

6.5.2 Training options for the data librarian role.

The findings reveal two broad training options filtered from the synthesised views of LIPs/ULs and e-Researchers. They comprise personal opportunities and organisational opportunities. However, while personal opportunities are exclusive to the LIPs/ULs common grounds between the LIPs/ULs and e-Researchers can only be found within the organisational opportunities.

Personal opportunities comprise self-development opportunities such as working with librarians and other professionals who are experts in the area, getting exposed to other support services in the area, conducting some research with technology for hands-on experience, and personal reading. They also include talking to researchers about how they use data, the practices they use to manage data, and what sort of tools or programmes they use among other things.

Organisational opportunities include both those provided directly and indirectly by the research organisations: organisational support for training in the form of sponsored formal learning such as courses or training programmes as in a university or in-house training or bringing in an expert singly or in partnership with other libraries; exchange course arrangements with other libraries or places doing RDM; sponsorship to attend professional meetings such as conferences and workshops; professional collegial or peer support to someone new to a role; and learning on the job through opportunities such as (pilot data management) projects and conferences. Some of these options have been discussed by Read (2007, p. 64) and Simons and Searle (2014, pp. 10-13). However, most of the LIPs/ULs

preferred librarians to learn on the job through various but mostly informal opportunities. As such, designing courses for them in the form of open educational (Cox et al., 2014) or online (de Smaele et al., 2013) resources appears more suitable.

It must be noted that the experts within the Triad also favoured such options as conferences and professional networks, training courses, online courses, self-learning, and project experience which can be summed up as learning on the job. Furthermore, Corrall et al. (2013, p. 662) surveyed the bibliometric and data support activities of one hundred and forty libraries in Australia, Ireland, New Zealand and the UK and reported that 8 surveyed libraries in New Zealand favoured the 'learn on-the-job' option for current staff education on RDM support. This preference for the training option by prospective trainees is also a very important consideration in this respect as exemplified by Bresnahan and Johnson (2013) and Johnson and Bresnahan (2015) since it allows convenient learning in a secure environment that facilitates learning, understanding and learning outcomes.

While it is clear that there are various alternatives within the two main training options from the findings any choice should be based on what is appropriate for the organisation as well as the environment in which it is located. For instance, the findings identified some challenges in the training of librarians for the DL role in New Zealand ROs: lack of formal training opportunities in New Zealand; the task of convincing prospective librarians to buy into the DL role; the likely demand (time and workload) of the DL role on existing staff, and lack of (national or organisational) RDM policy incentives. Some other considerations are the nature of the training needs as well as the available organisational resources, and organisational culture and structure.

Focusing on designing a training programme for interpersonal skills training for librarians, Odini (2007, p. 8) advised taking organisational objectives, and financial and time commitments into consideration. Odini (2007) believed that external courses conducted away from the work area are unnecessarily expensive and, thus, favoured in-house training. The findings indicate that one of the case institutions, UN3, already does this. It developed an in-house training programme in RDM titled Data Literacy 101 and trained the subject librarians with it.

However, some useful training strategies were provided by Paris (1996, p. 9-10). Although her primary context was South Africa, some of her conclusions may be generally applicable. First, the training or retraining of librarians "…should be done in line with the needs of those

wanting and needing the services" and, as such, should address all levels and needs. Second, information technology and other mechanisms should be applied to enhance the development process of information seekers. Paris (1996, p. 10) added that stakeholders within the field of Library and Information Services that should assist in training, including library associations, are:

> the vendors of technological and commercial products - by giving basic training in their software; library schools - by updating and redesigning curricula as the changes in the information provision environment occur; University and Academic Library Administrators - through strategic planning of in-service training programmes in word processing, database, online network searching and information management skills; and finally Government Departments who should make the necessary funds available to acquire the technology and training facilities needed to empower and build the capacity of academic librarians.

A group of academic libraries can initiate a collaboration with all these stakeholders or push for a collaboration coordinated by the professional association depending on whatever works best in New Zealand.

There is a need to end the discussion in this section by considering a few things specific to interpersonal and communication skills since they are critical to working with researchers. Interpersonal and communication skills point to people skills that enable interaction between a person and one or more others. Odini (2007, p. 8) revealed that many librarians and information workers do not admit that they require training in interpersonal skills. However, he argued that they need to be competent in interpersonal functioning and their organisations must design or organise training programmes which respond to real learning needs in interpersonal skills training.

Odini (2007) discussed a number of reasons why interpersonal skills are very important. These include: information work is a people-directed profession involving social and communicative interactions that require them; they lead to great organisational development; they lead to better customer care; they help to reduce unnecessary conflicts in the organisation; they lead to competence in dealing with special groups; they facilitate unity, cooperation and team spirit; they help staff become and remain cost effective through their ability to exploit and present available information to clients; and they enable staff to redefine and project a good image of their library.

Cronin and Martin (1983, p. 118) provided some tips for implementing a social skills training programme that may be applicable to interpersonal and communication skills in particular:

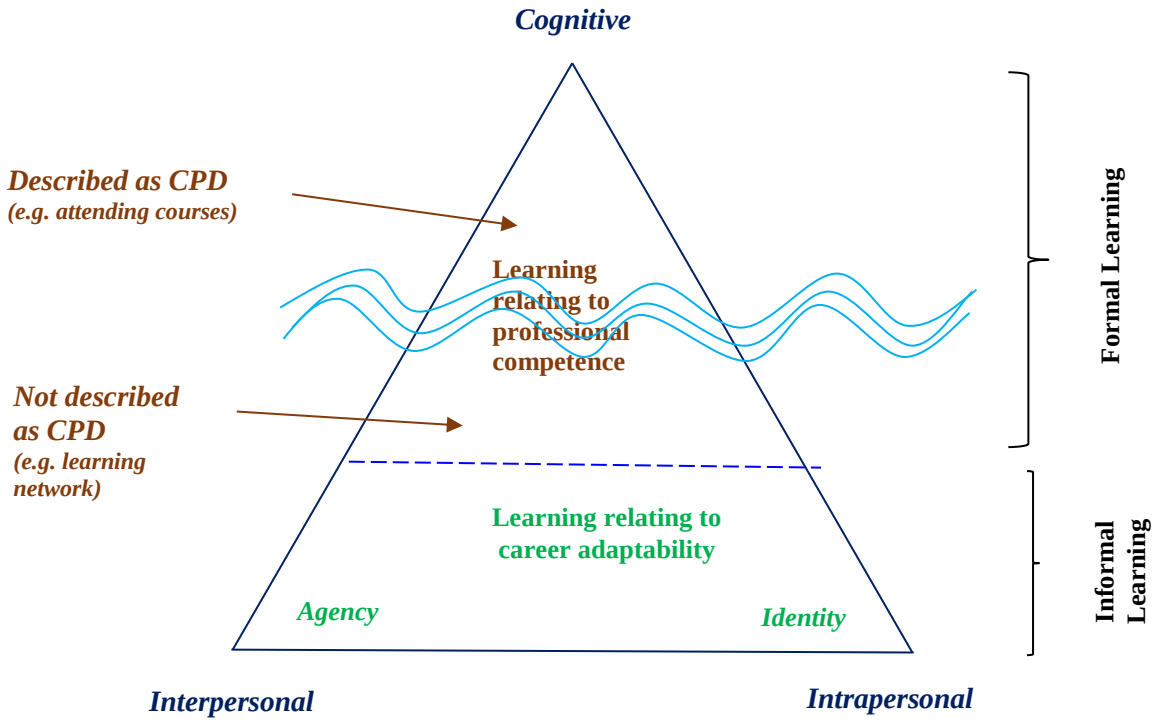
1. Appoint someone to run the programme (*as a training manager*).
2. Carry out a situational analysis of routine social interactions involving public service (*prospective data role*) staff.
3. Identify the principal categories of social (*interpersonal and communication*) skills required by library staff to function successfully in a particular work environment.
4. Profile the social (*interpersonal and communication*) skills competence of staff.
5. Prepare an introduction for (*prospective data role*) staff to the whole question of social interaction and its practical relevance to librarianship.
6. Determine whether the training programme will be based on 'live' performances, simulations, or a mixture of the two approaches.
7. Devise modelling exercises so that staff can identify the responses appropriate to a variety of librarian-client interactions, and imitate correct behaviours.
8. Organise role-play sessions in which individuals simulate encounters in order to develop a finer appreciation of the constraints and perspectives which determine the character of particular social exchanges.
9. Provide continuous (non-critical) feedback, discuss performance, set realistic targets and endeavour to sustain motivation.
10. Explore the possibility of staff monitoring their own progress and performance using self-report checklists.

The training on interpersonal and communication skills may be part of the general training or arranged differently as the organisational situations may dictate. Whatever will work best is advised.

6.5.3 Training for the data librarian role and the Professional Learning Iceberg.

This section discusses the identified training needs and the preferred training options in the light of *The Professional Learning Iceberg* as shown in Figure 6-9.

Figure 6-9: The Professional Learning Iceberg.



Adapted from Lindsay (2013, p. 197).

Lindsay's (2013) model is designed as an iceberg within a triangle and is based on three dimensions of learning: cognitive, intrapersonal and interpersonal. At the apex of the triangle is cognition while interpersonal and personal learning are on both sides of the base respectively. Formal learning of professional competence, described as continuing professional development (CPD), lies above the waterline (shown as wavy blue lines) as having "the potential to provide the visible accountability required in the public interest" (Lindsay, 2013, p. 197). The model separates the learning relating to professional competence that is often found within the mandatory CPD schemes from the wider learning of career adaptability. However, informal learning lies below the waterline with personal learning which relates to career adaptability being further underwater.

According to Lindsay (2013, p. 199), "career adaptability, rooted in the concepts of agency and identity, enables individuals to develop, grow and respond continuously and reflexively to their own changing environment." Career adaptability implies learning on the job with/from others as well as through reflection. While the concept of agency refers to such

factors as work-life balance, change, office politics, shaping one's career, and looking to the future the concept of identity includes motivation and confidence.

From the findings of this study subject librarians are favoured to play the DL role. Accordingly, how will the identified training needs and preferred training options for these librarians be viewed in the light of Lindsay's model? Generally, the training needs represent the competences to be learnt or acquired and, as such, they are cognitive in nature. If these form part of CPD then they default to such preferred formal learning options as courses or training programmes as in a university or in-house, or bringing in an expert singly or in partnership with other libraries, and exchange course arrangements with other libraries or places doing RDM. However, in terms of learning relating to career adaptability the agency concept suggests the following preferred options:

- Professional collegial or peer support to someone new in a role;
- Learning on the job through opportunities such as (pilot data management) projects and conferences;
- Working with librarians and other professionals who are experts in the area; and
- Getting exposed to other support services in the area of RDM.

In terms of the concept of identity, suitable preferred learning options include the self-development opportunities such as conducting some research with technology for hands-on experience and personal reading. While professional interest, background and experience provide the motivation, possessing the required personal qualities provides the needed confidence.

Thus, the general picture is that formal learning is not enough although it may be more visible. Informal learning is more focused on gaining experience and facilitating career adaptability. Both types of learning are useful and complementary.

6.6 The Fit of the Data Librarian Role Blueprint

The needs of the researchers that are drawn from Table 5-14 imply researchers' need profiles such as could arise from a research consultation. Table 6-4 shows that these have been aligned to the Reznik-Zellen et al. (2012) tiers of service and mapped to the type of RDM duty and the corresponding RDM requirements. Note that the RDM requirements' columns include data from the Triad. Table 6-4 demonstrates the fit of the Blueprint.

Table 6-4: The Fit of the Data Librarian Role Blueprint.

CONSULTATION (Research Needs)	**RESEARCH NEEDS' DESCRIPTION**	**CATEGORISATION** (Tier of Service)	**RDM Duties** (Type)	**RDM Requirements**	
				Knowledge	Skills
Storage	Includes software versions; software simulation codes with their parameters; Artefacts; Disk space	Infrastructure	Data/Things	Technology and standards (including metadata); Software; RDM	Technology and standards (including metadata); Software; RDM
Management of datasets	Intermediate or working datasets	Infrastructure	Data		
Data preservation and access	*Description of data for re-use*	Infrastructure	Data		
Version control	*Use system to track changes on a file*	Infrastructure	Things	Software; Computer	IT; Technical
Information management	*Organising information through its cycle*	Infrastructure	Things	Background in information professions	Information management
Data catalogue	*Metadata for data*	Infrastructure	Things	Background in Librarianship; Data	Metadata; Information
Experiment records	Searchable electronic holding for curated experiment records	Infrastructure	Things	Technology and standards (including metadata)	Technology and standards (including metadata)
Discovery (Web) tools	For visualisation	Infrastructure	Things	Technology (Web tools and visualisation platforms)	Technology (Web tools and visualisation platforms)
Implementing DOIs	For datasets and resources connected to dissertation to make them citeable and accessible	Consultation	People	Background in Librarianship; DOIs	Metadata; Liaison; DOIs
Support research projects	Involvement in research projects; Working with Research Office and ITS to coordinate data storage	Consultation	People	Research; Project management	Research; Project management; People
Training on data management plan	*For one or more people*	Education	People	Teaching or pedagogy; RDM	Data literacy; RDM; Teaching
Data registry	List of data repositories	Education	Things	Information management	Organisational

Note: The difference between the Research Needs' Description cells for rows three and six involving metadata is that the former involves the description of data while the latter is about the use of data catalogue.

6.7 Issues with the Data Librarian Role Blueprint

A few issues may be raised by the model that require clarification. Two of them are addressed here. First, its focus on the e-Research/RDM support may suggest that it is only for a single-role position so may not permit embedding it into another role. On the contrary, the idea is to provide a blueprint for the aspects of the DL role which could now be performed in any number of ways. For instance, in most of the case institutions subject librarians or their equivalents were favoured for the role. As an embedded role, subject librarians need to conceptually understand what is expected of them. In this way, they are better prepared for the role. Moreover, the employers' component of the Triad discussed in Chapter 4 shows that the role can take a number of forms.

Finally, the model lacks any component regarding the professional background or qualifications of prospective DLs. This is so because it is taken for granted that the role is within the remit of qualified librarians. However, this is implied by the motivation context factor 'professional interest, background and experience.'

6.8 Other Aspects of the Study

Beside the main aspects of the study around which the Blueprint is built, there are two other identified aspects that are discussed in this section. They include the RDM stakeholders that may influence the DL role and the similarities and differences between the two categories of organisations used in the study.

6.8.1 RDM stakeholders and the data librarian role.

Some stakeholders were mentioned in relation to the factors influencing the DL role. They include entities and humans with each either already playing or is expected to play a role in RDM. Each needs either to be motivated about or to promote RDM in order to positively influence the DL role. These stakeholders are listed below along with their actual or expected roles. The nature of their impact is put in parentheses.

Humans:

Researchers: Drive for RDM through research interests and needs (Direct)

Librarians: Professional interest and RDM buy-in (Direct)

Organisational leadership: RDM buy-in and leadership within the ROs - policy, infrastructure and funding (Indirect)

Academic/research library leadership: RDM buy-in and leadership within the library - staff training, RDS and tools (Direct)

Entities:

Research organisations: Support service structure, collaborations (Indirect)

Research bodies (e.g. Royal Society, the Health Research Council): Code of ethics for researchers (Indirect)

Consortia (e.g. CONZUL): RDM advocacy, minimum metadata requirements for describing data in the universities (Indirect)

Interest groups (e.g. Lincoln Hub, New Zealand Data Futures Forum, CRI data management interest group): RDM advocacy (Indirect)

Library school: Training support (Indirect)

Professional bodies (e.g. LIANZA): RDM advocacy and training support (Indirect)

New Zealand Government: E-Research/RDM national leadership, new research funding model (Indirect)

Thus, researchers, librarians and academic/research library leadership having direct impact or influence on the DL role constitute the most important RDM stakeholders in the ROs.

6.8.2 The differences and similarities between the university and CRI case institutions.

The universities and CRIs are fundamentally different. For instance, while the CRIs have a commercial focus the universities focus on education. A common ground between the two categories of ROs is research. However, this study did not aim to provide a comparative study of the two categories, but an insight into the findings from the study reveals that there are similarities and differences between the universities and the CRIs used as case institutions in the research that may influence the DL role. As such, they need to be highlighted.

6.8.2.1 The similarities between the universities and the Crown Research Institutes.

The similarities are:

- The choice of subject/liaison librarians or their equivalent to play the DL role. Some CRIs have knowledge navigators or advisors who play the client-facing role as subject librarians in the universities.
- The pragmatic handling of obscure research requests or needs.
- A common unit that the library collaborates with is ITS.
- Apart from three universities (UN1, UN2 and UN4) and one CRI (CRI2) that were at different stages of developing a RDM policy, no RO had a RDM policy that was operational by the time of data collection.

6.8.2.2 The differences between the universities and the Crown Research Institutes.

The differences are:

- The e-Research advisory group was mentioned only in relation to the universities (3).

- Responsibility for RDM in CRI is more likely to be held by units (e.g. records management, centre for information management) other than the libraries unlike the case in the universities. Thus, the university libraries appear to be ahead in their approach to RDM in terms of training and deployment of staff.
- The librarians are seen by researchers in the universities more as collaborators in the research process than by their counterparts in the CRI where they are seen rather rigidly as librarians and the researchers tend to not see them as collaborators and will likely continue to do so unless there is a major dispositional shift.
- There are no research offices in the CRI as there are in the universities. Rather there are science teams and other teams which do not exist in the universities that the library collaborates with in terms of research.
- While each participating university in the research has an institutional repository only one CRI was reported as having one.
- The number of staff in CRI libraries is always lower than that of the universities.

These differences reveal why the universities may be ahead of the CRIs in their approach to RDM.

6.9 Chapter Summary

This study has taken a qualitative case research approach for exploring the DL role in New Zealand ROs in terms of RDM. In this chapter, the findings were discussed in the light of an emergent model, the Blueprint. The components of the Blueprint were defined and described. Also, the main aspects of the study around which it is built were discussed in detail as were other aspects of the study. Furthermore, the stakeholders of RDM that may influence the DL role as well as a comparison of the two categories of ROs in the study were discussed.

CHAPTER 7: CONCLUSION

This study represents an attempt to fill some gaps in the area of library involvement in e-Research/research data management (RDM) support particularly as it relates to New Zealand. It aimed to explore the data librarian (DL) role in New Zealand research organisations (ROs) from a social constructivist lens combined with a case research approach. The main question it sought to answer was *what are the dimensions of the DL role in New Zealand ROs?* The study was introduced in Chapter 1 while the literature background was discussed in Chapter 3. While Chapter 3 focused on the conceptual model underpinning the study and the research design, the analysis of three complementary sources of data were provided in Chapter 4 as a filter for discussing and interpreting in Chapter 6 the data presented in Chapter 5. This chapter provides a conclusion to the discussions on the study.

In this chapter, I present my thoughts regarding the contributions from some literature and the place of Abbott's *The System of Professions*. Also, I present my reflections on the case research approach used for this study in terms of its advantages and challenges. Finally, I discuss the quality, contributions/implications and limitations of the study, and areas for future research.

7.1 The Place of Literature in the Study

One of the reasons for doing literature reviews is to provide an overview of the sources explored while carrying out a study so that prospective readers of a research report can see how the study fits within a larger subject area. However, some of the reviewed resources may be very useful as to contribute to the design of a study (Pickard, 2013, p. 25). Some reviewed resources contributed to this study in a number of ways.

First, there were two sources that provided the insight about the DL role in relation to RDM. One of them was the work of Martinez-Uribe and Macdonald (2009) that suggested that a professional category of information professionals called the DLs who have been used to managing social sciences' data could expand their role to include managing the data from other disciplines. However, another work by Swan and Brown (2008) identified four data role stakeholders including the DLs whom they defined as "people originating from the library community, trained and specialising in the curation, preservation and archiving of data" (p. 1). A reflection on these and the apparent lack of detailed information on the DLs' involvement in managing all kinds of data informed my decision to make this the subject of my study.

Second, a job analysis framework adopted by Kim et al. (2011) and also adapted by Alvaro et al. (2011) provided me with a tool to organise the DL role performance components (responsibilities and requirements). The latter authors also provided an additional insight to apply this framework to the analysis of position announcements.

Third, there were a two set of sources that provided some information indicative of the role performance components of the DL. They were Alvaro et al. (2011), Cox et al. (2012), Creamer et al. (2012a), Kim et al. (2011), Maattah (2013) and Simons and Searle (2015).

Fourth, there was also a category of sources that provided an indication of the factors that might influence the DL role. These were Brandt (2007), Newton et al. (2011), Soehner et al. (2010) and Tenopir, Sandusky, et al. (2012).

Fifth, Reznik-Zellen et al.'s (2012) tiers of services were insightful about the categorisation of responsibilities involved in research data services (RDS) which became part of the Blueprint (see Figure 6-1).

Finally, the parameter of professional work in Abbott's System of Professions provided the main conceptual lens for the study and was complemented with components from other literature discussed above. The next section has more information on the contributions of Abbott's (1988) theory to the study.

7.2 Use of Abbott's System of Professions in this Study

The construct Professional Work from Abbott's theory influenced the conceptualisation of the study and the Blueprint that emerged from its findings. Abbott viewed the tasks of professions as human problems amenable to expert service. While he compared the problems to diseases he referred to expert services as their treatment. Thus, the DL role was conceived as a professional position within academic librarianship that embodies e-Research/RDM support tasks that are amenable to RDS. Abbott's concept of diagnosis influenced the thought about Research Consultation.

However, although the two processes of diagnosis described by Abbott as Colligation and Classification could not be supported by the findings of this study the Researcher's Needs Profile and Categorisation components of the Blueprint are related to them. Also, it was responses from the LIP participants to the question around inference in Abbott's theory that produced the component of Pragmatism in the Blueprint. Finally, the component RDS in the Blueprint is directly related to the concept of Treatment in Abbott's theory. However, this

was shown in the Blueprint as a possibility within the relevance of the performance components.

7.3 Case Research Approach

This section reflects on the case research approach used for the study in terms of its contributions and challenges. The outcome underlines the advantages and also proves that the challenges were successfully managed.

7.3.1 The advantages of using case research.

The literature shows that using a case research approach may have considerable impact. Bryman (2012, p. 69) noted that it is distinguished by its idiographic approach aimed at elucidating the unique features of a case. This provides more detailed information about the case than other methods (Neale, Thapa and Boyce, 2006, p. 4). The findings in this study regarding the dimensions of the DL role underline this advantage.

Furthermore, Voss et al. (2002, p. 195) mentioned four advantages of case research. First, it can lead to new and creative insights. Second, it can lead to the development of a new theory. The Blueprint emerged from this study and, together with the findings that it represents, provides new and creative insights about the DL role that enhance its understanding. Third, case research can have high validity with practitioners that can be increased further through a triangulation of multiple means of data collection. Case research design allows data collection from different sources (Baxter and Jack, 2008; Neale et al., 2006; Yin, 2009). In this study, the views of the different categories of participants were triangulated to arrive at the findings. Furthermore, different contexts of data sources were triangulated (the Triad discussed in Chapter 4) as a filter to discussing the findings in this Chapter. Unobtrusive measures such as the job advertisements analysed as part of this study "are particularly useful for triangulation" (Marshall and Rossman, 2006, p. 124).

Finally, case research enriches researchers themselves by exposing them to real problems, the creative insights of people from organisations and the varied contexts of cases. While I have had to deal with the problem of exploring the DL role dimensions in New Zealand ROs I must stress that the views of the various participants have been insightful, enlightening and exciting.

7.3.2 The challenges of the case research approach.

As rewarding as the case research approach has proved in this study it was not without some challenges that are discussed in this section. However, these were managed in order to ensure that the research intent was not jeopardised.

7.3.2.1 Case selection and sampling.

Seawright and Gerring (2008) and Voss et al. (2002) discussed the challenge of selecting cases and their samples in relation to multiple or cross-case studies. Moreover, Miles and Huberman (1994) suggested that qualitative researchers generally struggle with resolving what the case is and where it leaves off. However, Yin's (2009) five rationales for single case studies have been helpful in guiding my decision to select a single case design. I opted for Creswell's (2007) single instrumental case study which corresponds to Yin's single-case holistic design. I could also have chosen a single-case embedded design with the universities and CRI as embedded units of analysis although that would have meant using a conceptual framework that supports it. The conceptual model underlying this study is of a holistic nature.

7.3.2.2 Recruitment, commitment and availability of research participants.

Gaining acceptance in the research setting is an important challenge because as Gagnon (2010, p. 58) argued, "the approval of the key player who gave permission for the study does not necessarily guarantee that the other informants approached in the course of the study will be cooperative." I first approached the prime contacts as links to their prospective participant staff. Although I referenced the prime contacts when approaching others, I aimed to gain acceptance by approaching each prospective participant individually and highlighting their importance to the study.

However, I still encountered some challenges. First, a few prospective participants declined to participate. Some of them did not respond to my e-mail invitation. Others, who initially did, were either evasive in their response or appeared to be willing to participate but did not respond subsequently due to official engagements or personal reasons. I tried following up my invitation to them for as long as possible. Second, among those who responded positively, I had to persist with a couple of emails and phone calls in order to schedule an appointment. Also, one person did not want to be recorded so I could only take notes.

7.3.2.3 Use of technology for data collection.

There were challenges with a number of tools that I used during data collection such as digital voice recorder, Skype, Free Video Call Recorder for Skype, Callnote, Lync and

Scopia. First, Lync and Scopia were used only because they were respectively preferred by two participants as the tools available to them in their organisations. The challenge was that it was the first time I used those tools. However, one of them graciously assisted by audio-recording and sending the files to me via Dropbox. However, the other interview could not be recorded so I had to take notes.

Second, I experienced a technical problem with the tools in the course of two interviews. One was with Skype. Due to a problem with the internet, Skype prompted that I should turn off the video for an enhanced recording. I had to alert the interviewee and sought her permission to switch off the video. However, shortly after that the interviewee requested that I put it on so she could watch my lips to overcome any difficulties understanding my accent and follow the conversation better. I had no option other than to sacrifice good quality recording in order for the interview to proceed. The transcribing of this interview was laborious because of poor recording. However, the transcript was sent for respondent checking as were others. The other problem was that I wrongly assumed that I pushed the right button when I had not. Again, my notes filled the void.

Lastly, two participants did not have video in their computers during a Skype call interview. Thus, I could not see their faces while they saw mine. Nonetheless, this did not jeopardise the interviews in any way as both went on well and were recorded.

7.3.2.4 Issues with transcribing interviews.

Marshall and Rossman (2006, p. 110) stressed that transcribing interviews is a non-technical task that entails judgment and interpretation, for instance, placing a period or a semicolon that shapes the meaning of the written text and, by extension, the interview. Punctuation is necessary because, as these authors clarified, "we do not speak in paragraphs, nor do we signal punctuation as we speak." Thus, the transcribed interview can no longer be said to mirror the spoken word. Similarly, audio-recordings do not contain the visual cues we rely on to interpret others' meanings. Another issue with transcribing raised by Marshall and Rossman (2006) is that some people's speaking styles tend to be incoherent and repetitive. The main challenge from these issues is making sure that meaning is accurately rendered in the transcribed account of participants' words.

In this study, I captured within parentheses relevant visual cues such as laughter and contexts in the transcripts. Also, I ensured that the transcripts were sent to the participants for respondent checking.

7.3.2.5 Blending of sources of data.

Case research has the advantage of allowing data collection from multiple sources (Creswell, 2014; Miles and Huberman, 1994; Yin, 2009) but this equally poses the challenge of blending data sources. However, following the advice of Voss et al. (2002) I sought for convergence or otherwise of the ideas of various categories of research participants while generating categories and themes. I triangulated other sources of data such as the literature, online job advertisements and the interviews similarly as a filter for discussing the findings from the main study's interview data.

7.3.2.6 Knowing when to stop.

Voss et al. (2002) pointed out the temptation of collecting more data than is needed in case research. They highlighted that "knowing when to stop is an important skill of a case researcher" (p. 210). Thus, I stopped interviewing in line with some advice gleaned from the literature (Creswell, 2014, p. 189; Voss et al., 2002, p. 210). First, I stopped when I had enough data to satisfactorily address the research questions. Second, I had to stop in order to have enough time to complete the analysis and the report within the available time for my PhD programme. Finally, I stopped when I achieved saturation in terms of the categories and themes emerging in the study.

7.4 A Summary of the Findings from the Study

The findings of the study from which the Blueprint emerged are in the three main areas of the study which correspond to the three specific research questions that drove the study. These are summarised below.

Research question 1 was *what factors may influence the DL role in New Zealand ROs?*

In the study the identified four context factors influencing the DL role within the ROs that participated in the study were national, research, organisational and motivational contexts. These were found to have interrelationships at the level of their components each of which could impact the DL role either positively or negatively. Altogether, six pairs of contextual factors were observed. While four could have positive influence on the DL role the other two could have a negative influence on the role.

Research question 2 was *what are the performance components of the DL role in New Zealand ROs and how are these different from those of the research support librarians (RSLs)?*

In terms of the responsibilities of the DL role people and thing-related duties but no data-related duties were identified. The lack of data-related duties could be traced to the fact that the role of the LIPs in RDM was believed to be limited to educational and advisory services as RDM was presumed to be the primary responsibility of the researchers. However, the identified people-related duties were provide advice on data management, liaise with people (e.g. researchers), organise training and help with research needs. The identified thing-related duties were assist with tools, apply metadata and manage systems.

In terms of the requirements, knowledge, skill and ability requirements were identified. Knowledge requirements were in areas such as technical knowledge (e.g. technology platforms, systems, tools, etc.), research/scholarly publication, metadata, a background in information literacy and liaison, science and statistics, researchers' needs, and research data. Regarding skills, citation tools, keeping up to data, research/searching, training and data literacy, data, database and project management were required. The non-technical skills identified were people (communication, interpersonal and interaction) skills. Finally, the required abilities identified were the abilities to communicate, relate, use technology, liaise and catalogue.

Moreover, it was discovered that the support service aspect in data and RDM was the major difference between the specific DL role and the more general RSL role. Beside all that have been discussed so far in answer research question 2 other important findings around performance components that emerged from the study were as follows:

- E-Research/RDM support was conceived at the institutional level.
- Subject/liaison librarians or their equivalents in the CRIs were mostly favoured for the DL role.
- Specialist DL role could exist short-term for training subject/liaison librarians and long-term in the future when the RDM support role increases or there is the need for that.

Research question 3 was *what is the nature of the training needs of the LIPs and what are their options for meeting them in order to play the DL role in New Zealand ROs?*

The identified eight main areas of training needs were research, technology, information management, research data, metadata, organisational knowledge, customer relationship, and interpersonal and communication skills. The indicated training options were of two main types, namely personal and organisational opportunities. Of these, a common component

preferred by the UL/LIP participants for prospective DLs was learning on the job through various but mostly informal opportunities.

However, these findings underline some contributions of the study as well as implications for RDM stakeholders which are discussed in the next section.

7.5 Contributions and implications of the study

Generally, the value of this research lies in a number of its contributions, and its findings discussed in earlier sections have some implications. The contributions and implications discussed in this section are both conceptual and practical in nature. These are important to various stakeholders including the research organisations, research and library communities especially in New Zealand, and the New Zealand Government, among others.

7.5.1 Contributions to research.

Generally, through the three aspects that constitute its lens, the study makes some contributions to research. In Section 2.3.2.2 it was shown that the focus of the literature has been on e-Science librarianship and RDM. As such, DL has never been contextualised in any study as in this study, although it was mentioned in some woks (Alvaro et al., 2011; Pryor and Donnelly, 2009; Puttenstein, 2011; Swan and Brown, 2008). The first of the main aspects of this study, the factors influencing the DL role in ROs, discussed in Section 2.3.2.1, has never been given focused attention in the literature. Some works (Brandt, 2007; Newton et al., 2011; Soehner et al., 2010; Tenopir, Sandusky, et al., 2012) only provided clues.

This study identified four contexts of factors (national, organisational, research and motivational) influencing the DL role in New Zealand ROs that were used as case institutions in this research. These provide what may serve as a template, or at least a beginning point, for investigating the DL role in research organisations elsewhere.

The second aspect of this study is the DL role performance components. RDM duties and requirements could be gleaned from the respective literature (Alvaro et al., 2011; Cox et al., 2012; Creamer et al., 2012a; Kim et al., 2011) that collectively form the literature perspective on DL role dimensions. In Chapter 4 of this study this literature perspective was brought together with two other contexts of data views of e-Research experts obtained through an exploratory study and the views of academic library employers gathered through the analysis of forty-three relevant job advertisements selected from some websites. A synthesis of the three contexts, termed the Triad in this study, has generated robust information regarding the

DL role dimensions that are more reliable than what is found only in the literature. The Triad represents a trustworthy approach to how ROs or library schools can investigate the dimensions of an emerging role towards developing an academic programme to support it.

The third aspect of this study is the training needs of librarians for the DL role which also includes how the LIPs in the study preferred these needs to be filled. A few related studies could be found. Kim et al. (2011) focused on the education of e-Science professionals and identified a number of elements of the categories of work (people, things and data) and worker (knowledge, skills and ability) characteristics following a job analysis framework they used to organise their findings. However, their research participants were not librarians and the preferred options for training were outside their scope.

However, Bresnahan and Johnson (2013) surveyed twenty potential trainee subject librarians in a university based on a list of thirteen training topics related to research data. Their aim was to evaluate gaps in their skills in order to develop a plan for their training that would take into account potential trainees' opinions of relevance, current knowledge or lack of it, feelings of anxiety and comfort, and preferences for training formats. It is observed that the training topics are a mixture of duties and requirements. It would have made more sense to split them into duties and requirements. In that way, the duties that require particular knowledge and skills would have been clarified. In contrast, this study focused on exploring and eliciting the training needs for the DL role from research participants as well as their preferred training options. These were discussed in Sections 5.4 and 6.3.3.

7.5.2 Contributions to theory.

According to Creswell (2003, p. 131-133) the use of theory in qualitative research serves two main purposes. At the beginning, it is either a source of interesting themes to study or a theoretical lens to guide the study and raise the questions to be addressed. On the other hand, it can be the result of a study. This study is a combination of the two. While the preliminary conceptual model guided the study the final model, the Blueprint, is a product of its findings and provides a good understanding of the DL role. The Blueprint is relevant in a number of ways.

First, it grounds the DL role within the factors influencing it. The role in any organisation is shaped by the contexts within and around the organisation. There is a need to understand these factors in order to take advantage of the positives and deal with the challenges that could hamper the success of the role. Second, it places the role performance components in

the context of rendering RDS. Besides, this context enhances the understanding of the DL role conceptually within the confines of professional duties and requirements which provide a background for discovering the training needs for the role. Third, there was nothing in the findings to suggest that the LIPs have a dictionary of RDM problems like the medical doctors' Medical Diseases and Conditions A-Z List. The study made use of the literature to show the lack can be handled by mapping researchers' requests to the Reznik-Zellen et al.'s (2012) 'tiers of services.'

These will help both prospective DLs and library managers in research organisations in articulating an approach to RDM involvement. Furthermore, the LIS research community now has a good background for carrying out further research in the area.

7.5.3 Contributions to practice.

The study provides understanding about the role that is both necessary for and informs practice. The study showcases that the role focuses on the researchers' needs that translate to duties within RDS. It is the knowledge and skills that give the ability to render those services. Therefore, it shows that the emphasis of professionals interested in the role should be on acquiring the relevant knowledge and skills such as are contained in the findings of this study.

In other words, the DL role performance components contain relevant information regarding the responsibilities and requirements of the DL role for prospective DLs or librarians who have an interest in RDM, or those who are beginning a role in RDM. Even a practising DL may find them a very useful means of appraising or strengthening him/herself for insight into areas where improvement or development may be needed. S/he will be able to learn a few new things or at least be able to view his/her role differently in the light of the findings from this study.

Although the Blueprint that emerged from the study was particularly focused on the DL role, it could provide an insight for analysing various librarian roles such as subject, reference, acquisitions, electronic resources and digital librarians. First, any consultations that a particular librarian role is required to make with clients, colleagues, other institutional units, the stakeholders, etc. may take the place of research consultation. Second, the particular services that a librarian role offers could be considered in the place of RDS. Finally, the responsibilities and requirements applicable to any other librarian role in relation to its training needs could be similarly analysed as those of the DL.

7.5.4 Implications for the New Zealand Government.

The national context factors influencing the position of the DL role were discussed in Section 5.2.1. The findings highlight a lack of leadership or national approach/direction for e-Research/RDM in New Zealand. Moreover, there is clearly a need to change the funding model for ROs (PBRF) which inadvertently encourages a fragmented and divisive approach to RDM in New Zealand. Each of the above-mentioned findings has implications for the Government. These comments from the research participants were made in relation to countries such as the USA, the UK and Australia. The areas of focus in this regard include a national research (data) policy framework, funding and service infrastructure for RDM. These are currently lacking in New Zealand and the Government is expected to put them in place in order to incentivise RDM. When RDM is boosted thus the DL role will be equally enhanced.

A number of steps can be taken. In terms of policy, the Government through its agency, the MBIE, should bring together representatives from relevant stakeholders for a discussion on this. The stakeholders were mentioned in Section 7.2.1.6. Jones (2012, p. 61) reported that a precursor to MBIE, the Ministry of Research, Science and Technology, held the 'Data Matters' event in July 2010 in which it sought "the representatives from research institutes, libraries, archives, universities and the government to discuss what was needed to make the most of publicly funded research data." However, there is no national RDM policy today to suggest that the initiative succeeded.

The Government may need first of all to examine what was done and why the initiative did not progress as planned. This will help to prevent another failure. Then, the stakeholders can build on the past and work towards a draft national RDM policy for New Zealand. The Australian version, ACRCR, may provide insight to the stakeholders. The input from the stakeholders will provide the Government with a basis for developing out a national research policy embodying RDM.

With regard to funding, the Government should be more flexible and expansive. An improved PBRF or new funding model that will accommodate research data within the reports of researchers is expected from the Government. Such a model is also expected to encourage collaboration among the ROs. This results in economy and synergy, and will facilitate sharing among the ROs. The competition arising from the current model does not allow for any of these. There is a need to set up a committee drawn from the ROs to explore

this on behalf of the Government. Universities New Zealand and equivalent bodies across different types of ROs may assist the Government in selecting representative researchers for such a committee. The Government needs to make more funding available for its agencies funding research and include the percentage that should be specifically devoted to RDM. Finally, it must be made mandatory for these government agencies to make a RDM requirement part of the funding process.

Lastly, a national research data service infrastructure is needed in New Zealand. The Government's skewed emphasis has been on NeSI. As discussed in Section 1.4, NeSI represents only the technical side of research so no attention is given to the cultural or social side. It must be noted that data management is as, if not more, important as its production. Research data that must be reused over time must be preserved and not just stored. This is why a national data service is required. The Government needs to study various options and decide on which one is best suited in terms of cost effectiveness, technological changes, usability, longevity and maintenance. Two such options are discussed below.

The first option is to establish a New Zealand-owned national data service infrastructure. This may either be built from scratch or a few IRs may be chosen for upgrading to national infrastructure just like NeSI. The challenges in this respect include the financial cost and technicalities involved. A second option, as mooted by Georgia, a research participant, is to explore the possibility of becoming part of ANDS. The idea is to change the name of ANDS to Research Data Australasia (RDA). There are two challenges with this option. One, the Australian Government will have to be convinced to buy into the idea. Two, the money Australia may demand is unknown and could be so much that building a New Zealand service infrastructure would be cheaper.

7.3.5 Implications for New Zealand library community.

The library community includes all categories of librarians represented by LIANZA, the Library School at Victoria University of Wellington and CONZUL among others. Since there is no opportunity in New Zealand for formal training in RDM as discussed in Section 5.2.1.2, research participants expected LIANZA to play a leadership role. This would involve offering RDM courses for librarians or advising the Library School through an advisory or steering committee towards putting together lectures for the up-skilling of librarians.

Indeed, there is a dire need for the provision of RDM education in New Zealand. One of the research participants from UN3 revealed that their development of Data Literacy 101 was as

a result of an existing gap in this area. This is a challenge to the Library School. Apart from receiving advice from LIANZA, the Library School can also use the findings of this study as a foundation for further efforts around developing or expanding its curriculum in order to accommodate RDM. Moreover, CONZUL and LIANZA are expected to lobby for an advocacy role in RDM. However, they can work together to put pressure on the government in terms of provision of policy incentives and service infrastructure.

7.3.6 Implications for library and information studies training.

A number of the findings in this study have implications for library and information studies training especially in New Zealand. One, subject librarians or their equivalents in the CRIs were favoured for the DL role. Two, eight areas of training needs were identified. Finally, learning on the job rather than formal studies was the commonly preferred training option for the DL role. Fortunately, the work of Cox et al. (2014) may be very insightful regarding how the Library School at Victoria University of Wellington could assist with curriculum development in the light of the findings. First, a funded project to develop a study module within the principle of open educational resource may be an option. Also, the Library School may collaborate with some interested academic libraries in a participative curriculum development process. The main goals of such curriculum efforts could be to develop some learning materials for the subject librarians' self-directed continuing professional development or for their internal training by their libraries.

7.3.7 Implications for New Zealand research organisations.

The organisational context of factors was discussed in Section 5.2.4 and has implications for ROs. The need for academic/research libraries to lead in RDM has implications for library management of the various ROs. The library leadership that desires RDM buy-in at the organisational leadership level needs to take initiatives in RDM. The experience at a few of the case institutions supports this claim. The university librarians in those organisations did not wait for full organisational support before initiating the training of their staff in RDM or developing a RDM policy.

In addition, it is advised that every library that wants to be involved in e-Research/RDM support should conduct staff audits, work analysis and workforce planning. Discovering the knowledge and skills the staff have and do not have in relation to new roles and their requirements will put the library in good stead to determine how best to approach emerging challenges.

However, the need for organisational leadership to support RDM cannot be overemphasised. Policy framework at the organisational level, the development of infrastructure as well as funding for RDM projects may not be possible without the support from organisational leadership. The library leadership must articulate ways to bring the organisational leadership on board. Advocacy and lobbying are unavoidably indispensable.

7.6 Areas for Future Research

The findings of this research highlighted that the majority of the ROs favoured the subject librarians to play the DL role in New Zealand ROs. There are a few studies related to either or two of RDM, subject/liaison librarians and New Zealand. However, none of them is focused on subject/liaison librarians and RDM within New Zealand. Bresnahan and Johnson (2013) surveyed subject librarians of a university to assess their scholarly communication and research data training needs. Two other studies included New Zealand in their focus. The first, conducted by Auckland (2012), is an investigation into the role of and skills of subject/liaison librarians for effectively supporting the evolving needs of researchers. However, only the University of Canterbury, New Zealand was included in Work package 1 of this study. The second, by Corrall et al. (2013), focused on emerging trends in library support for research in the areas of bibliometrics and RDM services. Their respondents were librarians responsible for research support services in the universities of the four countries surveyed in the study including eight New Zealand universities.

Therefore, a study focusing on subject /liaison librarians and RDM in New Zealand is suggested. The findings of this study provide the foundational information with which to survey subject/liaison librarians in all the universities of this country. The aims of such a study should include exploring their levels of comfort or anxiety surrounding RDM, what knowledge and skills they already possess and what else they need, and what training options they prefer. The findings could extend those of this study and equally help develop training modules for the librarians in RDM both at the ROs and the Library School.

7.7 Limitations of the Study

Both the researcher and whatever procedures s/he adopts for any research project are critical to the success or otherwise of the set goal. Therefore, any limitations are traceable to either or both of them. This study is not an exception.

First, Leedy and Ormrod (2013, p. 141) indicated that the major weakness of a single case design, typical of all qualitative approaches, is that the findings cannot be generalised to other

situations. However, Yin (2009, p. 38) argued that as opposed to statistical generalisation associated with deductive approaches, there is analytic generalisation in case studies which is at the point of theory.

Second, in terms of deciding how to proceed, Leedy and Ormrod (2013) further emphasised the flexibility of qualitative methodologies as providing an advantage to experienced researchers rather than novices without sufficient background and training. While I cannot claim to have extensive background and training in research I do have a professional and academic background that is sufficient for the study.

Third, Pickard (2007, p. 181) asserted that interviews produce rich and detailed data that can often be very complex to analyse. This, in a way, is connected to sampling. Liamputtong and Ezzy (2005, p. 49) revealed that purposive sampling aims to create rich, in-depth information but added that the detail and breadth required in research need to be balanced with the resources of time and money available to the researcher. The funding and time available for this PhD study may not have been enough for gathering all the possible data. However, this researcher believes that the available resources have been sufficient for the purpose of this study.

Fourth, the literature consulted was limited to publications in the English language so that some literature in other languages that could be relevant to the study might have been missed. However, it is believed that sufficient literature was reviewed for this research so that any omissions did not jeopardise the successful carrying out of this research.

Fifth, deciding on a case and its boundaries is challenging (Creswell, 2007). For instance, RDM is very intertwined with the DL role and it is a ‘big’ space that may accommodate different data roles (see section 2.3.2). Therefore, narrowing RDM to the dominant DL role may appear to some people to be either too skewed or misleading. However, it was never my intention to prove that the DL role has sole stake to or is synonymous with RDM.

Finally, to some people the study might appear to have a narrow focus in terms of New Zealand as its location and library and information studies as its perspective. However, it must be explained that the primary reason for this focus was informed by gaps from the reviewed literature as was discussed in Section 2.6. As such, consideration was given to relevance in terms of making some contributions to knowledge over covering a wider scope. Moreover, I felt more comfortable approaching the study from my own professional

background that I have been familiar with and whose interest I am always willing to represent and prioritise.

7.8 Conclusion

In this chapter, I discussed my reflections on the contributions from literature, the relevance of Abbott's the System of Professions case research approach and the summary of the findings, the contributions and implications for, and limitations of the study, as well as the areas for future research.

Overall, the findings of this study represent the dimensions of the DL role that are important to librarians in relation to the researchers. First, they provide conceptual positioning and understanding for practice in the DL role. Second, they reflect the value that librarians bring to the research process in the area of e-Research/RDM support. Thus, the whole essence of the role fits into the mission statement of Lankes' (2011, p. 15) new worldview of librarianship presented in Chapter 1:

> The mission of librarians is to improve society through facilitating knowledge creation in their communities.

In this study, while the researchers from the universities showed an understanding of the place of librarians in the research process it was different from those from the CRI. By libraries of ROs committing to the DL role and reaching out to researchers through e-Research/RDM support services they may improve the views of researchers about librarians to the maximum benefit of enhanced knowledge creation in their communities.

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Appendix A1: Interview Guide for the Library and Information Professionals

Introduction **(10 min.)**

Appreciation: Begin with "Thank you for accepting to facilitate my study."
Introducing the Facilitator: Mention name, country and programme - PhD study at the School of Information Management, Victoria University of Wellington, New Zealand.
Purpose of the Discussion: State that the primary purpose of the discussion is an exploratory study to provide relevant and contextual information towards refining the questions for the main research interviews and the conduct of the study generally.

Informed Consent: Clarify the components briefly.
PAUSE to find out if there are any questions about the informed consent document.
COLLECT informed consent document if there are no more questions about it and kindly request him/her to sign if that hasn't been done (Ensure participants retain a copy).
EXPLAIN the ground rules:

- Of interest is not how right or wrong your answers are but your experiences
- The emphasis is that the questions are clearly understood and your answers provide some perspective.

The Interview

Opening Remarks**:** There are two parts to this interview. The first set of questions is focused on your background information. The second part revolves around 3 main areas of interest in my study regarding the role of the data librarian. They include: factors influencing, performance components and training needs for the role.

It will be highly appreciated if you do not speak so fast so I can better grasp your opinion.

Introductory Questions **(10 min.)**

1. Tell me about your role and how long you have been here.
   a. What are the main responsibilities in your role?
   b. What ancillary responsibilities do you combine with your main role?
2. Briefly describe your professional background in relation to your qualifications and where you obtained them, subject specialisations and your past roles.

Factors Influencing the Transition to Data Librarian Role (20 minutes)

3. What is the nature of your organisation's (University/Institute) research support arrangement in terms of organisational structure and staff composition?
   The context of this question is the place of the library in this research support arrangement in terms of level of attention given to e-Research in the areas of funding of the library, policies around things like research reward system and staff development, RDM and the infrastructure for managing research output including research data and the role of the library therein
4. If your organisation would give (more) attention to e-Research and research data management and commit your library to its specialty within her services, how do you think your library can go about this?
   a. In your thinking, which category of librarians constitutes the suitable background for transitioning to the new role and why?
   b. What may constitute the motivations for you or any other librarian within your library to want to play this role?

c. What factors within your organisation can be the enablers for the emergence of this role?
d. Within the national context, which bodies (research or professional like NSF in the USA and ALIA in Australia), policies and programmes in New Zealand could (directly or indirectly) be of benefits to your organisation and how?
The main aim is here is an attempt to find out any national context to the transition to e-Research expertise.

5. How would you describe the collaboration between the faculty and the librarians in your organisation?
This description is in terms of the academics' perception of librarians as collaborators in the research enterprise, the relationship between this perception and their collaboration with academics, qualifications of librarians, especially higher degrees or those obtained in the same organisation where they work, and opportunities for them to promote their projects and services to academics.
6. Can you please describe your library's collaboration with other unit(s) within your organisation and/or with other organisations that may facilitate the emergence (or development) of this role?

Performance Components of Research Support Role and Data Librarian Role (25 minutes)

7. Briefly describe the range of your or the average research support librarian's main responsibilities towards services to the faculty.
In line with Kim et al.'s *(2011) framework, the aim here is to identify the responsibilities (work characteristics) of RSL role involving:*
   - *Working with/through people.*
   - *Working with tools such as information technology, software, documents, etc.*
   - *Working with research data.*
8. If you or any librarian would transition to full research data management expertise or role, what responsibilities would this entail for you or him?
In line with Kim et al.'s *(2011) framework, the aim here is to identify the responsibilities (work characteristics) of DL role involving:*
   - *Working with/through people.*
   - *Working with tools such as information technology, software, documents, etc.*
   - *Working with research data.*
9. To what extent does your research support service arrangement cover all (pre-research, during research and post-research) phases of research cycle?
10. How would you describe what you have discovered in the course of your collaborations with faculty members to be their prominent research needs including data needs?
11. Are you able to explain how you have handled requests from faculty members that you could not readily meet because of lacking the required experience, knowledge base or skills?
This question is aimed at eliciting information in relation to the component "inference" from Abbott's (1988) The System of Professions.
12. Drawing from your experience, what knowledge base and skills (technical and non-technical) are required by research support librarians?
In line with Kim et al. *(2011) framework, the aim here is to identify the requirements (worker characteristics) for RSL role such as Knowledge, Skills (technical and non-technical skills), and Ability.*

13. Are you able to articulate what knowledge base and skills (technical and non-technical) that may be required of you or any librarian in order to play full research data management role?
    In line with Kim et al.'s *(2011) framework, the aim here is to identify the requirements (worker characteristics) for data librarian role such as Knowledge, Skills (technical and non-technical skills), and Ability.*

Training Needs of Librarians (18 minutes)

14. Can you please attempt to recollect the gaps in your knowledge base and skills at the beginning of your current role and how you addressed them?
    It is thought that comparing their initial knowledge base and skills with those required for their current role will provide an understanding of the gaps that existed.

    The areas to focus in terms of how they addressed the gaps are:
    - *The initial challenges that they faced having to fill the discovered gaps.*
    - *Whether the option for filling the gaps came from the professionals or their organisations and what assistance they received from their organisations.*
15. What gaps do you have currently in your knowledge base and skills (technical and non-technical)?
    The aim here is to find out whether the gaps are part of those identified at the beginning of the transition to the current role or they are new.

16. If you would take up full research data management role what knowledge and (technical and non-technical) skills do you think that you would need?
17. How would you choose to fill your current or arising knowledge/skill gaps and why?
    The aim here is to find out whether the options are different from the previously chosen ones and the challenges they envisage in terms of receiving assistance from their parent organisation or the library.

Conclusion (4 minutes)

18. Do you please have any other comments?

Wrap-Up (3 minutes): The following statements may be used.
- Thank you so much for your time and sharing your thoughts with me today.
- Remember that the thoughts you shared will be used to explore the role of the data librarian in New Zealand research organisations.
- Remember also that your thoughts will be kept confidential to me and my supervisors.
- If you have any questions or concerns use the contact information in the information sheet.

Appendix A2: Interview Guide for the University Librarians

Introduction (8 minutes)

Appreciation: Begin with "Thank you for accepting to facilitate my study."
Introducing the Facilitator: Mention name, country and programme - PhD study at the School of Information Management, Victoria University of Wellington, New Zealand.
Purpose of the Discussion: State that the primary purpose of the discussion is an exploratory study to provide relevant and contextual information towards refining the questions for the main research interviews and the conduct of the study generally.

Informed Consent: Clarify the components briefly.
PAUSE to find out if there are any questions about the informed consent document.
COLLECT informed consent document if there are no more questions about it and kindly request him/her to sign if that hasn't been done (Ensure participants retain a copy).
EXPLAIN the ground rules:

- Of interest is not how right or wrong your answers are but your experiences
- The emphasis is that the questions are clearly understood and your answers provide some perspective.

The Interview

Opening Remarks: There are two parts to this interview. The first set of questions is focused on your background information. The second part revolves around 3 main areas of interest in my study regarding the role of the data librarian. They include: factors influencing, performance components and training needs for the role.
It will be highly appreciated if you do not speak so fast so I can better grasp your opinion.

Introductory Questions (7 minutes)

1. Tell me about your role and how long you have been here.
   a. What are the main responsibilities in your role?
   b. What ancillary responsibilities do you combine with your main role?
2. Briefly describe your professional background in relation to your qualifications and where you obtained them, subject specialisations and your past roles.

Factors Influencing the Transition to Data Librarian Role (20 minutes)

3. What is the nature of your organisation's (University/Institute) research support arrangement in terms of organisational structure and staff composition?
   The context of this question is the place of the library in this research support arrangement in terms of level of attention given to e-Research in the areas of funding of the library, policies around things like research reward system and staff development, RDM and the infrastructure for managing research output including research data and the role of the library therein.
4. If your organisation would give (more) attention to e-Research and research data management and commit your library to its specialty within her services, how do you think your library can go about this?
   a. In your thinking, which category of librarians constitutes the suitable background for transitioning to the new role and why?
   b. What may constitute the motivations for you or any other librarian within your library to want to play this role?

c. What factors within your organisation can be the enablers for the emergence of this role?
d. Within the national context, which bodies (research or professional like NSF in the USA and ALIA in Australia), policies and programmes in New Zealand could (directly or indirectly) be of benefits to your organisation and how?
The main aim is here is an attempt to find out any national context to the transition to e-Research expertise.

5. How would you describe the collaboration between the faculty and the librarians in your organisation?
This description is in terms of the academics' perception of librarians as collaborators in the research enterprise, the relationship between this perception and their collaboration with academics, qualifications of librarians, especially higher degrees or those obtained in the same organisation where they work, and opportunities for them to promote their projects and services to academics.
6. Can you please describe your library's collaboration with other unit(s) within your organisation and/or with other organisations that may facilitate the emergence (or development) of this role?

Performance Components of Data Librarian Role (12 minutes)
The questions in this section are predicated on the possibility of incorporating e-Research support with research data management into your research support arrangement (if this has not been done by the libraries or if they have done so minimally but wish to give full attention to it).

7. What extent do you think that your library can go in terms of covering e-Research support and research data services within the (pre-research, during research and post-research) phases of research cycle?
8. What specific responsibilities do you think this role would confer on your library for your chosen librarians?
In line with Kim et al.'s *(2011) framework, the aim here is to identify the responsibilities (work characteristics) of DL role involving:*
- *Working with/through people.*
- *Working with tools such as information technology, software, documents, etc.*
- *Working with research data.*

9. What knowledge base and skills (technical and non-technical) do you think they would require?
In line with Kim et al.'s *(2011) framework, the aim here is to identify the requirements (worker characteristics) for RSL role such as Knowledge, Skills (technical and non-technical skills), and Ability.*

Training Needs of Librarians (9 minutes)

10. Briefly describe any mechanism within your organisation regarding discovering the job requirements or knowledge/skill needs of your library staff including the librarians.
11. What option(s) for filling the knowledge/skills gap of your librarians would you normally prefer and why?
12. What specific role has your library been playing in respect of filling your librarians' knowledge/skill needs?
The context of this question is finding out what challenges university librarians may envisage in their libraries trying to help librarians fill identifiable gaps.

Conclusion (4 minutes)

13. Please do you have any other comments?

Wrap-Up (3 minutes): The following statements may be used.

- Thank you so much for your time and sharing your thoughts with me today.
- Remember that the thoughts you shared will be used to contextualise my main PhD research and especially to refine my interview questions.
- Remember also that your thoughts will be kept confidential to me and my supervisors.
- If you have any questions or concerns use the contact information in the information sheet

Appendix A3: Interview Guide for the e-Researchers

Introduction **(10 min.)**

Appreciation: Begin with "Thank you for accepting to facilitate my study."
Introducing the Facilitator: Mention name, country and programme - PhD study at the School of Information Management, Victoria University of Wellington, New Zealand.
Purpose of the Discussion: State that the primary purpose of the discussion is an exploratory study to provide relevant and contextual information towards refining the questions for the main research interviews and the conduct of the study generally.

Informed Consent: Clarify the components briefly.
PAUSE to find out if there are any questions about the informed consent document.
COLLECT informed consent document if there are no more questions about it and kindly request him/her to sign if that hasn't been done (Ensure participants retain a copy).
EXPLAIN the ground rules:

- Of interest is not how right or wrong your answers are but your experiences
- The emphasis is that the questions are clearly understood and your answers provide some perspective.

The Interview

Opening Remarks**:** There are two parts to this interview. The first set of questions is focused on your background information. The second part revolves around 3 main areas of interest in my study regarding the role of the data librarian. They include: factors influencing, performance components and training needs for the role.
It will be highly appreciated if you do not speak so fast so I can better grasp your opinion.

Introductory Questions **(10 min.)**

1. Tell me about your role and how long you have been here.
   a. What are the main responsibilities in your role?
   b. What ancillary responsibilities do you combine with your main role?
2. Briefly describe your professional background in relation to your qualifications and where you obtained them, subject specialisations and your past roles.
3. What sort of data does your research produce and how do you manage it?
   The emphasis is on knowing how they store data in terms of its accessibility both to them and other people afterwards.
4. What sort of storage problems have you witnessed and how have you handled them?
   The endpoint to this question is identifying what their problems are and if they see any role for libraries in this regard.

Main Questions (18 minutes)

5. To what extent do you see librarians as collaborators in the research process?

This question is aimed at understanding their perception of LIP and basis for that (e.g. qualifications, higher degrees, services, etc.). What views they hold may reveal their dispositions towards any collaboration with LIP in RDM.

6. What do you consider to be your research data needs and how will you relate them to the research support services you receive from your library?

The idea is two-fold. The first is to identify their needs within the three phases of the research cycle. The second is to compare their data needs with data responsibilities in the views of the LIP and the literature (collect data, store data, manage data, analyse data, and present data).

7. What sort of knowledge base and skills do you think that the librarians need in order to meet your data needs?

   Their response here is targeted at providing insight to the knowledge/skill requirements of librarians for e-Research from e-Researchers' perspective in terms of if domain knowledge and any discipline-specific skills may be required.

8. In what areas and ways do you feel the library may need to improve their support services in order to meet your data needs better?

   Their response may provide a perspective on the gaps within the librarians' professional kits. They may further be probed in the following areas:

   a. What sort of training will the staff need and how do you suggest that the library can best go about it?

   b. How would you expect the parent organisation of your library to get involved?

Conclusion (4 minutes)

9. Do you please have any other comments?

Wrap-Up (3 minutes)**:**

- Thank you so much for your time and sharing your thoughts with me today.
- Remember that the thoughts you shared will be used to explore the role of the data librarian in New Zealand research organisations.
- Remember also that your thoughts will be kept confidential to me and my supervisors.
- If you have any questions or concerns use the contact information in the information sheet

Appendix A4: Interview Guide for the Institutional Repository Managers

Introduction **(10 min.)**

Appreciation: Begin with "Thank you for accepting to facilitate my study."
Introducing the Facilitator: Mention name, country and programme - PhD study at the School of Information Management, Victoria University of Wellington, New Zealand.
Purpose of the Discussion: State that the primary purpose of the discussion is an exploratory study to provide relevant and contextual information towards refining the questions for the main research interviews and the conduct of the study generally.

Informed Consent: Clarify the components briefly.
PAUSE to find out if there are any questions about the informed consent document.
COLLECT informed consent document if there are no more questions about it and kindly request him/her to sign if that hasn't been done (Ensure participants retain a copy).
EXPLAIN the ground rules:

- Of interest is not how right or wrong your answers are but your experiences
- The emphasis is that the questions are clearly understood and your answers provide some perspective.

The Interview

Opening Remarks**:** There are two parts to this interview. The first set of questions is focused on your background information. The second part revolves around 3 main areas of interest in my study regarding the role of the data librarian. They include: factors influencing, performance components and training needs for the role.
It will be highly appreciated if you do not speak so fast so I can better grasp your opinion.

Introductory Questions **(10 min.)**

1. Tell me about your role and how long you have been here.
   a. What are the main responsibilities in your role?
   b. What ancillary responsibilities do you combine with your main role?

2. Briefly describe your professional background in relation to your qualifications and where you obtained them, subject specialisations and your past roles.

Main Questions (23 minutes)

3. What is the place of institutional repository in your organisation's research support arrangement in terms of the range of services rendered through it?
4. What challenges are there for using institutional repository to support e-Research and manage research data?
5. What level of attention does your organisation (university) give to e-Research?
   The level of attention given to e-Research is in terms of funding the library and/or repository, policies around things like research reward system and staff development, and research data management.
6. To what extent do you think your university library should have a role in e-Research?
   It is presumed that the IRM may not be librarians so that their views may be fundamental to their disposition towards having any collaboration with librarians.
7. What factors within your country and research organisations (like your university) would you consider the enablers for librarians to play a role in e-Research?

The main aim is here is an attempt to understand any national or organisational factors that may facilitate the transition of a librarian to e-Research expertise.

8. What specific responsibilities do you think librarians have in your institutional repository especially in terms of managing research output including research data?
   The main interest here is identifying the extent of involvement of LIP in repository activities which may reflect research data handling or otherwise. Besides, involvement in managing research outputs may enable them extend their involvement to research data management.
9. What do you think should be the required qualifications, knowledge base and skills for the librarians to be involved in e-Research and research data management?
   It is important to compare their perspective with that of the LIP themselves.
10. What challenges would librarians face trying to fill any gaps arising from e-Research and research data management involvement and how would you advise them to go about them?
    This is an attempt to know if they have a different opinion from those of the LIPI intend to compare their thoughts with those of the librarians as to identify if these are along professional lines.

Conclusion (4 minutes)

11. Do you please have any other comments?

Wrap-Up (3 minutes):

- Thank you so much for your time and sharing your thoughts with me today.
- Remember that the thoughts you shared will be used to explore the role of the data librarian in New Zealand research organisations.
- Remember also that your thoughts will be kept confidential to me and my supervisors.
- If you have any questions or concerns use the contact information in the information sheet.

Appendix A5: Interview Guide for the ITS Manager

Introduction **(10 min.)**

Appreciation: Begin with "Thank you for accepting to facilitate my study."
Introducing the Facilitator: Mention name, country and programme - PhD study at the School of Information Management, Victoria University of Wellington, New Zealand.
Purpose of the Discussion: State that the primary purpose of the discussion is an exploratory study to provide relevant and contextual information towards refining the questions for the main research interviews and the conduct of the study generally.

Informed Consent: Clarify the components briefly.
PAUSE to find out if there are any questions about the informed consent document.
COLLECT informed consent document if there are no more questions about it and kindly request him/her to sign if that hasn't been done (Ensure participants retain a copy).
EXPLAIN the ground rules:

- Of interest is not how right or wrong your answers are but your experiences
- The emphasis is that the questions are clearly understood and your answers provide some perspective.

The Interview

Opening Remarks**:** There are two parts to this interview. The first set of questions is focused on your background information. The second part revolves around 3 main areas of interest in my study regarding the role of the data librarian. They include: factors influencing, performance components and training needs for the role.

It will be highly appreciated if you do not speak so fast so I can better grasp your opinion.

Introductory Questions **(10 min.)**

1. Tell me about your role and how long you have been here.
   a. What are the main responsibilities in your role?
   b. What ancillary responsibilities do you combine with your main role?
2. Briefly describe your professional background in relation to your qualifications and where you obtained them, subject specialisations and your past roles.

Main Questions (23 minutes)

3. What is the place of institutional repository in your organisation's research support arrangement in terms of the range of services rendered through it?
4. What challenges are there for using institutional repository to support e-Research and manage research data?
5. What level of attention does your organisation (university) give to e-Research?
   The level of attention given to e-Research is in terms of funding the library and/or repository, policies around things like research reward system and staff development, and research data management.

6. What is the place of the position Academic Enabler (e-Research Development) in the ITS research support structure? Why was it established or what mission does it exist to accomplish?
7. To what extent do you think that university libraries should have a role in e-Research and why?

It is presumed that the views of the ITS Manager may be fundamental to their disposition to collaborate with LIP. They may be specifically asked:

a. Do you see any need for IT (at least represented by your team) to collaborate with the library in e-Research and research data management support?
b. What specific responsibilities do you think your university library will have in e-Research and research data management collaboration?

8. What sort of knowledge base and skills atop those of traditional librarianship do you think that the librarians involved in e-Research and research data management support may need?
   It is important to compare their perspective with that of the LIP themselves.
9. What challenges would librarians face trying to fill any gaps arising from e-Research and research data management involvement and how would you advise them to go about them?
   This is an attempt to know if they have a different opinion from those of the LIPI intend to compare their thoughts with those of the librarians as to identify if these are along professional lines.

10. What do you think may be the best ways for LIP to train or up-skill for e-Research and research data management support role?
11. What factors within your university would you consider the enablers for librarians to play a role in e-Research and research data management support?
    The aim here is to identify organisational factors that may enable the emergence of the DL role.
12. Within New Zealand what factors including national policies, programmes and institutions or bodies can facilitate e-Research and data management support?

Conclusion (4 minutes)

13. Do you please have any other comments?

Wrap-Up (3 minutes):

- Thank you so much for your time and sharing your thoughts with me today.
- Remember that the thoughts you shared will be used to explore the role of the data librarian in New Zealand research organisations.
- Remember also that your thoughts will be kept confidential to me and my supervisors.
- If you have any questions or concerns use the contact information in the information sheet

Appendix B: Brief Research Proposal for Initial Invitation

Brief Research Proposal

Research Data Management: An Exploration of the Role of the Data Librarian in New Zealand Research Organisations

Isaac Ohaji
(PhD Candidate)
School of Information Management (SIM)
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The context of this research project is e-Research and its purpose is to explore the role dimensions of the data librarian in New Zealand research organisations (ROs). It specifically focuses on universities and the Crown Research Institutes (CRI). The study will be guided by the question: *What are the role dimensions of the data librarian in New Zealand ROs*? In order to gather data towards answering this question, participants will include: library managers; librarians having responsibilities towards research support/institutional repositories (IRs); IR managers; and academic staff who are involved in e-Research. However, the study has received ethical approval from Victoria University of Wellington. Via negotiation with the participants, the interviews may hold between mid-November, 2013 and March, 2014.

The study will use qualitative case research approach and the main data collection method will be semi-structured interview with open-ended questions. Preferably, the participants will be interviewed on a face-to-face basis. Where this is not possible, interview over Skype may be considered. The expected maximum length of the interviews with the various categories of participants is as follows:

- University Librarians - 1 hr.
- CRI library managers/librarians (from the universities) with respective oversight or that work in the research support unit and the repository - 1.30 hrs.
- Institutional repository manager - 45 min.
- E-Researchers - 45 min.

With regard to the last category the participants from each organisation will be kindly requested to advise on their recruitment on the basis of at least one e-Researcher (preferably from data-intensive disciplines) per organisation.

This study could be of many benefits. First, it will highlight the training needs of library practitioners/information centre specialists towards stepping up to the e-Research and research data management support role. Second, it will offer useful insight to the library managers of the universities and CRIs on their approach to the e-Research challenge. Third, besides being beneficial to the library and e-Research communities, it will enable library schools to modify their curriculum towards ensuring that relevant graduates are produced.

Finally, it will contribute to the theory and practice of academic librarianship with particular respect to the role of the data librarian.

Appendix C: Information Sheet for Research Participants

INFORMATION SHEET FOR A PHD RESEARCH

Title of Project:
Research Data Management: An Exploration of the Role of the Data Librarian in New Zealand Research Organisations

Researcher:
Isaac Ohaji
School of Information Management (SIM)
Victoria University of Wellington (VUW)
New Zealand

This project seeks to explore role dimensions of the data librarian position in New Zealand research organisations (ROs). However, my specific focus is the universities and Crown Research Institutes (CRI). The study has received ethical approval from a VUW's Human Ethics Committee.

I am inviting the following people from the selected New Zealand ROs to participate in this research: library managers; librarians with respective oversight or that work in research support units and institutional repositories (IRs); IR managers; and e-Researcher-patrons. The expected maximum length of the interviews with the various categories of participants is as follows:

- University Librarians - 1 hr.
- CRI library managers and librarians (2 from each participating university) with respective oversight or that work in the research support unit and the repository - 1.30 hrs.
- Institutional repository manager (1 from each participating university) - 45 min.
- E-Researchers (1 associated with each RO) - 45 min.

The main data collection instrument is semi-structured interview with open-ended questions. Preferably, the participants will be interviewed on a face-to-face basis. Where this is not possible, an interview over the telephone or Skype will be considered. The responses of participants will be recorded and kept confidential to me and my supervisors, Prof. Pak Yoong and Dr. Brenda Chawner. The information and opinion from the participants will only be reported in non-attributable form as the basis of a dissertation to be submitted to SIM for marking before being deposited in the University Library and in its online Research Archive. In addition to the right to check the interview transcripts, a summary of the findings from the study will be provided to all the participants. It is also intended that one or more articles based on or related to the study will be submitted for publication in scholarly journals.

However, throughout the study all raw data will be stored in locked files with access restricted to me and my supervisors. Similarly, all electronic information will be kept in password-protected files with access restricted to me and my supervisors. The raw data and any audio recordings will be destroyed/deleted two years from the completion of the project. If as a participant you feel the need to withdraw from the project, you may do so without question any time before the data analysis, within two weeks after the interview transcript is received.

If you have any questions or would like to receive further information about the project, please contact me or my supervisors with the information below.

Thank you for your time and cooperation.

Isaac Ohaji
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Appendix D: Consent Form

CONSENT TO PARTICIPATE IN RESEARCH

You are kindly requested to sign this form as your consent to participating in my research following your agreement with a tick to the following items:

- ☐ I have been provided with adequate information relating to the nature and purpose of this research project, I have understood that information and have been given the opportunity to seek further clarification or explanations.
- ☐ I understand that I may withdraw from this study at any time before the final analysis of data (within two weeks after receiving the interview transcript) without providing reasons and, if I withdraw from the project, any data I have provided will be removed from the study
- ☐ I understand that any information or opinion I provide will be recorded.
- ☐ I understand that the information I have provided will be kept confidential and reported only in a non-attributable form.
- ☐ I understand that the information I have provided will be used only for this research project and that any further use will require my written consent.
- ☐ I understand that when this research is completed the information obtained will be destroyed/deleted in 2 years
- ☐ I understand that I have the right to the check interview transcripts and receive feedback in the form of a summary of key findings when the research is completed.
- ☐ I agree to take part in this research.

Name of participant: ……..

Institution: ……..

……

Position: ……..

…….……. …..…….

Sign **Date**