A gender study of the LIS academics' productivity in the UK

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Declaration of originality

I, Mehrnoush Scarman confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Understanding research productivity in higher education is an important issue because of the impact it has on both individual advancement and departmental planning and policymaking. To date most of the previous studies have recorded a gender imbalance in productivity especially in science and engineering fields. This study has chosen Library and Information Science (LIS), which is known to be a female dominant discipline, to investigate research productivity and compare its differences between men and women in the UK. This study also investigates the impact of institutional factors on the productivity of academics. With a quantitative approach, this study employs bibliometrics' methods and techniques for data collection and develops two datasets of people and publications for the analysis. Productivity is measured by collecting the data related to the number of publications, number of citations and h-index of academics. In addition, this study also analyses the subject of the publications and the sub-disciplines that men and women are publishing in. Finally LIS men and women are compared against institutional factors such as affiliations, academic professional level and academic status. The results of the statistical analysis suggest that there are not statistically significant differences between LIS men and women academics' productivity in the UK. The number of citations of the male academics at reader level is statistically significant compared to women. This has been explained by comparing men's and women's length of career in this discipline. This study also found that there is a tendency for men to collaborate more with other men than women while women collaborate with both men and women equally.

Table of Contents

List of Figures

List of Tables

Dedication

One of the reasons that I started this journey was because of the support of my very dear friend Mike Skeet. Unfortunately Mike passed way a month before I submitted this thesis and it breaks my heart that he is not here to see the final result. I hope that by dedicating this thesis to his loving memory, I can show my love, gratitude and respect for him. Mike your memory continues to be my source of strength in everyday life. Thanks for teaching me how to believe in myself, set my goals high and achieve my dreams none of which would have been possible without you.

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Chapter 1- INTRODUCTION

The matter of women's equality in higher education emerged soon after the scientific revolution of the seventeenth century when the development of human and natural world science challenged medieval beliefs about the physical and mental inferiority of women (Levack, Muir et al. 2011). Ever since, the battle for women's education has pervaded the history of education.

Although through the hard work of women's rights campaigners women's path to universities and higher education has now been made easier, there is still evidence that women have not yet achieved equal status with men (Solomon 1986). This is because, despite the growing number of women in higher education, there is still a debate regarding women's academic productivity.

This thesis is a gender study that investigates the productivity of Library and Information Science (LIS) academics in the UK. The research is also a quantitative study that uses both bibliometric methods and statistical analysis to measure productivity. The two datasets that have been used for analysis in this study have been created and developed using bibliometric techniques and online resources. The LIS academics, as the study's sample, are the links between the two datasets.

The purpose of this chapter is to outline the problem and the motivation behind this research and its importance for the field of Information Studies. The aims and objectives of the study are explained and the research questions defined. This chapter also includes an outline of the thesis.

1.1 Statement of the problem: 'Productivity puzzle'

Understanding academic productivity at national and institutional level is an important issue in the sociology of science because of the impact it has on individual advancement as well as departmental policymaking and budget planning (Helsi and Lee 2011). Academic productivity is also used as an index for departmental and institutional evaluation which affects academic advancement and the reward systems (Sax, Hagedorn et al. 2002). The literature suggests that academic productivity is generally measured by looking at research publications[1] (Zuckerman and Cole 1975; Fox 1983; Levin and Stephan 1991; Lemoine 1992; Ramsden 1994; Xie and Shauman 1998; Rhoades 2001; Toutkoushian, Porter et al. 2003; Mauleon and Bordons 2006). In the UK, both the Research Assessment Exercise (RAE)[2] and Research Excellence Framework (REF), which has replaced the RAE, use the analysis of academic publications to understand research productivity in order to distribute funding between higher education institutions (Sheikh 2000; Harley 2003; Moed 2008; RAE 2008). Productivity, or research output, is affected by various factors. Previous studies have considered a number of these factors when they measured productivity. Factors affecting productivity can be categorised into four different groups of variables including professional variables, demographic variables, family related variables and cultural variables. Examples of professional variables are academic rank and membership of a group. Demographic variables can be

[1]. This has been discussed in depth in chapter two. Therefore, in this chapter the terms academic publication, productivity, and research performance might be used interchangeably.

[2]. RAE is conducted jointly by the Higher Education Funding Council for England (HEFCE), the Scottish Funding Council (SFC), the Higher Education Funding Council for Wales (HEFCW) and the Department for Employment and Learning Northern Ireland (DEL) and was established in 1986 to formalise assessment of the quality of selected research outputs by academics in the UK.

summarised into variables such as age, race, and gender. Family related variables include marital status and the number of children in the household. Cultural variables are the result of an existing culture and can have an impact on productivity. Discrimination is an example of a cultural variable (Cole 1979; Kyvik 1990; Yentsch and Sindermann 1992; Ramsden 1994; Kaplan, Sullivan et al. 1996; Sax, Hagedorn et al. 2002; Costas, van Leeuwen et al. 2010; Malouff, Schutte et al. 2010; Puuska 2010; Abramo, D'Angelo et al. 2011; D'Amico, Vermigli et al. 2011; Hedjazi and Behravan 2011; Lissoni, Mairesse et al. 2011; Reed, Enders et al. 2011). Among these variables, gender is an important determinant in measuring productivity as it is linked with the subject of equality between men and women in higher education (Acker 1992; Bagilhole 2000; Benschop and Brouns 2003; Deem 2003; Knights and Richards 2003; Evertsson, England et al. 2009; Garforth and Kerr 2009). The results of previous studies have recorded a gender gap in research productivity among male and female academics showing that women are academically less productive than men (Zuckerman and Cole 1975; Berryman 1983; Kyvik 1990; Zuckerman, Cole et al. 1991; Lemoine 1992; Long 1992; Garfield 1993; Hanson, Schaub et al. 1996; Jacobs 1996; Black and Holden 1998; Long, Bowers et al. 1998; Xie and Shauman 1998; Gupta, Kumar et al. 1999; Goel 2002; Prpic 2002; Deem 2003; Naldi, Luzr et al. 2004; Xie and Shauman 2004; Fox 2005; Jagsi, Guancial et al. 2006; Mauleon and Bordons 2006; Petersen, Snartland et al. 2007; Rodgers and Neri 2007; D'Amico, Vermigli et al. 2011). Cole and Zuckerman (1975) name this phenomenon the 'productivity puzzle' as they failed to find reasons or possible explanations as to why women publish less than men do. Since then, the 'productivity puzzle' has turned into a popular phrase and has been used widely in different studies to refer to women's number of publications versus men's.

1.2 Productivity and gender in the UK

Gender participation in higher education has also been an issue of interest for researchers in the UK with the role of women being under debate (Acker 1992; Bagilhole 2000; Booth, Burton et al. 2000; McTavish and Miller 2009; Bird 2011). Ledwith and Manfredi (2000) have referred to the National Association of Teachers in Further and Higher Education (NATFHE) in which concern was raised about women's promotion in higher education in the UK. They stated that according to NATFHE, reaching a principal lectureship position is a key promotional stage in the UK academic hierarchy. However, women are less likely than men to become principal lecturers. In addition, the promotion prospect of women researchers was reported as almost non-existent (Ledwith and Manfredi 2000:10). Female under-representation in senior positions in higher education was also reported by Bett (1999). Bett (1999:23) argues that despite the fact that women constitute just over half (51%) of all staff in higher education, the number of men in senior positions is almost double that of women in the UK.

Apart from women's position in higher education, the difference between the productivity of male and female academics has been an area of concern for more than four decades, with the result of different studies showing that men are more productive than women (Kyvik 1990; Long 1992; Xie and Shauman 1998; Fox 2005; Mauleon and Bordons 2005; Bird 2011). The explanations offered by these studies for women's lower level of productivity centre around arguments that highlight discrimination and the unpleasant male-dominated social environment women may experience throughout their careers (Bagilhole 2000; Knights and Richards 2003; van Anders 2004). These studies, however, are mostly conducted in science with the

exception of Bird's (2011) study in which the productivity of academics in social science was examined. This matters since the number of women is generally higher in social sciences, and in the humanities, than in the sciences. Library and Information Science (LIS) is a discipline that attracts both men and women both as practitioners and as academics (Peñas and Willett 2006). However, little is known about the scholarly output of male and female LIS academics in the UK as previous studies of gender and productivity have been mainly undertaken in the United States. Whether there is a difference between the productivity of male and female LIS academics in the UK, and whether academic rank and position affect productivity of LIS scholars are areas that require further examination. This research aims to illuminate these areas and determine whether the differences that have been observed in other subjects are applicable in the LIS discipline in the UK.

1.3 Motivation for the study

As discussed, women's under-representation in higher education has been well documented around the world as well as in the UK. The matter of equality between men and women is an important and fundamental issue for countries within the European Union (European Union Commission Statement 2010). In the past, The European Union (EU) has considered a number of different strategies and policies in order to maintain equality between men and women in higher education. One of these policies is to systematically collect data and publish gender-disaggregated statistical results. The purpose of gathering such data is to reflect on the current situation while being able to use them for further policy development and planning. However, the European Commission (2000:71) states it is still hard to determine the

position and participation of women in higher education, due to lack of relevant data. Therefore, there are three key issues motivating this study:

a) There is a need for further insight into the productivity of women in higher education in the UK to establish whether women are still less productive than men. This is particularly important because statistics for the UK show an increase in the number of women in higher education. Table 1-1 compares the number of male and female full-time academic staff in higher education, using the Higher Education Statistics Agency (HESA) website. According to Table 1-1, the number of women in higher education has increased by nearly 11 per cent from 1995 to 2011. Although this is not a dramatic change, it shows a substantial improvment over a 16 year period which might have had a positive impact on women's productivity. In addition, there is a possibility that because of the increase in the number of women, women's productivity in female-dominated disciplines is becoming comparable with men. Bird (2011) argues that in diciplines such as Social Policy and Psychology, women's publication rates are related to their relative numerical presence within the field. Since LIS is often branded as female dominant (Golub 2010) a gender-focused study of publication rates in this area could provide useful evidence for the validity or otherwise of this assertion.

Table 1-1 A gender comparison of full time academic staff in higher education in the UK (HESA 2011)

	1994-95	2003-04	2010-11
Percentage of men	72.3	64.8	61.3
Percentage of women	27.7	35.2	38.4

b) According to the existing literature, more studies have been conducted in science disciplines than in social sciences and humanities with regards to gender and productivity. Examples of some of these disciplines are Medicine (Kaplan, Sullivan et al. 1996), Science and Enginnering (Long 1978; Koehler and Persson 2000; Bordons, Morillo et al. 2003; Long 2003; Carayol and Matt 2006; Fanelli 2010; Reed, Enders et al. 2011), Material and Life Science (Xie and Shauman 1998; Fox 2005; Mauleon and Bordons 2006), Psychology (Leahey 2006; Malouff, Schutte et al. 2010), Politics and Criminal justice (Stack 2002; Snell, Sorensen et al. 2009; Hesli and Lee 2011). In Library and Information Science, there are a few studies (Olsgaard and Olsgaard 1980; Adamson and Zamora 1981; Cline 1982; Metz 1989; Buttlar 1991; Garland 1991; Terry 1996) that have measured productivity and authorship characterstics among LIS academics, some of which have reported gender differences in academic publications (Hakanson 2005; Mukherjee 2009; Reece-Evans 2010). However, a great number of these studies are rather dated and were mainly undertaken in the United States using American journals as their sample of population. An exception is a study conducted by Peñas and Willet (2006) in which only two of the UK's LIS departments are part of the sample. Therefore, there is a need for additional current research

to investigate gender productivity among the UK's Library and Information Science academics, a study that has not been undertaken before.[1] This also provides new insights into the productivity of LIS academics in the UK as well as a platform to compare this subject to previous studies with a fresh insight into the discussion.

c) There is a need to apply a comprehensive method, which uses both bibliometric techniques and a variety of variables, in order to gain a clear picture of academic productivity within the LIS discipline in the UK. The methodologies used by previous studies have focused on only a limited number of variables. Variables such as academic rank, collaboration, type of publication, affiliation, and the subject of papers have never been used all together in one study. However, it is also important to include bibliometric indicators such as citation analysis and h-index in the study of productivity because of the significance of these indicators in research assessment (Thomas and Watkins 1998). Therefore, it is important to develop a methodology which uses a broad number of variables, and applies bibliometric techniques, in order to gain a fresh insight into the matter of productivity among LIS academics in the UK.

1.4 Aims and Objectives

The primary aim of this thesis is to assess the impact, if any, of gender on the research productivity of academics in LIS in the UK using bibliometric methods and

1. It should be noted that the matter of gender issues within LIS in the UK has been examined by studies such as McDermott (1998), Jones and Goulding (1999), and Jones and Oppenheim (2002). However, these studies were concerned about other gender related issues not productivity.

indicators and statistical analysis. Productivity will be compared by examining the number of publications, number of citations, and the h-index of male and female LIS academics. This research also aims to understand the impact of institutional factors, and the various bibliometric indicators on the publication patterns of male and female academics within LIS in the UK. The work will complement existing research on gender and productivity in LIS in particular, and indicate any changes to scholarly publication trends in general.

The objectives of this study are as follows:

- To compare the research productivity of male and female LIS academics in the UK. The objective is to discover any differences between male and female academics' publications in terms of the number of publications, number of citations and h-index.
- To investigate the impact of institutional factors on the productivity of male and female LIS academics. These factors include affiliation, academic rank, academic status, length of career, co-authorship and the sub-disciplines the LIS academics publish in.

1.5 Main research questions

In order to achieve these aims the following research questions will be answered:

- Does gender have any impact on academic rank and status of academics in LIS?
- Considering gender, what is the distribution of LIS academics across LIS departments in the UK universities?

- Does gender have any impact on the productivity of LIS academics in the UK in terms of the number of publications, citations and h-index?
- What is the gender distribution of LIS academics across specialisms that make up the LIS discipline?
- Considering gender, what are the differences between LIS academics in terms of the type of materials they publish?

1.6 Scope

This study is confined to Library and Information Science and investigates the productivity of academics within this discipline in the UK. In order to find the academics, LIS departments within the UK universities were identified as the primary source. The procedure of identifying LIS departments in the UK is described in section 3.6 of Chapter 3. In alphabetical order, the selected universities for this study are Aberystwyth University, City University, Manchester Metropolitan University, Loughborough University, Robert Gordon University, The University of Sheffield, and University College London (UCL). The next stage identified those academics who were working at the selected LIS departments at the time of this study's data collection. This was done by finding a list of academic staff from each of the universities' websites. Therefore, the academic staff working in LIS departments in each university comprise the main population for this study. There were a few members of staff who seemed to have left their departments, but, as their names were still in the list of the active academic staff in their university's website, they were also included in this study. The next stage included searching for the identified academics' publications. The academics' publications make up the second population

for this study. It should be noted that all academics identified for this research are included in this study, whether or not they have had any publications.

In relation to publication type, the scope for this research was to collect all forms of publication including: academic papers and articles, conference papers, book chapters, books, reports, and editorial notes. In terms of time scale for publications, the strategy was to retrieve all published publications in order to obtain as comprehensive a list as possible for each academic. As the data collection process was completed by the end of September 2010, those items published later are not included in this study. In addition, any academics who started working for any of the departments included in this study after the data collection was ended are excluded from this study.

It should be noted that although the focus of this study is productivity, the research also compares elements such as length of career and collaboration patterns with a gender perspective. This is to provide a clear and holistic image of gender issues in the LIS discipline in the UK.

1.7 Distinctive quality of the study

This study's characteristics make it distinctive among other research studies conducted on gender and productivity. The main distinctive quality of this study is its comprehensiveness. As previously described, this research does not use a particular group of academics or particular type of publication within a limited time but includes all academics and their publications within the LIS discipline in the UK. Therefore, the results of this study will provide invaluable information about current publication patterns and productivity among LIS academics in the UK.

Another distinctive quality of this research is that the productivity of LIS academics in the UK has not been investigated before. Also, as outlined in the previous sections, most of the studies concerning productivity and gender have been conducted in science and engineering disciplines. Those studies that measured productivity in LIS are rather dated and were conducted in other countries, mainly in the United States. Therefore, this study will not only provide a fresh insight into the matter of gender and productivity of LIS academics in the UK but will also fulfil the need for this type of study in social sciences and humanities.

Finally, the methodology used in this study makes it unique compared to similar types of studies. The data collection method, which will be described in chapter three, gathers comprehensive data using bibliometric methods. The mixture of bibliometrics and statistical analysis provides a rich picture of productivity among LIS academics in the UK.

1.8 Thesis Outline

This thesis is divided into five chapters and six appendices. The current chapter, Introduction, explains the background to the research and describes the motivation for the study. This chapter also presents the scope of this research, the questions and the study's aims and objectives. An overview of the literature is presented in chapter two, in two parts. Part one of Chapter 2 reviews the literature on subjects related to the history of women's presence in academia, the definition of productivity in higher education, variables related to productivity, and productivity within LIS. Part two offers a review of research methodology and defines the related terms. This part also explains bibliometrics as well as reviewing the methodology of previous articles that have investigated productivity in LIS. Chapter 3 presents the research design and the

research process, and discusses the applied procedures and methods for specifying the research population and the data collecting process. Chapter 4 begins with an overview of the study's variables before illustrating the findings of this research. This chapter also presents the results of the analysis and offers a discussion section for each of the results. Finally, this chapter ends by matching the results with the research questions. Chapter 5 presents the discussion and conclusion on the findings in line with the research objectives. This chapter also presents the contributions of this study, its limitations and the possibilities for further research in this area.

1.9 Summary

This chapter presents the scope of this study by explaining the aims and objectives, and motivation of the research. In this chapter, the background related to the research problems is portrayed and the distinctive quality of this study is discussed. The chapter ends with the presentation of the thesis outline, giving a brief description of the chapters of this study.

Chapter 2- LITERATURE REVIEW

The purpose of the literature review in academic research is to understand the history of the subject to be studied as well as gaining an appropriate knowledge of the ideas and work done by others. Hart (1998:27) offers a comprehensive list for the purpose of literature review emphasising its importance in establishing the context of the topic or problem, gaining a new perspective of the study and discovering the important variables relevant to the topic. Another important purpose of a literature review is to understand the main methodologies and research techniques that have been used in the area of the study (Hart 1998). This will help the reader to learn about methodological assumptions and data collection techniques related to the topic at hand as well as evaluating the relative merits of different methodologies. Therefore, a literature review not only helps the reader acquire sufficient knowledge of the subject and previous work done, it also helps them in structuring the framework of the research through understanding of the methodological assumptions and data collection techniques in the subject area of study. Focusing on these purposes, this chapter is divided into two parts. Part one elaborates on the subject matters related to the topic of this thesis while part two reviews the literature related to research methodologies. Part two also includes a comprehensive review of the research methods related to this study and evaluates the different data collection techniques within the reviewed methodology.

Part One

2.1 Overview

Subjects related to this research include productivity, gender and women's studies, library and information studies (LIS) and bibliometrics. Decisions about what research should be covered within the literature review for this research was a challenging process. This is because these subjects are very broad areas in their own context and seeking research that has only covered these subjects would have narrowed the literature review. Therefore, it was decided firstly to review those subjects that are fundamental for understanding the purpose of this research, and then move on to the specific subject areas related to the research. This was done with the aim of providing a platform to understand and define the related subjects, as well as reviewing previous researches' approaches and methods.

To serve these purposes, this part of the literature review consists of four sections. The first section, with rather a narrative approach, will review the history of women in science and their contribution to science and academia. This is followed by a review of the status of academic women in the UK. The second section examines the definition of productivity particularly in higher education. The third section elaborates on the measurement of productivity and its related variables in four subsections. Finally, the fourth section reviews the literature related to the measurement of productivity in LIS. It is worth nothing that the matter of gender and productivity was a high profile issue during 70s and 80s. To reflect this, it was essential that the literature review should comprise a great number of papers published during that time. However, the researcher acknowledges that the female academic population and hence the number of publications by women has changed

during recent years. This phenomenon makes research of this kind necessary to reflect the current status of women in academia.

2.2 Women's status in higher education

2.2.1 History of women's presence in academia

The history of women in academia is a broad subject which involves different issues such as the sociological aspects of women's presence in science and academia. However, this section will focus only on the obstacles that have limited women's progress throughout the history of higher education.[1]

The literature related to women in science and academia suggests that throughout history, women have been channelled into domestic roles and barred from formal education in most countries (Frize 2009:145). It has been documented that women with the desire to work in science[2] have faced various barriers ever since the scientific revolution in the 17th century (Zuckerman, Cole et al. 1991:11). Fox (2001:656) argues that even now academic women have to face barriers of selection, including self-selection into science fields, and selection by institutions in order to stay in higher education. The difficulties that women have faced through history have been categorised into three main areas by Zuckerman and Cole (1975:84). The first area focuses on social and cultural aspects of society suggesting that, either directly or indirectly, women are not as appropriate as men for scientific and academic jobs. This matter has negatively influenced recruitment systems and

1. For a detailed history of women in science and engineering, please see Frize (2009)

2. It seems the term 'science' in the literature has a broader meaning than just natural science; it merely used to refer to all scientific practice.

resulted in the creation of male-dominated environments in a number of academic workplaces. The second issue refers to the problems of those women who have passed the first barrier, and have entered into academic jobs. These women might have had to put up with negative and discouraging environments monitoring their competency to do their job. It is believed that this has created a negative effect on women's motivation and self-confidence in their jobs during the past few decades (Frize 2009:210). Finally, the third issue, which is also a result of the second, refers to the ongoing discrimination that some women have faced throughout their entire academic careers (Sonnert and Holton 1996).

To discover the rationale behind the ongoing idea of women's incapability in science, Schiebinger (1989:1-2) conducted research which uncovered a controversial debate originating in the 17th and 18th centuries. It was claimed on average women's brains are smaller than men's due to biological differences. Scheibinger (1989) challenges this idea by stating that even if a woman's brain is not as capable as a man's, due to its supposed smaller shape and size; the obstacles that have been thrown in women's paths cannot be justified. For an example of this, Sheibinger (1989:2) refers to Marie Curie[1], who faced discrimination and was never allowed to be a member of the *Academie des sciences*, despite winning two Nobel Prizes, simply because she was a woman.

In accordance with Sheibinger's discussion, Zuckerman, Cole et al. (1991) state that even during the 19th century, when the number of women was increasing in different areas in science, people of either sex in science and academia were known as 'men of science'. It was only at the beginning of the Victorian era that William Whewell, an

[1] . Marie Curie (1867-1934) was a famous physicist and chemist. She was the first women to win a Nobel Prize.

English philosopher of science, used the genderless term 'scientists' for everyone who was working in scientific fields (Zuckerman, Cole et al. 1991). However, despite the negative atmosphere surrounding women in science, the number of women who showed interest in subjects such as medicine and astronomy increased significantly by the end of 18th century. An additional example of women's attempts to progress in science was the European women's movement. The movement happened between 1880s to 1920s and was based on women's greater presence and engagement in science (Schienbinger 1987:309).

Alongside women's bolder presence in science and academia, a conference specifically related to women and science, was held in 1894 in Paris. The outcomes of this conference were published in two books about women who were working in science. The first book was written by Alphonse Rebière, a French author, and was called '*Les femmes dans la science'*. The second book, written by a German author, Elise Oelsner, focused on the achievement of German women[1]. Both of these books were published in an encyclopaedia format and included information about women and their academic publications (Schiebinger 1987:310). Without doubt, the publication of these books was a big step forward in demonstrating women's progress in science. It was also good practice to highlight women's achievements in academic careers. Nonetheless, these books were challenged by Gino Loria, an Italian anti-feminist mathematician, who made a notorious statement about these books and women's success by stating: "even if there are enough distinguished intellectual women to fill three hundred pages, an equivalent project for men would run to three thousand pages" (Schiebinger 1987: 310). Although this statement was declared with the negative intention of humiliating women in science and academia, it created a

[1] . The original title of this book is *'Die Listungen der deutschen Frau'*

positive outcome as women's rights activists noticed that understanding the barriers and problems women face through their career is as important as highlighting their success (Wyer 2001).

2.2.2 Women in Academia: Present

The literature suggests that, despite the significant improvement in the presence of women in science and academia in the 20th century, women are still far behind men in terms of participation in research and scientific output (Zuckerman, Cole et al. 1991:13). The objective of gender equity, which was raised by the end of the 20th century, was to bring equality for all, regardless of their gender, in personal, social, cultural, and political promotions (Goulding and Cleeve 1998:297). In Europe, this led to different investigations of how to provide and promote gender equality in all policies (Rees 1998). In 1999, the European Union (EU) adopted a communication to set out action plans in order to promote gender equality in science. This was followed by European Technology Assessment Network (ETAN). ETAN's purpose was to provide a report on the status of women in science (European Commission 2000). According to European Commission report, ETAN was formed to give high priority to redressing the imbalance between male and female researchers and to maximise the research position for both men and women.

Currently, the EU Gender Institution is responsible for providing expertise, knowledge, and visibility of equality between men and women for the period 2010-2015.

However, despite all these efforts, it has been claimed that even now, women often do not have same rights and opportunities as men in access to funds and grants, involvement in research projects and having enough space in laboratories

(Zuckerman, Cole et al. 1991:13). Bornmann, Mutz et al's (2007:236) study showed that among applicants for grants, men had greater chances of success than women by about 7 per cent. Similar findings were also suggested in a study conducted by Bentley and Adamson (2003).

2.2.3 Women's status in the UK higher education

In the United Kingdom concerns have been aired about the status of women in academia and higher education. Various studies have been undertaken to determine the position of women in the British academic environment (Acker 1992; Bagilhole 2000; Booth, Burton et al. 2000). For instance, programmes like GIST (Girls Into Science and Technology) are introduced by the Department of Sociology at the University of Manchester to understand and investigate girls' motivations in choosing the subjects they intend to pursue in higher education (Kelly 1984). Additionally, in September 2004, the UK Resource Centre for women, known as UKRC, was funded by the Department for Innovation, Universities and Skills (DIUS) with a mission to provide advice, services and policy consultation regarding the under-representation of women in science, engineering and technology (SET), as well as improving women's participation in industry, research, and academia in order to enhance female productivity in the UK academic environments in the future. Another activity which is supported by UKRC is called WISE (Women Into Science, Engineering and construction) and its mission is to encourage UK schoolgirls into science, technology, engineering and mathematics (The UKRC and WISE 2004).

2.3 Productivity in higher education

2.3.1 Productivity: general understanding

The main mission of every academic institution is to provide its members with facilities that enable them to learn from, make use of and add to existing knowledge. This simple definition can be equated to what has been called academic productivity. However, the literature indicates that various phrases have been used to refer to what is understood as productivity in academic and higher education institutions. Faculty productivity, academic productivity, research productivity and just 'productivity' have been used to define productivity in different academic fields. In general, it seems that the term faculty productivity usually refers to teaching output and is mostly used in studies related to sociology. Research productivity, on the other hand, is used to refer to academic outputs in form of publications. However, these two terms have been used interchangeably in different studies mainly based on the purpose of the research. This section briefly elaborates on these definitions.

The definition of productivity at academic level is slightly different in various previous studies. For example, Rhoades (2001:620) claims that productivity in academic institutions focuses on faculty activity including research and teaching. He states that within colleges and universities, the most commonly identified functions of productivity are summarised in teaching and research (Rhoades 2001:622). Other researchers have separated teaching from research by referring to the former as institutional or academic productivity and the latter as research productivity (Toutkoushian, Porter et al. 2003: 123-125). Some of the studies that have used the term faculty productivity to refer to teaching are those of Michalak Jr and Friedrich (1981); Webster (1985); Hattie and Marsh (1996); Diewert and Fox (1999); Middaugh

(2000); Rhoades (2001); Marsh and Hattie (2002). These studies are mostly related to sociology where perhaps teaching and its impact on academic life is the focus of the study.

Another definition of productivity relates to research output in the form of academic publications. It seems that academic publications play an important role in what is understood and measured as productivity. Hesli and Lee (2011:393) argue that studying publication records provides information that is crucial for faculty performance evaluations, research grant awards, and promotion and salary decisions. An example of this in the UK is the Research Assessment Exercise (RAE), which generates a distribution model for governmental funding to academic institutions based on their research output in the form of publications. Therefore, it is plausible that phrases such as "publish or perish" which highlight the importance of research productivity are becoming increasingly prominent in higher education (Fanelli 2010). Moreover, the literature of Library and Information Science shows that the emergence of evidence-based librarianship (EBL), which evaluates a profession by its publications, has also created an awareness of the value of the research publications and the potential they have to improve the profession (Koufogiannakis, Slater et al. 2004). This highlights the importance of publishing and the various applications of publication performance in academic evaluations. On the other hand, academic publications as a means of evaluation are largely used in bibliometrics which is considered as one of the LIS sub- disciplines. Bibliometrics uses a set of methods to quantitatively analyse academic publications (De Bellis 2009) and evaluates academic performance and productivity by using publications.

Therefore, based on the above discussion, the term productivity or research productivity will be used in this thesis to refer to academic and research publications. As a result, those studies that have used productivity as teaching output are excluded from literature review. This chapter also reviews bibliometrics and its method as they are closely linked with studies of productivity.

2.3.2 Definition of research productivity

This section will elaborate on how research productivity, with the meaning of academic publications, has been defined in different studies.

Perhaps one of the earliest definitions of research productivity was offered by Zuckerman and Cole (1975): "Research productivity can be defined and understood by analysing scientists' publications". Later Fox (1983) acknowledged Cole and Zuckerman's definition and argued that publications are the most tangible source of communication for research findings and results, as well as a help to understanding productivity in different disciplines. Examples of other studies that have defined productivity as the number of academic articles published in foreign or local journals by academics at universities or research centres are Long (1992), Lemoine (1992), Bellas and Toutkoushian (1999) and Mauleon and Bordons (2005).

Reviewing the literature suggests that many of the researchers who have worked on productivity have based their main understanding of productivity on Cole and Zuckerman's definition but have also added other aspects or their own understanding to the initial definition. For example, Levin and Stephan (1991) believe that productivity (in the sense of academic publications) should be

understood as a lifelong process which rises sharply to a peak at a certain age and then declines gradually. This definition shows that for Levin and Stephan age plays an important role in understanding and measuring productivity. In a slightly different argument, Xie and Shauman (1998: 849) have described productivity as the amount of 'research output' in a period of 'exposure'. Ramsden (1994:207), moreover, emphasises that measuring productivity in the form of publication output is not only essential for individual promotion and institutional excellence, but also for fund raising and departmental performance.

Although different aspects have been considered in defining productivity above, it seems that academic publication is unanimously applied for measuring and understanding productivity. In a study of productivity measurement, Long (1992: 161) also uses academic publications to understand productivity and argues that while the number of publications and citations are the most commonly used measures, other factors such as number of co-authors should be considered when measuring productivity. He therefore defines three dimensions for measuring productivity in his study. These are frequency, collaboration and utilisation. He explains that the frequency of publications is the total number of publications in a given time period. The second dimension is collaboration. This is defined as the number of authors per paper. Finally, utilisation reflects on the quality of a paper and the impact a publication can have in a specific discipline (Figure 2-1). Long explains that the reason why he includes collaboration as a dimension in measuring productivity is because gender differences in the number of papers published may be distorted by the effects of collaboration (Long 1992:167). He also emphasises the positive impact of co-authorship on productivity and states that those who are

involved with more collaborators may publish more papers than those with fewer collaborators.

Prior to Long's study, Harris (1990: 249) has described productivity based on the four following concepts: quantity, impact, quality and importance. He explains that quantity is measured numerically and deals with the number of publications during a certain period of time. This is more or less equivalent to Long's explanation of frequency. The second concept in Harris's model of productivity is impact. Harris describes impact as the influence a paper or academic research can have on the subject area to which it belongs. According to his definition, impact can be measured by counting the number of citations a paper receives during a certain time period. Explaining the quality and importance Harris (1990:249-250) states that "quality and importance cannot be objectively measured. The assessment of quality is highly dependent on value judgment and the importance of a piece of research may not become clear until time has passed". Although Harris's explanation of quality and its dependence on value judgment is an issue to consider, it seems that further studies have applied Long's explanation of quality (utilisation) and have used citations as a way to describe and measure the quality of papers as part of the productivity measurement. Some of these studies are conducted by Lemoine (1992), Ramsden (1994), and Lewison (2001).

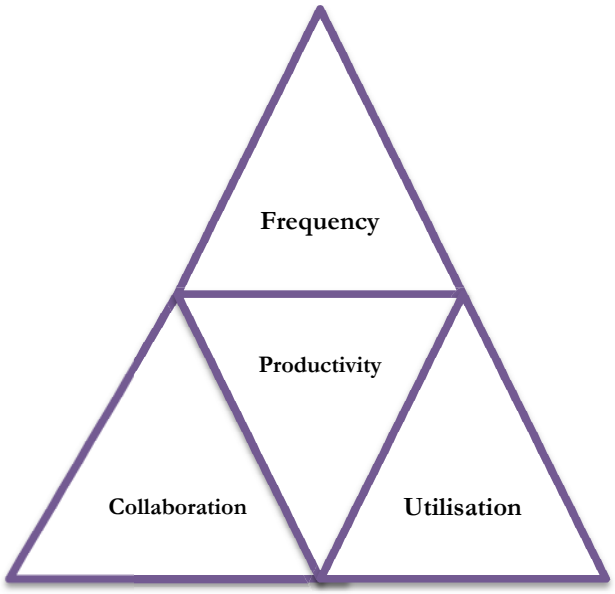

Figure 2-1 Three dimensions of productivity based on Long's (1992) study

In summary, productivity at individual and departmental level can be measured and understood by investigating academic publications. Studying publications can involve measuring the number of publications as well as the number of citations and collaborative authors in order to understand productivity. In this study, to measure productivity, the two dimensions of frequency (number of publications) and utilisation (number of citations) from Long's (1992) definition of productivity will be used. However, while this study uses collaboration to compare the publication pattern of male and female academics, it does not consider collaboration as a dimension of productivity. This is because the definition of an academic's productivity in this research is based on the number of publications they publish and the impact of these publications on the profession's literature rather than the number of people with whom they work.

2.4 Measuring productivity

Productivity and its related variables have been measured and studied across various disciplines and countries. In this section, some of these findings are presented. It was decided to categorise these studies based on the way productivity and its variables were measured. The productivity variables are divided into four main categories: *professional* variables which include academic rank, membership of a group and collaboration; *demographic* variables including age and gender; *family related* variables such as marital status or the number of children; and finally *society related* variables which include cultural issues and discrimination. Table 2-1 offers a summary of studies that have measured productivity at universities or academic institutions using the mentioned variables. Not all the literature related to measuring productivity and the related variables is claimed to be covered in the table. The idea is rather to provide an overview of the productivity related variables and the studies related to them.

2.4.1 Productivity and Professional variables

Professional variables are those which are related to the professional aspects of an academic's career. Professional variables can affect the achievements of individuals within their academic roles. Professional variables have also been named as environmental variables in some studies (Fox 1983; Ramsden 1994) and refer to factors such as graduate school background, the prestige of the department, degree of collegiality within the department, and the amount of freedom an academic department provides for its members to pursue their individual interests (Ramsden 1994:210). In order to investigate the professional variables more carefully, they are divided into three groups in this review. The groups are academic rank, membership

of a group and collaboration. Academic rank, as an important influential factor on academic productivity, will be reviewed in a separate subsection and membership of a group and collaboration will be reviewed together.

2.4.1.1 Academic rank

The results of previous studies have confirmed the positive effect of academic rank on productivity. These studies showed that the average rate of publication for academics working in senior ranks is higher than those academics working at lower rank levels. That is, academics occupying full professorial ranks publish more than those academics who occupy the lower ranks such as lecturers or research staff (Aleamoni and Yimer 1973; Long 1992; Xie and Shauman 1998; Jacobs 2001; Prpic 2002; Bordons, Morillo et al. 2003; Leta and Lewison 2003). Abramo, D'Angelo et al. (2011:916) argue that academics in higher rank positions generally have greater seniority and consequently have greater experience in their profession which can result in higher productivity. On the other hand, it has been argued that age might negatively influence productivity (Cole 1979). Aging is certainly inevitable while an academic climbs higher on the academic ranks' ladder, but it seems that before age itself could have an impact on high ranked academics, holding a top rank position positively influences the academics' productivity. Therefore, according to Abramo, D'Angelo et al. (2011) academic rank not only correlates positively with productivity but it is also the most influential factor that affects publication productivity.

Table 2-1 A summary of studies related to measurement of productivity and its related variable

Classification	Variable	References
Professional Variables	Academic Rank	Aleamoni and Yimer (1973); Long (1992); Leibenluft, Dail et al. (1993); Schurmann, Denzel et al. (1996); Kaplan, Sullivan et al. (1996); Black and Holden (1998); Green (1998) Xie and Shauman (1998); Jacobs (2001); Prpic (2002); Bordon and Morillo (2003); Leta and Lewison (2003); Malouff, Schutte et al. (2010); Abramo, D'Angelo, et al. (2011); D'Amico, Vermigli et al. (2011)
	Membership of a group	Ramsden (1994)
	Collaboration	Zuckerman (1967); Lee and Bozeman(2005); Levitt and Thelwall(2009)
Demographic variables	Age	Lehaman (1953); Dennis (1956); Cole (1979); Fox (1983); Horner, Rushton et al. (1986); van Heeringen and Dijkwel (1987); Levin and Stephan (1989); Kyvik (1990); Kaplan et al. (1996); Carayol and Matt (2006); Kyvik and Olsen (2008); Costas, van Leeuwen et al.(2010); Hedjazi and Behravan (2011); Lissoni et al.(2011)
	Gender	Zuckerman and Cole (1975); Berryman (1983), Cole and Zuckreman (1984); Schiebinger (1987); Lemoine (1992); Long (1992); Jacobs (1996); Hanson, Schaub et al (1996); Bellas and Toutkoushian (1999); Gupta and Kumar (1999); Goel (2002); Pripic (2002); Sax, Hagedorn et al. (2002); Long (2003); Maske, Durden et al. (2003); Mauleon and Bordons (2005); Bornmann, Mutz et al. (2007); Snell, Sorensen et al. 2009; Baker (2010); Fox (2010); Puuska (2010); Reed, Enders et al. (2011)
	Race	Sax, Hagedorn et al. (2002:438); Maske, Durden et al. (2003:559)
Family-related variables	Marital status	Schienbbinger (1987); Kyvik (1990:155); Xie and Shauman (1998:865); Sax, Hagedorn et al. (2002:439)
	Having dependent children	Cole and Zuckerman (1975); Kyvik (1990:155); Sax, Hagedorn et al. (2002:439);
	Number of Children	Kyvik (1990:155); Long (1990); Yentsch and Sinderman (1992) Prpic (2002);
Society-related variables	Cultural Factors	Hanson, Schaub et al. (1996); Goel (2002); Shaditalab (2005); Mozaffarian and Jamali (2008)
	Discrimination	Bagilhole (1993); Ragins (1998); Rothausen-Vange, Marler et al. (2005); Ceci and Williams (2011)

Knowing the positive impact of rank on productivity, some researchers have examined its effect on women's productivity. The results of these studies suggest that a lower proportion of women work in higher professional ranks (Leibenluft, Dial et al. 1993; Kaplan, Sullivan et al. 1996; Schurmann, Denzel et al. 1996; Black and Holden 1998; Green 1998; Bordons, Morillo et al. 2003; Abramo, D'Angelo et al. 2009; Malouff, Schutte et al. 2010; Abramo, D'Angelo et al. 2011; D'Amico, Vermigli et al. 2011). This is even the case in female dominant professions such as psychology and psychiatry both in Europe and the United States (Leibenluft, Dial et al. 1993; Kaplan, Sullivan et al. 1996; Schurmann, Denzel et al. 1996; Black and Holden 1998; D'Amico, Vermigli et al. 2011). It seems that one consequence of working in lower academic ranks is lower productivity for women in these professions. Leibenluft, Dial et al. (1993) explain that in their sample of study, academic psychiatrists, men were more likely to have had research training and therefore occupied higher posts than women and as a result men were more productive.

Bordons, Morillo et al. (2003) investigated productivity among natural sciences and chemistry scholars. They argue that productivity tends to increase as professional category improves. They explain that promotion depends on productivity and as a result only the most productive academics reach an upper rank category. On the other hand, once a high rank position is attained, it is easier for academics to maintain a high level of productivity as they are more likely to be the head of teams, have access to funding and projects and have more collaborators. They explain that productivity appears to be related to academic rank, and the lower productivity of women can be explained by the fact that they are working at lower professional ranks compared to men. However, in their own study, they

found no significant difference in the productivity of men and women. They consider that if academic ranks were not to be taken into account, male scientists would show greater productivity than female scientists. This is what has been reported by other studies (Cole and Zuckerman 1984; Long 1992; Abbott 2000). However, when the productivity is measured in the same rank category, men and women are equally productive (Bordons, Morillo et al. 2003:169). Therefore, it is fair to say that women in high ranking positions are just as productive as their male counterparts. The problem is that somewhere in the academic advancement path women drop out and therefore fewer women than men reach higher rank positions. According to D'Amico, Vermigli et al. (2011) women's productivity is growing in parallel with their representation in academia. However, it takes longer for a strong and steady female doctoral with strong scientific productivity to reach the top rank in her profession. Some of the variables reviewed in this chapter could be the reason why fewer women reach higher rank positions but while measuring productivity it is important to measure women's productivity on an aggregated level, or on an individual level.

2.4.1.2 Membership of a group and Collaboration

The next two variables in the professional variables category are membership of a group and collaboration. As these two are barely separable, they are reviewed together in this section.

Academic membership in a highly active research department has a huge positive impact on an individual's academic productivity (Ramsden 1994: 219). Measuring research productivity among Australian scholars, Ramsden (1994) claims that on average, members of a highly active group produce more than five times more than

members of groups with less activity. He shows that active research departments produce more publications than less active ones. This consequently affects the level of the individual's productivity. The reasons why this happens could lie within the cooperative management of the department, or the departmental context that creates an environment that leads to a high level of individual productivity. Ramsden (1994: 219) believes that the best structural predictor of individual output is the academic's membership of a highly active research group. Prior to his study, Bland and Ruffin (1992) had also examined the effect of academic membership on productivity. Their results correspond closely with Ramsden's findings.

Collaboration, or multi-authorship, in studies of productivity, refer to publications that have more than one author and the work produced is based on the collaboration of these authors (Levitt and Thelwall 2009). Academics may collaborate within their own departments or within their discipline, either nationally or internationally. In some subjects with interdisciplinary topics, collaboration can happen between academics working in different subject fields. Studies of collaboration have been undertaken with the underlying assumption that the activity has a positive impact on productivity (Zuckerman 1967; Godin and Gingras 2000; Lee and Bozeman 2005). It seems that policy makers also believe in the positive effects of collaboration on research productivity (Lee and Bozeman 2005:674). According to Abramo, D'Angelo et al. (2009:156) European Union research policies have acknowledged and supported the creation of networks to achieve higher productivity performance. Moreover, it seems that researchers themselves assume that collaboration results in greater productivity (Beaver 2001). It is suggested that collaborating with highly productive scientists tends to increase personal levels of productivity, and collaboration with less productive scientists decreases it (Lee and Bozeman 2005).

This is because working with a productive group of people produces a synergistic effect among the member of the group and results in higher individual productivity.

Despite the empirical findings that show positive impacts of collaboration on productivity, this is questioned in some theories. The argument is that even if the effect of collaboration on productivity is agreed, it is hard to accept that there is a straightforward relationship between the two. Lee and Bozeman (2005) offer a model which suggests that various individual, institutional, and environmental factors affect collaboration and productivity (Figure 2-2). The model suggests that there might be some direct relationship between collaboration and productivity, but the interaction of other variables can also affect collaboration and productivity.

According to other opinions, not all collaborations result in greater productivity. Despite the building of interdisciplinary institutions and inter-sectoral projects and programmes to promote collaboration, collaborators had often participated in projects that were never finished, nor achieved the intended outcome, as the result of poor performance by a number of the collaborators involved (Behrens and Gray 2001; Lee and Bozeman 2005). Without doubt, other factors such as the complexity of human relationships can influence collaboration between scholars and the productivity.

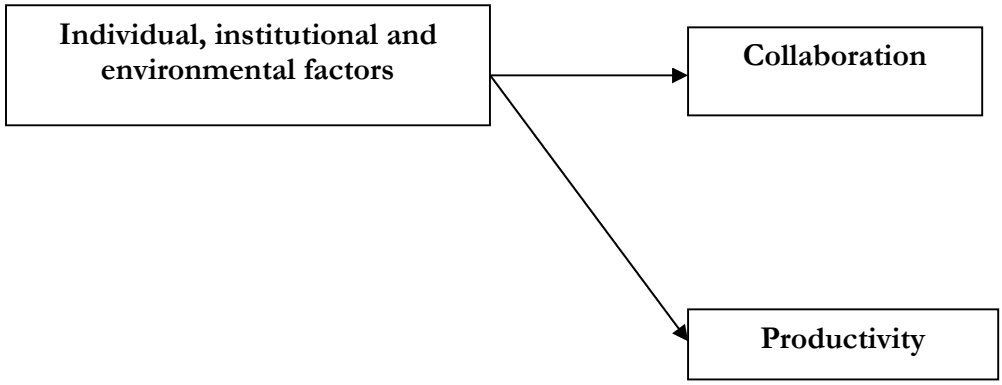

Figure 2-2 basic relationship between collaboration and productivity (Lee and Bozeman 2005:677)

In summary, it can be deduced that while collaboration does have a positive impact on productivity, other influential factors might change the result of this positive impact.

2.4.2 Productivity and demographic variables

This section reviews the literature that has measured the impact of demographic variables on academics' productivity. Demographic variables are those that describe current characteristics of a population such as age, ethnicity, income, education, gender, and race. The literature shows that the main demographic variables that have been considered as determinants of academic productivity are age and gender. However, studies such as Sax, Hagedorn et al. (2002) and Maske, Durden et al. (2003) have also measured the effect of race in academic productivity. The following two subsections review studies that explored the relationship between age and productivity and gender and productivity.

2.4.2.1 Age

The effect of age on productivity seems to have been a serious and well-studied topic in sociological studies of productivity (Lehman 1953; Dennis 1956; Cole 1979; Fox 1983; Horner, Rushton et al. 1986; Van Heeringen and Dijkwel 1987; Levin and Stephan 1989; Kyvik 1990; Kaplan, Sullivan et al. 1996; Carayol and Matt 2006; Kyvik and Olsen 2008; Costas, van Leeuwen et al. 2010; Hedjazi and Behravan 2011; Lissoni, Mairesse et al. 2011). In one of the earliest such studies, Lehman (1953:9) argues that productivity declines with aging and scientists' major findings occur in their 30s or 40s. He highlights that in theoretical disciplines such as physics the age peak occurs earlier than in empirically based fields such as biology.

Some years later Cole's (1979) results suggest that there is a relationship between age and scientific performance. However, he argues that this relationship can be influenced by the operation of the reward system. He states that as age goes up productivity declines unless the reward system encourages authors to remain as productive as before. Studying psychologists' productivity, Over (1982) attempts to find the reasons why psychologists over the age of 45 are less productive than psychologists under the age of 45. He suggests that generational differences or differences in attitude and commitment towards research might be the reason for changes in the patterns of productivity in different age groups (Over 1982:515). The decline in productivity with aging has been also documented in other studies (v an Heeringen and Dijkwel 1987; Levin and Stephan 1989; Kyvik 1990; Costas, van Leeuwen et al. 2010; Shin and Cummings 2010; Hedjazi and Behravan 2011). On the other hand, Levin and Stephen (1989) suggest that age is a fairly weak predictor of academic performance. However, they acknowledge that in some disciplines such as physics, earth sciences, physiology and biochemistry, older scientists publish less

than their younger and middle age colleagues. Alongside age, factors such as gender, institutional promotions and working status also affect productivity (Kyvik 1990; Prpic 2002; Carayol and Matt 2006). The results of studies looking at age, gender and productivity suggest that age affects men and women equally. Kyvik (1990) reports that women are most productive within the age range 50 to 54 while men are more productive between the ages of 45 to 49. He suggests that differences in the age range between men and women could be due to childbirth or other family responsibilities (Kyvik 1990).

2.4.2.2 Gender

Gender is possibly the most controversial yet important variable amongst the demographic variables related to studies of productivity. The importance of gender studies is due to the fact that gender is a "universal ground for social differentiation that cuts across all other social categories and variables" (Assié-Lumumba 2001:[1]). Gender studies are also part of a bigger concept known as "gender equity". Gender equity's mission is to provide equalities for all, in social, cultural, and educational aspects of life regardless of gender (Goulding and Cleeve 1998:297). To support gender equity, United Nations Women (UN Women), which is the United Nations' entity for gender equalities and the empowerment of women, was established in 2010. UN Women's vision is to ensure elimination of discrimination, empowerment of women, and achievement of equality between women and men as partners and beneficiaries of development, human rights, humanitarian action and peace and security (United Nations Women 2010). Therefore, any academic and higher education institution as part of any society should ensure equality for both men and women. This highlights the importance of gender studies which has been an area of interest among academics. The literature related to studies of gender and

productivity suggests that most of the studies which have examined the effects of gender on productivity have revealed that women publish less than men (Zuckerman and Cole 1975; Berryman 1983; Cole and Zuckerman 1984; Schiebinger 1987; Lemoine 1992; Long 1992; Hanson, Schaub et al. 1996; Jacobs 1996; Bellas and Toutkoushian 1999; Gupta, Kumar et al. 1999; Goel 2002; Prpic 2002; Sax, Hagedorn et al. 2002; Long 2003; Maske, Durden et al. 2003; Mauleon and Bordons 2006; Bornmann, Mutz et al. 2007; Snell, Sorensen et al. 2009; Baker 2010; Fox 2010; Puuska 2010; D'Amico, Vermigli et al. 2011; Reed, Enders et al. 2011). A small number of studies, however, have reported few or no gender differences in publication rates when they have considered other factors such as academic rank (Lemoine 1992; Sonnert and Holton 1995; Ward and Grant 1996; Xie and Shauman 1998; Gupta, Kumar et al. 1999; Mauleon and Bordons 2006). A historical review of the situation reveals that one of the earliest studies that discovered women's under-representation in publication rates was conducted by Cole and Zuckerman (1984). They referred to more than fifty studies in different disciplines suggesting that on average men publish twice as much as women.[1] Since they could not explain the existing gender disparity in publications, they called it 'productivity puzzle'. Since then, the 'productivity puzzle' has been used as an accepted term by other researchers to refer to gender disparity in academic publications. This was used especially in cases where the researchers were unable to explain the causality of the productivity puzzle (Blickenstaff 2005). There are other terms and phrases that have been used to refer to women's under-representation in academia. An example of these phrases are 'leaky pipeline', 'crystal glass ceiling', and 'scissors effect' (Xie and

[1] . It should be noted that most of the studies that Cole and Zuckerman referred to were American. Therefore, in some studies the matter of women under-representation is addressed as a strong case in the United States.

Kimberlee 2003; Naldi, Luzr et al. 2004). Leaky pipeline, which was introduced by Berryman (1983), compares science with a pipeline. The pipeline connects academic education to academic occupation. He explains that women leak out of the pipeline before they reach its end which is senior academic occupations (Xie and Kimberlee 2003:7). As was shown in the rank section, rank correlates positively with productivity and therefore this model partially explains women's fewer publications as it claims that women rarely reach high rank positions.[1] While this model can explain that as the result of the leakage fewer women reach the end of the pipeline, it is unable to explain why women 'leak out'. Other studies argue that it is hard to accept that only women leak out of the science pipeline. Blickenstaff (2005) states that the leakage happens to both men and women through their journey, from getting degrees to working in academic or scientific occupations, but it seems that women leak out more than men. The next popular term to describe women's under-representation in academia is 'crystal glass ceiling'. This phrase was initially defined by the US Department of Labor in 1991 and was used to refer to the artificial barriers that stop qualified women from progression and advancement to senior management level positions within their organisations (Snyder 1993). Poland, Curran et al. (1996) explain that these artificial barriers consist of individual, interpersonal, and organisational factors which lead to the construction of the glass ceiling. Finally the 'scissors effect' in women in academic careers (González-Alcaide, Alonso-Arroyo et al.[2006] ; Naldi, Luzr et al. 2004).

To understand the productivity puzzle and to explain why women publish less, researchers have examined the impact of some factors on women's productivity such

[1] . It is important to note that the argument here is about all women's summarised publications compared to men. As it was discussed in the rank section, women who reach top rank positions are as productive as men.

as the impact of household duties and childcare (Cole 1979; Kyvik 1990; Fox 2005). However, the results contradict the explanations, as unmarried and childless women publish less. Kyvik (1990) argues that perhaps women with children have more stamina and have better health, and married women receive more support from their husbands. It should be added that the age of the children has also been addressed and it seems that women with young children are less productive than both men and other women, while there are hardly any gender differences between men and women with children older than 10 years (Kyvik and Teigen 1996). Some studies claim that gender differences have contributed to women's lower rank in academic positions and hence their lower productivity (Cole and Zuckerman 1984; Xie and Shauman 1998; Prpic 2002). In a fairly new study, Puuska (2010) compares the number of women in Finnish universities with the number of women in the highest rank position and affirms that despite being well represented in universities, Finnish women are under-represented in high rank positions. Another explanation of the gender disparity between men and women is that research networks are mainly male-dominated and women do not have easy access to them (Cole 1979; Fox 1991). Kyvik and Teigen (1996) discovered that productivity of female academics is influenced by lack of collaboration which can itself be due to the lack of professional confidence among female academics. Ward and Grant (1996) also propose a set of explanations for women's fewer publications. They maintain that the organisation of research training and academic careers is based on a male role model that makes it harder for women to cope academically. They also suggest that women are less likely to receive mentoring, socialisation into scientific community and preparation, or research and publishing practices. They also believe that academic males and females allocate their time differently; women devote more time to teaching and

administrative work while men tend to have more students under their supervision. Difference in motivation is another possible explanation of the productivity puzzle. Wennerås and Wold (1997) believe that women are less motivated and career orientated than men. Subject specialisation is claimed to be another reason for women's lower productivity. In a study conducted by Leahey (2006), productivity is measured among academics who work in the two disciplines of sociology and linguistics. He considers research specialisation as an intervening variable. The result of his study suggests that women specialise less than men, and this negatively affects their productivity. Finally, Fox, Fonseca et al. (2011) emphasise the organisational impact on productivity and argue that in order to understand women's productivity and their status in academia, features of the organisations in which women work and study should be considered. In addition, a recent study conducted by D'Amico, Vermigli et al. (2011) confirms women are under-represented in productivity and top rank positions. This is a rather disappointing result because of the following reasons:

(a) The chosen discipline for the study is psychology, which is claimed by the authors to be a female dominant field for decades;

(b) The chosen country is Italy which is also claimed to have the highest representation of women among university faculty (D'Amico, Vermigli et al. (2011);

(c) The study is rather new and examined the productivity of psychologist academics over seven years, from 1998 to 2004.

They argue that their result could be explained by the differences in female-male seniority status within ranks, and the fact that women were a minority in full professor ranks (D'Amico, Vermigli et al. (2011). Another recent study, with similar

results, examines the productivity of scholars at the University of Helsinki, Finland during the period 2002-2004 (Puuska 2009). The results of this study reveal that gender distinction is smaller but still exists. This study showed that despite the increase in the number of female professors, they still publish less than their male counterparts (Puuska 2009:434-435).

In summary, it can be said that productivity is still a puzzle despite different theories and explanations. Moreover, recent studies do still record an imbalance in the number of publications by men and women. On the other hand, there is much evidence that academic rank plays a crucial role in productivity and therefore academics in higher ranks do publish more. The literature review also showed that once men and women are compared in the same professional rank categories, they are as equally as productive as each other. This should be taken into account in further studies in a way that women's productivity should be measured in aggregated or individual level rather than comparing all summarised publications of men and women. It is also important to acknowledge that both men and women leak out of the academic pipeline. However, traditionally women have leaked out more than men as the result of traditional family obligations, male hierarchies or simple disfavouring of women.

2.4.3 Productivity and family related variables

This section briefly reviews those studies that have investigated the impact of variables relating to academics' personal and family life. These variables include marital status, number of children and number of dependent children. The impact of these variables on gender productivity was briefly mentioned in the gender section.

However, it was decided to review these variables in a separate section, as both gender and family related variables can be the cause or the effect of the other, depending on the study. Also in some studies such as Fox, Fonseca et al. (2011) family related variables are the focus of the study rather than being an explanation for gender differences. Therefore, this section reviews those studies that have investigated the effect of family related variables on productivity and gender.

The positive impact of marriage on productivity of academics has been reported in previous studies. Conducting a survey analysis in the United States, Xie and Shauman (1998) confirm that despite the general assumption that men benefit more from marriage, both men and women benefit equally from being married. The positive impact of married life on academic productivity is also argued by Luukkonen-Gronow and Stolte-Heiskanen (1983). They state that family life and being married do not have a negative impact on academics' productivity, but improves it. Long (1990) also argues that there is no evidence to show marriage affects academic performance negatively and that single academics publish more. This is in line with Cole and Zuckerman's study (1984) that showed married female academics with children publish more than unmarried female academics. On the contrary, Fox, Fonseca et al. (2011) argue that family/household interferes with work and work interferes with family/household but there is more interference of work with family/household than the other way round. They also argue that there is a gender difference in this interference and for women family/household interferes more with work.

Having children does not seem to have much impact on productivity for both men and women. In an early study, Cole (1987) argues that number of children has no

impact on women's productivity and women publish less regardless of their marital status and number of children. Kyvik (1990) also argues that women's lower productivity cannot be due to having children. He states that it is misleading to compare the productivity of people with children with those without children, but the matter of childcare becomes crucial when the age of the children is considered as a variable. Kyvik's (1990) results show that, in a similar family situation and academic position, women with children older than 10 years of age are as productive as men. This result is consistent with Fox, Fonseca et al. (2011) which also reveals that the age of children (under the age of 6) increases the chances of family interferences with work for both men and women and can create family-work conflicts.

The impact of family life and children is slightly ambiguous with different studies showing different results, however, the age of the children certainly plays an important role in academics' life and can affect their productivity.

2.4.4 Productivity and Social variables

In this review, those variables that are related to society and can affect an academic's career are classified as social variables. These variables include cultural issues and discrimination. Cultural issues can play crucial roles in some countries and could have direct impacts on the life of academics, especially women. Discrimination, which still exists in many places, is also a prohibiting factor that can negatively influence productivity.

2.4.4.1 Cultural factors

In some countries, the impacts of social and cultural factors on women are among the main causes for women's under-representation in higher education. In India, for

example, female's upbringing forces women to believe in fate and stops them from fighting for their rights (Goel 2002:245). As in life, this kind of beliefs can appear in workplaces and can severely disadvantage women. Surprisingly, in a highly developed country like Japan, the role of cultural issues is still very strong and acts as a barrier for women. Hanson, Schaub et al. (1996) argue that Japanese women do not reach high academic ranks in subjects such as mathematics, physics and chemistry as much as they do in biology. This is the result of a cultural belief that labels subjects such as physics and mathematics, to be more suitable for men than women. Iran is another country where academic women are still suffering from cultural factors. Throughout the history of Iran, the idea of being a housewife rather than working outside the home has been well appreciated among uneducated as well as some educated people (Shaditalab 2005). Therefore, results such as Mozaffarian and Jamali (2008), which shows Iranian women's contribution in academic publications is significantly lower than expected, are not surprising[1].

2.4.4.2 Discrimination

It is likely that discrimination is still among the reasons to explain women's lower productivity. More than 35 years ago, women were discouraged from taking part in scientific careers because the general idea of women's inappropriateness in science had contributed to discrimination against women (Zuckerman and Cole 1975). In search for an answer to women's fewer publications, Long (1992:59) deduce that women do not have access to different resources in the same way that men do and this therefore results in gender differences in academic productivity. Other studies claim that women are treated differently in masculine environments, especially in

[1] . This study shows that women's contribution to academic publications in 2003 was only 6 per cent while men contributed in 94 per cent of the publications.

managerial jobs. Ragins (1998) and Rothausen-Vange, Marler et al. (2005) argue that women's work is either not being taken seriously or is set up to higher standards. This makes women work harder than men to demonstrate the quality of their work. In the UK, the fact that academic women were in minority in the past, has resulted in discrimination against women in some disciplines at present (Bagilhole 1993). Bagilhole (1993:440) explains that discrimination includes the type of responsibilities that women are given or are not given because they are women. She also argues that women are excluded from research networks and collaborative research. A few years later, she calls for effective action to equalise the male-dominant environments of the universities and labels projects such as ATHENA[1] and CUCO[2] which aim to overcome the barriers to equal opportunity in universities as "too little and too late" (Bagilhole 2000:142).

Other studies in the 1990s, address discrimination as one of the reasons for women's under-representation in publishing and productivity. For example, a study of Brazilian women's productivity in three scientific subjects, shows that women publish at equal level as men both in terms of quantity and quality but they suffer from discrimination in their salaries (Leta and Lewison 2003). Park and Gordon (1996) argue that women are less likely to receive tenure positions despite being productive and publishing more papers than men during the first five years of their

[1] . The Athena Project was established in 1999 by the UK higher education funding councils, Universities UK and Office of Science and Technology, Department of Trade and Industry. This project's aims were the advancement and promotion of the careers of women in science, engineering and technology in higher education and research to achieve a significant increase in the number of women recruited to top posts.

[2]. CUCO stands for Commission on University Career Opportunity and was set up by Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom (CVCP) in order to overcome the barriers to equal opportunity in universities.

career. Being discriminated against in receiving tenure positions was also recorded by Lee (1990) who refers to a case that a female academic was not able to prove in the court of law that tenure was denied because of gender related matters. On the other hand, in a recent study, Ceci and Williams (2011) scrutinise the claims of discrimination against women in higher education and argue that women's under-representation in science and specifically in math-intensive fields, is not caused by discrimination in these domains but are the result of gender differences in resources, abilities and choices of women whether free or constrained (Ceci and Williams 2011).

Ceci and Williams (2011:3161) review previous studies and argue that discrimination against women has been addressed in journal reviewing, grant funding and job hiring by previous researchers. However, although the examples of these cases are more or less strong and can still exists in some domains and countries, in math-intensive fields, women have been treated as equally as men in hiring, funding and even in publishing given comparable resources. They also argue that women's under-representation is not "...due to women being bypassed in interviewing and hiring or being denied grants and journal publications because of their gender. It is primarily due to factors surrounding family formation and childrearing, gendered expectations, life style choices and career preferences" (Ceci and Williams 2011:3161). They conclude women's current under-representation results from a complex set of interrelated factors such as career preferences and family and life style choices. Although these arguments highlight that discrimination is not a strong reason for women under-representation as it has been before, cultural and traditional expectations of women still affect women's choices in pursuing certain lifestyles or careers. Therefore, it is fair to conclude that women are still under influence of

historical impact of discrimination (Lee and Bozeman 2005; Leta and Lewison 2003b; Park and Gordon 1996).

2.5 Studies of productivity within LIS

Studying the writing habits of librarians was one of the earliest studies of productivity within LIS that was conducted by Bloomfield (1966). This study employs citation counts and investigates the writing habits of librarians. Regardless of gender, this study points to a relationship between productivity and the award of a doctor's degree. A few years later, another study conducted by Watson (1977) investigated librarians' publications output in ten university libraries in the United States. This study examines the relationship between productivity and age, professional maturity, educational background and academic position among librarians at ten large universities, regardless of their gender. General studies of librarianship literature and the sociological aspect of publications in LIS are also studied by Kaser (1976), Childers (1984), and Feehan, Gragg et al. (1987). The matter of gender and authorship is addressed by one the studies of the 80s conducted by Olsgaard and Olsgaard (1980). They study ten years of LIS academics' publications in five academic journals. Their results reveal that the percentage of publications by women was lower than the percentage of female LIS professionals. That is, female LIS professionals tend to publish in disproportionately smaller numbers than men. This is an interesting result as women has reportedly outnumbered men in LIS profession (Buttlar 1991; Hakanson 2005; Morgan, Farrar et al. 2010). Olsgaard and Olsgaard compare librarianship with economics, psychology and science, and state that little has been done in understanding the bibliometric nature of LIS and its

professional literature. The importance of their study is that they aimed to raise awareness among LIS academics and their study has become a basis for further research in this area. Adamson and Zamora (1981) conduct a similar study to Olsgaards comparing publications of men and women in special library journals instead of academic journals. The purpose of their study is to investigate whether authorship characteristics in special library journals differ from those found in the Olsgaards' study. Although the results of their study show some similarities to Olsgaards' model, they find that female authors publish 9.3 per cent more frequently in special library journals than in academic ones. Although this was an encouraging result compared to Olsgaards', they argue that women are not as represented in proportion to the number of special library communities (Adamson and Zamora 1981:23). Buttlar (1991) studies publications and authorships in sixteen American LIS journals. She analyses various characteristics of authors such as gender, occupation, affiliation and geographic location. Her results show an improvement in the number of published women, particularly among special librarians. She confirms the gap between the proportion of male and female contributors in articles is slowly closing (Buttlar 1991:50). Also analyzing five years of publications[1] of a random sample of American Library Association (ALA) members, Garland (1991) discovers that if other types of publications such as book chapters, monographs, and proceedings papers are included in the analysis as well as the journal articles, the mean scores for women's publications would be greater than men's.

Studying the literature suggests that representation of women in LIS publications has improved through time. Three studies, in different time periods, are the evidence of this claim. These studies, have all investigated authorship characteristics in the

[1] . From 1980 to 1984

journal of College & Research Libraries (C&RL). The first study is conducted by Cline (1982). Cline studies various authorship characteristics such as authors' sex, affiliation, and collaboration in 40 years of the journal publications, from 1939 to 1979. Her results suggest that the average number of male authors is consistently around 80 per cent. Then Metz (1989) updated Cline's research by examining the same variables for eight years of publication, from 1980 to 1988 in C&RL. Metz's results are extensive as they show a significant increase in the number of female authors since 1979. For a better interpretation of the results, he divides the 8 years into two 4 year periods and shows that in the first four years, from 1980 to 1984, the average number of male authors is 65 per cent and in the next four years it drops to 56. Although Metz's result shows a great improvement in the overall number of female authors, the decline in the number of women in the second four-year period is rather disappointing. Finally, Terry (1996) follows Cline and Metz's studies and updates their results by studying the same authorship characteristics in C&RL from 1989 to 1994. His results suggest that for the first time in the history of the C&RL, women as primary authors are represented as equally as men (Terry 1996:380). Terry's study is a proof to Metz's (1988) prediction. Metz had suggested that continuation of the trend that he observed in his study would result in a balance in the gender of the authors. Although Terry's results are promising in terms of the number of publishing women, Terry (1996:382) indicates that when the total population of women in LIS is compared to the number of publishing women, women are still under-represented.

Most of the studies investigating authorship characteristics in Library and Information Science have been published in American journals. To balance this, instead of studying American journals, Raptis (1992) examines authorship in five

international library science journals. His findings suggest that while some authorship characteristics such as rank and affiliation follows the same pattern as American journals, there is a dramatic gender gap between male and female authors. Considering that Raptis' study only covered two years of publications, from 1989 to 1990, in just five international journals, it is difficult to conclude whether LIS women do publish less internationally. That said, Peñas and Willet (2006) find a gender difference in publications of five international LIS universities. The sample of their study is what they label as top LIS departments worldwide in the UK, Europe and the United State's universities. They argue that women's smaller number of publications in their sample could have been affected by two main factors. Firstly, men in the sample had worked for longer and perhaps had more chances to publish; and secondly men in the sample had reached a higher level in the profession and consequently had a greater visibility that would facilitate their publications (Peñas and Willet 2006:483). The matter of advancement in careers is previously addressed by Korytnyk (1988). She argues that there is a link between high rate of publications and advancement in profession which also correlates with salary, position, and prestige in one's career (Korytnyk 1988:53).

Watson (1977:380-82) also looks into variables that could affect the publications' pattern of LIS academics. She studies the publications of ten academic librarians and discovers three variables that affect the publications. The first was professional maturity. She finds out that the job experience and the number of working years correlates positively with productivity. The second variable in her study is job description. According to her results, subject specialisation and technical expertise improve publishing pattern. The last variable she studies is education. In her sample, more than half of the publications belong to librarians who hold a higher education

degree such as a second master's or a PhD. The effect of education on career advancement has also been addressed by Swisher and Du Mont (1984:137) study in which they argue that men and women publish at different rates but women who hold lower educational levels, work in lower job positions too. As previously discussed, working in lower job positions and lower rank can result in lower productivity. Therefore, one of the reasons of under-representation of LIS women in publications could be because of the fact that women work in a slightly lower positions compared to men. The matter of productivity and professional advancement is also addressed by Korytnyk (1988). She argues that as education is part of professional advancements, it is likely that the discrepancy between men's and women's publications is because men receive doctorate degrees more frequently than women do (Korytnyk 1988:52). To put this to test, and to determine the extent to which qualification is correlated with productivity, she compares the publications of an equal number of men and women who hold PhD degree in Library and Information Science. Her results show that there is not a difference in productivity of men and women who have similar qualifications. The significance of her study, however, is that by comparing the number of unpublished women with men, she discovers that the number of unpublished women is six times higher than the number of unpublished men. She argues that men and women might enter doctoral programs with different aims and perhaps having more unpublished women could be the result of differences between men's and women's ambitions.

Studies that have been undertaken in recent years show that although there has been some improvements in the number of publications by women in LIS, there is still a gender bias in LIS academic publications (Hakanson 2005; Mukherjee 2009; Reece-

Evans 2010). Hakanson (2005) studies references and citation data from three core LIS journals[1] from 1980 to 2000 and finds that there is a gendered preference in the choice of references by male and female authors. This means that there are male authors who do not use references written by women as much as women use references written by men. Therefore, depending on whether the author population is mostly female or mostly male, publications by women and men receive a different share of citation. She paraphrases Merton's theory of accumulative advantage and calls this phenomenon a "gendered Matthew effect" [2] (Hakanson 2005:321). Exclusion of one sex from the citations of another was also recorded by Davenport and Snyder (1995:408). They argue that some researchers choose a reference on the basis of the author's gender and they relate the exclusion of women's work to factors such as quality and/or prestige of research i.e. men conduct better research overall. Mukherjee (2009) analyses publications in 17 open access electronic journals and finds that women publish less than men. He assumes that this might be because female authors prefer print media rather than electronic media. A year later, a similar gender study of the publications in two electronic journals of LIBRES and Information Research was conducted by Reece-Evans (2010). Her results also confirm that men published a greater number of articles compared to women.

The gender differences in publications that is found in these fairly recent studies is a matter to consider since older research such as Korytnyk (1988) and Terry (1996) had shown an improvement in the number of women's publications. This suggests

[1] . The journals are College and Research libraries, Journal of Academic Librarianship (JAL) and Library Quarterly.

[2] . Matthew effect is a term that was used by Robert K. Merton in sociology of science to describe how eminent scientists will often get more credit than a comparatively unknown researcher, even if their work is similar (Merton 1968).

that the matter of gender and productivity is not straightforward and is rather a complex issue.

Therefore, there is a need for a new study to look into this matter with a fresh insight and investigate the productivity of LIS academics. In addition, from a geographic point of view, productivity of the UK's LIS academic has not yet been investigated. Apart from in the United States, similar studies of LIS productivity, has been conducted in different countries and regions in the world such as Canada (Chu and Wolfram 1991), Australia (Wilson, Boell et al. 2012), Africa (Alemna 2001; Mabawonku 2004), Spain (Cano 1999), Scandinavia (Aarek, Jarvelin et al. 1992), Eastern Europe (Uzun 2002) Turkey (Yontar and Yalvaç 2000), Malaysia (Yazit and Zainab 2007) and China (Cooper 1987; Huanwen 1996).

Part Two

The purpose of this part is to review the literature related to research methodology and its related terms. As discussed in the beginning of this chapter, this is because one of the purposes of a literature review is to identify the methodologies and research techniques that have been used in previous work (Hart 1998:28). Therefore, this part will look at the definitions of research methodology and examine decisions that a researcher has to make in the research process. This is followed by a section on bibliometrics where related definitions and methods are explained. This part also explains why this research is not a feminist research by discussing theories of feminist methodology. The chapter ends with a section that reviews the methods applied in previous studies of this kind in library and information science.

2.6 Research methodology

Flick (2011) argues that researchers should read the relevant methodological literature before deciding on a specific method for their study. This will help the researchers to both choose their specific method(s) with an appreciation of the existing alternatives and to plan each step with the knowledge of methodological alternatives. For this reason, this section will firstly review some of the definitions concerning methodology and then explain some of the common methods that are used in empirical literature.

2.6.1 Definitions

Reviewing the literature of research methodology reveals that a few different phrases have been used by scholars to refer to the process of decision making and choosing the appropriate research methodology before gathering data.

It seems that 'research design' and 'research method' and sometime 'research approach' are used to refer to the same meaning in the area of social research methodology. According to Creswell (2009:3) 'research designs are plans and procedures for research that span decisions from broad assumptions to detailed methods of data collection and analysis.' A similar explanation is offered by Myers and Avison (1997) to define research method by stating that 'research method is a strategy of inquiry, which moves from the underlying philosophical assumptions to research design and data collection'. They explain that the choice of research method influences the data collection procedure. In contrast, Bryman (2004:27) recognises a significant difference between research design and research methods. He explains that research design provides a framework for the collection and analysis of data while research method is simply a technique for collecting data. However, Punch

(2005) uses the term 'method' to include design, data collection and data analysis. Greener (2011) argues that methods are the tools and techniques that are used in social research practice and the choice of methods has to be related to the particular problem and the research question that they need to answer. Reviewing these definitions suggests that research design and research method share a similar meaning and therefore have been used interchangeably in some studies. Paradigm is another term that is used in some of the literature related to research methods. Punch (2005) argues that paradigm is a complex term which occurs very frequently in the research methods literature. In social science, paradigm means a set of assumptions about the social world, and about what constitute proper techniques and topics for inquiry. In other words, it means a view of how science should be done (Punch 2005:27). Punch explains that paradigm also means encompassing elements of epistemology, theory and philosophy, along with methods. "Paradigms have been also the subject of vigorous debate, as in the phrase 'paradigm wars' which has been used to describe the arguments between quantitative and qualitative researchers" (Punch 2005:27). Another application of the word paradigm according to Creswell (2009) is to describe quantitative research or qualitative research by calling them 'the quantitative paradigm' or 'qualitative paradigm'. However, Punch (2005) argues that the term 'approaches' is a more preferred term to describe the configuration of assumptions and ideas that characterise quantitative and qualitative research.

2.6.2 Research Methods

The literature on social research methods points to some methods that help researchers to have a better understanding of the concept of research. This section briefly reviews some of the terms and definitions related to social research

methodology, such as primary and secondary research, induction and deduction, qualitative and quantitative methods[1].

Primary and secondary research projects are named after the type of data they collect which are primary and secondary. Greener (2011) explains that the data of primary research is collected in some ways by the researchers themselves. Secondary research, on the other hand, uses resources that are in some way collected by others or just others' work. For example if a researcher conducts a review of others' work, then that research is secondary (Greener 2011). However, this distinction is not always clear. In some disciplines such as history, sources found in archives are considered as primary while they have been collected by others before (Greener 2011). The other two terms are induction and deduction. Induction is a process of generalisation and deduction is reaching a certain conclusion from a general statement. According to Greener (2011), inductive research uses primary data to build a theory whereas deductive research uses theories to build specific cases. Therefore, deductive research works from more general ideas or theories to prove a specific case while inductive research uses observations and finding on a specific case to build theories. Informally, deductive research is called 'top-down' and inductive research is called 'bottom-up' (Bryman 2004).

Qualitative and quantitative research methods are two major approaches of research in different disciplines including LIS. There are arguments stating that both approaches have much in common and that the distinction between the two methods is ambiguous (Bryman 2004). Despite these arguments, the two methods have some fundamental differences that make them distinguishable. Greener (2011)

1. Other terms such as epistemology and ontology are excluded from this section as they are not widely used in LIS.

argues that the split between the two methods lies in the fact that quantitative research is mainly concerned with techniques that deals with numbers and figures, while qualitative method uses non-numeric data such as descriptions of concepts and perceptions. It is argued that qualitative research tends to be inductive as it leads to generalisation of theories from the observed data. Quantitative methods, on the other hand, tend to be deductive as they involve testing theories and seek findings that can be used to make generalisation across the field of research (Mansourian 2006; Greener 2011). Table 2-2 summarises some of the differences between these two methods based on this argument. However, it is worth noting that it is possible to do deductive qualitative research and inductive quantitative research and perhaps the mentioned specification (shown in Table 2-2) is because the majority of the researches fall with this grouping.

Table 2-2 Differences between quantitative and qualitative approaches based on Bryman (2004) and Greener (2011)

	Quantitative	**Qualitative**
Data	Numbers	Non-numeric data such as words or images
	Typically larger sample	Typically smaller sample
Analysis	Statistics	Interpretation
Principal orientation to the role of theory in relation to research	Deductive; testing of theory	Inductive; generation of theory

Each of these methods is useful to a greater or lesser extent based on the issues that the research is concerned with. Therefore, the so called 'paradigm war', that sought to make one superior over the other during the 60's and 70's, is now considered ineffective (Punch 2005; Galina 2009). Furthermore, in some recent studies a

combination of the two approaches has been used at different stages of the research to produce the overall outcome of the research (Punch 2005; Mansourian 2006). Therefore, it can be argued that both approaches are complementary in both a broader scale and detailed understanding of a specific situation (Williamson 2004).

2.7 Research design

Research design is the most important procedure in any research as it provides a framework for collecting and analysing data (Bryman 2004:27). Punch (2005: 62-63) elaborates on this and argues that, at a general level, research design can refer to all the issues involved in planning and executing a research project, while at a specific level the design of the study refers to the way a researcher tries to rule out alternative interpretations of the results. In another definition, research design is set to connect research questions to the data. Punch (2005:63) states that "the research design is the basic plan for a piece of research, and includes four main ideas. The first is the strategy. The second is the conceptual framework. The third is the question of whom or what will be studied. Finally, the fourth concerns the tools and procedures to be used for collecting and analysing empirical materials." Flick (2011) expresses this in a different way by emphasising the decision process in research design. He states that planning a research project involves making a series of decisions that serve to highlight some aspects and exclude others. Each of the decisions will help the researcher to delimit the perspective of the research as well as helping the researcher to define what part of a bigger picture the research can cover with the data and analysis. The decisions also require consideration of interrelated questions concerning the field of study, the issue(s) to be researched, the theoretical context, and the methodology involved. These decisions, which form the shaping of the

research design and the research process in its further steps, are displayed in Figure 2-3. Flick (2011) argues that same decisions can be applied to both quantitative and qualitative studies, when a researcher plans for a research project. The issues concerning each of these decisions for both qualitative and quantitative studies will be briefly reviewed here.

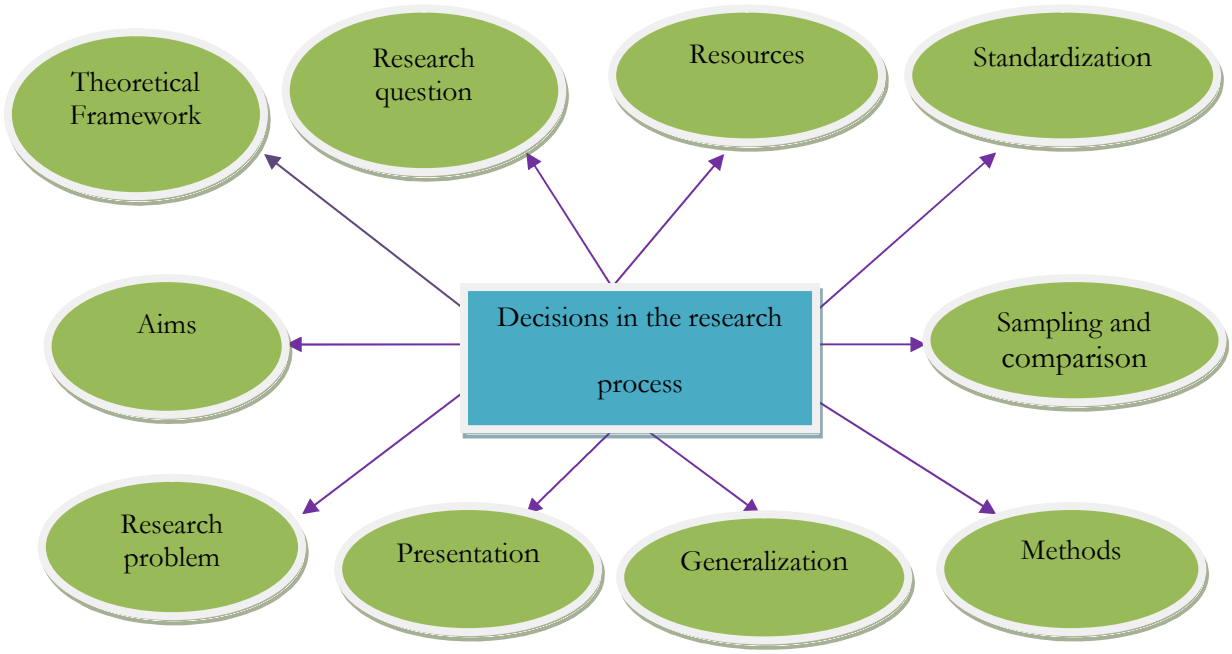

Figure 2-3 Decisions in the research process Flick (2011:95)

2.7.1 Research problem

Decisions concerning the research problem involve evaluating research problems with different criteria. These criteria include deciding whether the concept of the research is clear and whether the problem can be studied empirically. In quantitative studies, in terms of the research problem, the researcher should decide whether there is enough existing knowledge available for the research and the possibility of

gathering and finding relevant data. In qualitative studies, the research should also decide whether sufficient potential participants can be reached without making excessive effort (Flick 2011:82). It should be noted that these decisions will have a subsequent influence on the methodological decisions.

2.7.2 Aims of study

Flick (2011) argues that quantitative studies usually aim at testing an assumption in a form of hypothesis. In order to test the hypothesis, the aim of quantitative studies is to assess the connections between variables or to identify the cause of a specific event. Decisions on the aim of the study will also help researchers to distinguish between independent and dependent variables. The aim of the research is also determined by the research interest and the state of the previous research in the field of study. The researchers should also decide whether the aim of the research will focus on the issue itself or the field of study or the methodological orientation. In qualitative studies, the aim of the research is usually linked to providing descriptions or evaluations or developing theories. Therefore, the researcher should decide which aim they can realistically pursue in their study.

2.7.3 Theoretical framework

Using a theoretical framework in quantitative studies can influence the methodological approach. The researchers have to decide to what extent the theoretical framework is compatible with the research questions or the issue of the study. In qualitative research, the researchers might not necessarily use a theoretical model, but they should be aware how their research is related to previous theoretical and empirical work.

2.7.4 Research questions

In both quantitative and qualitative studies, the decision on research questions determines the issue of the study and shows what aspect of the subject is going to be studied and what is omitted. The research questions also reflect the methods that apply to the study. In other words, formulation of research questions orients the research. Research questions should also seek new insight into the subject; otherwise, the research will be a repetition of what is already available (Flick 2011).

2.7.5 Resources

Understanding the cost of the study, the time that it takes, and the experience it needs, builds up a knowledge that helps researchers to decide what is realistic in conducting the research. Flick (2011) argues that understanding the time is an extremely important factor in both quantities and qualitative studies. For example, it is easy to estimate the necessary time to conduct and interview but normally the time that is needed to recruit an interviewee is neglected by the researcher.

2.7.6 Sampling and comparison

In both studies, the decision the researcher has to make about selecting the sample is whether the sample represents the features that are needed for the study. In qualitative studies, the decisions are about persons, groups or the situation related to the study. The researchers should consider the relevance in the sample as well as the diversity (Flick 2011).

2.7.7 Methods

Flick (2011) argues that decisions concerning methods need to be made on a series of levels. The first level concerns the character of the data, its accessibility and suitability. The next level is about the way the data is going to be gathered. In

quantitative studies, the researchers should decide whether they will use existing data or they will collect their own data. These decisions are related to the research questions. Once the method of the study is chosen, the researchers should check the methods' reliability and validity for the research. In qualitative studies, the decision about method concerns the type of data that is needed and whether observation is going to be used as the method or interviews. The researcher should also decide on the degree of openness and the structure in the data collection and analysis. Other areas that the researcher considers are the aim of the study, type of research questions and the available resources.

2.7.8 Standardisation and control

In quantitative research, the researcher should be aware of standardising the research situation and procedures and control as many conditions as possible (Flick 2011). Researchers should also define variables and units of analysis and decisions on how these can be done builds up standardisation and control in research. In qualitative studies, standardisation and control play a minor role compared to standardised research. However, Miles and Huberman (1994) argue that researchers can apply tight design which involves narrowly restricted questions and strictly determined selection procedure in order to reduce the variety in their material. If researchers prefer less standardisation and control, they choose loose designs, which allow them to have a more open and less defined approach.

2.7.9 Generalisation

Generalisation normally is linked with the statistical representativeness of the sample of the study. Therefore, researchers should decide whether a specific target population could be used for generalisation of the bigger population that the sample

comes from. Flick (2011:88) states that the general question the researchers should ask is how appropriate is the intended generalisation to the issue of the study, the field of the study and the participants. In qualitative studies, it is argued that developing a theory can be a form of generalisation on various levels (Flick 2011:94). Generalisation can be advanced by developing a formal theory focusing on broader contexts. Furthermore, generalisation also impacts on the planning of the research and the selection of the cases in qualitative research. Finally, the researcher should consider how appropriate the type of generalisation that they are aiming at is in relation to the field of the study.

2.7.10 Presentation

How the research and its results are going to be addressed affects the decisions that the researcher should make about presentation. Flick (2011) argues that understanding the audience and the target group of the research can influence the style, and the way in which the research result is presented. This applies to both quantitative and qualitative studies.

2.8 Feminist Methodology

This section briefly reviews theories around feminist methodology. This is because this research is a gender study and such studies can sometimes be classified as feminist studies. This section argues why this research is not a feminist study and differentiates between the current research's method and the principles of feminist methodology.

Feminist methodology was formulated since the 'second wave' of feminism and has been considered part of social research since 1960 (Punch 2005; Somekh and Lewin 2011). According to Sarantakos (2004) feminist methodology studies "the social condition of women in a sexist society and enlightens people about taken for granted sexist practices and the gender-blindness of government and community practices (including publications) that displaced, ignored, and silenced women, led to an unequal and discriminating social order, and held them captive for millennia". It is argued that feminist methodology focuses on changing the status of women in modern societies, encourages women's studies and attempts to employ feminist researchers to do women studies (Sarantakos 2004). Another definition of feminist methodology is based on the assumption that men are the powerful dominant in social life and ideology and therefore research is owned by them. Feminist methodology also rejects positivism and takes an anti-quantitative attitude (Bryman 2004; Punch 2005). It has been argued that feminist researchers do not usually take any interest in measurement and generalisation but believe it is through qualitative research that women's voices can be heard (Bryman 2004; Sarantakos 2004). Sarantakos (2004) reviews some of the arguments that criticise feminist methodology. One of these arguments states that feminists believe quantitative research is incompatible but they use quantitative research to produce factual evidence on hours of work or income level to prove that women are discriminated against in family, society, or work place. Another argument is based on the issue that feminist methodology should be for women, on women, and by women. Sarantakos (2004) argues that this matter calls for men to make similar proposals on research and while feminists reject the 'male paradigm' because it is male why it should not be expected that males would reject 'female paradigm' for being female. Moreover, the

notion of 'female prism' disqualifies men from studying women but it does not disqualify women from studying men for not having the 'male prism'. It is also argued that feminism rejects the 'male paradigm' because it is male, but at the same time feminism does not allow males to reject 'female paradigm' for being female (Sarantakos 2004). Finally, it has been argued that feminists do not have a perspective of their own, but use theoretical and methodological principles of other paradigms such as Marxism, naturalism, critical theory and psychoanalysis. Therefore, without a distinct principle it is hard to believe that feminist methodology is essentially a separate methodology.

From what has been discussed it can be said that this research is not a feminist research for two main reasons; firstly, because it does not focus solely on women but on both men and women; and secondly, it uses quantitative analysis to find facts about the current productivity pattern of LIS academics.

2.9 Bibliometrics

As it will be explained in chapter three, this study has employed bibliometrics' methods and techniques as the main method for data collection. Therefore, this section reviews bibliometrics' definition and its related terms and justify why this method should be used in this study. This section also describes some of the issues related to this area such as multi-authorship, gender of the authors and methods of counting the authors.

As discussed earlier, publications are the main variable by which to measure productivity in many disciplines as well as LIS. Studying publications is also linked to another method that is mostly used in the field of library and information science; this method is bibliometrics. Aina (2002) argues that bibliometrics is a sub-field of

library and information science which can also be regarded as a type of research method. Bibliometric techniques have not only been used in LIS but also in other disciplines to assess publication patterns. This is because published research is the most important activity of researchers and bibliometrics can measure this by using quantitative analysis (Archambault and Gagne 2004). Bibliometrics has widely been used to compare the productivity of departments, research units, and research areas for both evaluation and funding purposes (Luukkonen 1990). In 2008, a new framework that involved bibliometric techniques was introduced by the UK government for research assessment and funding. These techniques have been used by Research Assessment Exercise (RAE) and have been tested by HEFCE[1] to be used for Research Excellence Framework with the purpose of assessing bibliometrics for producing research quality indicators (Mahdi, D'Este et al. 2008; Adams 2009).

Based on the above discussion bibliometrics is a suitable method for data collection in the studies of this kind. Also for measuring productivity, as it was defined in this chapter, a collection of bibliometric indicators are required. To gain a comprehensive view of bibliometrics' techniques and these indicators the following sections are designed to expand on the definitions, methods and techniques used in bibliometric studies.

2.9.1 Bibliometrics: Definitions

In the dictionary of bibliometrics, Diodato (1994: viii, 13) states that the term bibliometrics, previously known as statistical bibliography, refers to mathematical and statistical analysis of patterns that arise in the publication and use of documents. According to Egghe and Rousseau (1990) and Broadus (1987), it was E. Wyndham

[1] . Higher Education Funding Council for England

Hulme who first used the term 'statistical bibliography' in 1922 to describe the process of measuring science and technology by counting papers.

In 1969, Pritchard criticised the 'statistical bibliography' for being too clumsy, too descriptive and too confusing, and suggested the term bibliometrics (Shaeen 2010). According to Nicholas and Ritchie (1978), Pritchard's definition of bibliometrics as a research method is to shed light on the process of written communication and the nature of a discipline by counting and analysing the various aspects of written communications. Some other scholars have since tried to define the term, including McBurney and Novak (2002) who state that bibliometrics is the study of publication patterns by using quantitative analysis and statistics. Broadus (1987) bases his definition of bibliometrics on the American Library Association (ALA) Glossary and states that bibliometrics is the use of quantitative analysis and statistics to describe the patterns of publication within a given field or body of literature.

Scientometrics and Informetrics are sometimes used to refer to bibliometrics. However, there is a slight difference in the meaning of them. Diodato (1994) argues that bibliometics is a kind of informetrics and scientometics, the two of which in turn are a type of bibiometrics. Aina (2002) explains that bibliometrics overlaps with scientometrics while it is incorporated by informetrics. Aina (2002:50) cites Tague-Sutcliffe (1992) and defines scientometrics as quantitative analysis of a discipline and informetrics as quantitative analysis of information in any format. To understand the world of science, Leydesdorff (2001) offers a model in which he depicts the world of science as a three-dimensional scheme. For each of the three dimensions, there is a corresponding unit of analysis (Figure 2-4). The three dimensions are scientists (knowledge producers), text (academic output) and cognition. From the model, it is

understood that scientometrics is a unit of analysis to understand the relation between the scientists and their academic outputs. Sociology of the scientific knowledge is another unit of analysis that links scientists with cognition. The importance of this model lies in the fact that Leydesdorff has seen scientometrics and bibliometric methods as a means to understand the world of science.

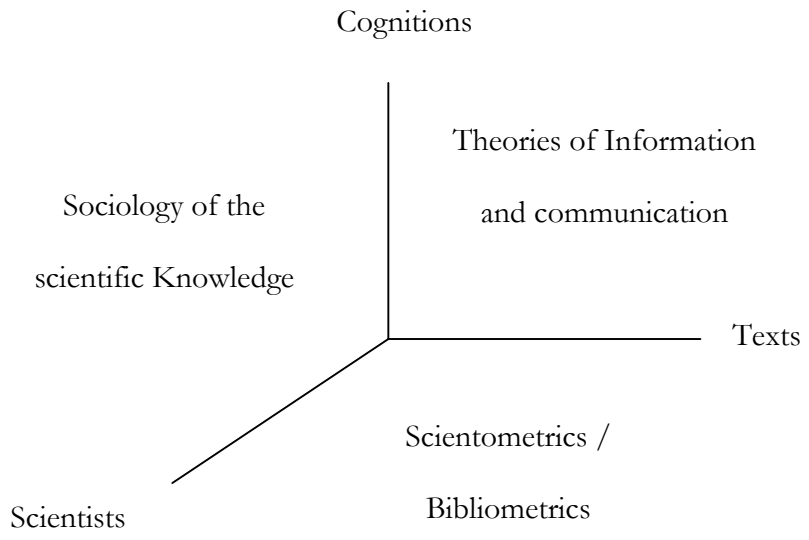

Figure 2-4 The study of the sciences as a multi-dimensional problem (Leydesdorff 2001:4)

Bibliometrics uses three main indicators: publication count, citation, and co-citation[1] (Archambault and Gagne 2004). Publication count is an indicator of the research output and refers to the number of published articles in academic journals during a specific time frame. In bibliometrics, number of citations is used to evaluate the academic impact of research. Co-citation is used to map research activity and

[1]. Co-citation refers to a situation in which two (or more) authors, documents, or journals are simultaneously cited by another document (Diodato 1994:42).

includes co-citation analysis, co-word analysis and bibliographic coupling. The co-citation analysis studies co-citation between authors. Co-word analysis is the analysis of the co-occurrence of two or more words in one or in different documents. Bibliographic coupling refers to the situation in which two documents each have citations to one or more of the same publication. The two citing documents are said to be coupled based on the argument that states if the two papers cite the same publication(s), they may deal with the same subject matter (Diodato 1994).

2.9.2 Bibliometrics' law

One of the main areas in bibliometric research concerns the application of bibliometric laws. The most commonly used laws in bibliometric are Bradford's law, Lotka's law and Zipf's law.

According to Bradford's law, in a certain period of time in a given field a few journals publish a relatively high percentage of articles in the field, while there are many journals that publish only a few articles each (Diodato 1994). Although Bradford's law has been used as a guideline to determine the number of core journals in a given field, there are claims that suggest this rule is not statistically accurate (Potter 1988).

Lotka's law, also known as the law of scientific productivity suggests that the number of authors making n contributions is about $1/n2$ of those making one. In other words, about 60% of all authors in a given field create one publication, about 15% create two publications, and about 7% three, etc (Petek 2008). In other words, the law suggest that only a few authors are prolific and account for a relatively large percentage of publications; many other authors produce only one or two publications (Diodato 1994). Petek (2008:176) suggests that Lotka's law is an inverse

square relation, as there is an inverse relation between the number of documents produced and the number of authors producing the publications. Although the applicability of Lotka's law has been confirmed in studies such as Nicholls (1989), Budd and Seavey (1990), Burnham, Shearer et al. (1992), Rousseau and Rousseau (2000) and Rowlands (2005), the accuracy of the results that Lotka's law produces has been criticised. Pao (1986) argues that Lotka's law ignores co-authors and each article is only assigned to just the first authors without considering the second or any of the collaborative authors. This can affect the accuracy of the results that Lotka's law produces simply because it is not always the first author who has the greatest contribution in a published paper. One possible reason why Lotka's law ignores the collaborative author could be because multi-authorship was less common during the 1920s when Lotka offered his law (Potter 1988).

Zipf's law is a well-known bibliometrics law that is used to predict the frequency of words in a text. The law states that in relatively lengthy text, if the words are ranked based on the frequency of occurrence, the rank of a word multiplied by its frequency will equal a constant. Potter (1988) explains that the equation for this relationship is $r \times f = k$ where r is the rank of the word, f is the frequency, and k is the constant. Despite not being statistically accurate, Zipf's law has been used by indexer and text analysers.

3.9.3 Bibliometrics methods

Bibliometrics involves two main approaches: theoretical and empirical. Both theoretical and empirical studies are concerned primarily with the impact and application of the bibliometrics data (Vinkler 2010). Bibliometrics data, which is obtained by studying publications is important because "science would not exist if

scientific results are not communicated" (van Raan 1999:417) and these communications are done through publications which themselves provide the bibliometric information. Bibliometrics can play a huge part in providing information for evaluation purposes in academic institutions as it can provide answers to questions such as how well the research activities are in terms of influence and impact. It can also provide information on how an academic institution contributes to a certain discipline worldwide. Bibliometric studies can also provide a landscape for academic institutions as to where they stand with their research activities in the world of academic landscape (van Raan 1999).

The central paradigm of bibliometrics is that academic research and publication as a system has quantitative aspects that can be characterised by statistical methods (Vinkler 2010). A general explanation of bibliometric method involves collecting reliable data, the application of appropriate methods and construction of relevant indicators. Braun, Glänzel et al. (1985) argue that empirical statistical data can form statistical indicators in order to have an explicit or implicit theoretical model in bibliometric studies. It should be noted that bibliometric indicators are more than simple data as they are the result of a specific mathematical operation with data even if it is simple arithmetic (van Raan 2004). For example the number of citations that a publication receives in a certain time period is data, while the measure which such citation counts for all publications of an academic institution compared to all the publications in that field is an indicator (Vinkler 2010). Bibliometric indicators are measures that can characterise a single or several aspects of academic research quantitatively and can be attributed to a single or several bibliometrics systems (Vinkler 2010). Bibliometric indicators can characterise research activity, productivity and performance indicators in the form of research input and output. As stated

earlier, publication counts are the basis for any bibliometric study. Archambault and Gagne (2004) argue that the number of publications by a scholar is an indicator of their level of production of new knowledge. The number of publications can be used by itself or can be expressed in relation to other factors such as the number of scholars and level of funding and therefore can generate an indicator of productivity.

Bibliometric methods have some limitations that should be addressed. Some argue that bibliometric relationships are only statistically valid when a large set of publications is used. Others argue that bibliometrics' laws such as Lotka and Bradford are not always accurate. In response to these arguments Vinkler (2010) states that assessment is necessary and bibliometrics' mission is to provide a platform to assess the academic and scientific performance. Moreover, bibliometrics and its laws and rules should be not be regarded as being exact ('hard') and bibliometric relationships should be considered as statistical relationships which are necessary for assessment but have limitations. The same applies for Lotka's or Bradford's laws; they should be considered more as trends rather than strict rules.

2.9.4 Reliability and validity of bibliometrics

Reliability and validity are two important criteria related to assessing the quality of any research. These two criteria have been traditionally linked with quantitative studies supported by the positivist or scientific paradigm (Tashakkori and Teddlie 1998) but have been reconsidered recently in qualitative research paradigms too (Golafshani 2003).

Reliability in research refers to the correctness of measurement and that whether the result of a study is repeatable (Bryman 2004:28). In other words, reliability means consistency. Punch (2005) argues that this consistency has two main aspects: the

consistency over time which is also known as stability, and internal consistency which relates to the concept-indicator idea of measurement. Reliability, also described as stability, is the degree to which the result of a measurement stays the same if the research is repeated with the same data but in a different time. Test-rested method is the way to determine stability and therefore the reliability of the research. The test involves administering a measure on one occasion and then re-administering it to the same sample (Tashakkori and Teddlie 1998; Punch 2005). Bryman (2004) argues that reliability can be linked with another criterion called replication or replicability. Replication means that a research method should be explained and formulated in a way that repeating the study by other researchers would be possible. As reliability and replicability are closely linked, Kirk and Miller (1986) merge the two and conclude that reliability means the degree to which a measurement, given repeatedly, remains the same, as well as the stability of a measurement over time and the similarity of measurement within a given time period.

Reliability is said to be a major strength in bibliometrics. This is because the discipline relies on measurements of readily accessible data and therefore the results can be easily replicated (Borgman 1990). In bibliometrics, the availability of the data, in particular sources such as printed pages or electronic databases makes it a much more reliable method in comparison with interviews or questionnaires where the results are dependent on the cooperation of the respondents. In other words, evaluation with bibliometric methods as explained by Weingart (2005) is based on 'non-reactive incidents' which are publications and citations. These resources are still available in different time periods and therefore the result of the study is repeatable and replicable.

Validity is said to be an important criterion in any research. "Validity refers to the issue of whether an indicator (or set of indictors) that is devised to gauge a concept really measures that concept" (Bryman 2004:72). In simple words, validity determines whether the research truly measures what it was intended to measure and how truthful the research results are (Golafshani 2003). Several different ways have been suggested in research method texts to determine validity. Construct validity, which is also known as measurement validity, is the most widely known type of validity. Construct validity also determines whether the research measures what it was intended to measure and how accurate the research results are (Wainer and Braun 1998). Bryman (2004) argues that construct validity is related to reliability in a way that if a measure of a concept is unstable, it is unreliable and cannot provide valid measure of the concept in question. Therefore, the assessment of construct validity presupposes that a measure is reliable. Construct validity applies in quantitative research. Another type of validity known as internal validity refers to the issue of causality and is only relevant in studies that aim to establish a causal relationship between variables. External validity is another type of validity that aims to ascertain whether the result of a study can be generalised beyond the immediate research context (Bryman 2004). External validity, in other words, is the degree to which the conclusions of research can be extended to make predictions about the entire population.

Validity in bibliometric studies is determined by the evaluation of various indicators. As discussed earlier, statistical functions on a set of bibliometrics' elements and units are known as bibliometric indicators. What determines validity here is the validity of the indicators that are being measured; that is, ensuring that what is being measured is what was identified and assumed to be measured (Glänzel 2003). Reproducibility is

another matter that was discussed in verifying validity in research. Glänzel (2003) argues that under identical conditions, bibliometric results are reproducible; that is to ensure all sources, procedures, and techniques related to academic publications are reliable and are properly documented. To ensure validity in bibliometric studies, researchers might need to combine bibliometrics with other methods to improve the validity of the study.

2.9.5 The units of analysis in bibliometrics

2.9.5.1 Publications

The definition of bibliometrics by Pritchard (1969) states that bibliometrics is the application of mathematical and statistical methods to books and other media of communication. This comprehensive definition includes books, monographs, reports, papers in serials and periodicals, electronic resources such as e-Books and e-journals, and even web resources as bibliometrics' units of analysis. However, during the past few decades journal publications have played an important part in communication in science and academia as the number of academic journals have grown both significantly and rapidly. As a result, academic papers published in refereed academic journals, inevitably have become the unit of analysis in bibliometric studies (Glänzel 2003). Other factors that have contributed to this include the system of reviewing in journal publications, the criterion of originality of research results, and the relatively transparent rules of publication. Despite the widespread use of academic papers as the unit of analysis in bibliometric studies, considering them as the only type of publication has been criticised. Ramsden (1994) argues that in some subjects such as arts and humanities, monographs and books are still the usual form of scholarly communication and solely considering journal

publication as the unit of analysis in such disciplines will result in an unfair judgment of them. Therefore, it is the researchers' responsibility to examine a discipline and the usual form of scholarly communications in them before conducting any bibliometric studies. Researchers should also take into account that the initial definition of bibliometrics' unit of analysis has never excluded other forms of publications and the researchers can choose the type of scholarly communication in their studies accordingly. The current research, as will be explained in further sections, will include any form of publication that has been indexed in the relevant LIS databases. This includes journal articles, books, book chapters, book reviews, editorials, conferences papers and reports.

2.9.5.2 Authors and co-authors

Besides publications, (co-)authors are other units of bibliometric analyses. There are two issues regarding the authors in bibliometric studies. First, is the matter of handling multi-authorship and second, which is mostly the area of concern in gender studies, is identifying the gender of the authors. These two are discussed in the following sections.

2.9.6 Multi-authorship

One of the challenges of bibliometric studies is the matter of handling multi-authorship. While it is impossible to determine the actual contribution of each author in a joint-written paper, the matter is linked with ethical issues in joint authorship known as gift, pressured or ghost authorship. Gift authorship refers to a situation where an author's name appears in a published paper where they had no contribution to that piece of written work (Singh 2009). Gift authorship is also known as guest authorship, honorary authorship, unjustified authorship or

undeserved authorship. Singh (2009) explains that gift authors do not fulfil the requirement of an author but let their name appear as the author either out of politeness or depending on their job position. In some cases, the editor will get a request to add someone's name at the time of publication for inclusion in the list of authors. Gift authorship is the most well-known form of misconduct related to authorship; however, other forms known as pressure and ghost authorship have also been increasingly reported. Pressured authorship defines a situation when a person takes advantage of his/her position to be included as one of the authors of a written work, when they had made no contribution towards it. Finally, ghost authorship explains a situation where the name of an author who has made a great contribution to a piece of writing is excluded from the published work. Ghost authorship is more likely to happen in scientific papers as the result of hours of work in labs by different people; the paper is published but not everyone's name necessarily appears as authors. The opposite situation to ghost authorship is known as hyper-authorship. Some argue that if someone has not been directly involved in writing a paper but has contributed to the work and has their name published as authors, creates what is known as hyper-authorship (Cronin 2001; Stuart, Thelwall et al. 2007). Hyper-authorship can be dealt with by mentioning those who have contributed to the result of a published paper as contributors than authors.

In bibliometric studies and studies of research assessment performance, it is almost impossible to identify these issues for each paper; yet such assessments have been criticised for not considering gift, pressured or ghost authorship (Sheikh 2000). Although these issues can impact on someone's productivity, bibliometric studies have no other choice but to trust that anyone appearing as authors in a publication are the actual authors of that paper. However, how the productivity of each author is

measured in co-authored papers is still a challenge. There are three methods (strategies) for recording each author's share in papers with more than one author. These methods are known as adjusted count, complete count and straight count (Wennerâs and Wold 2001; Petek 2008).

- **Adjusted count:** The adjusted count, also known as fractional count, calculates the share of authors by giving them one share divided by the total number of each author. For example, in a paper written by three authors, each will receive one-third credit for that paper.
- **Complete count:** The complete count calculates productivity of the authors by giving each author an equal share of one despite the number of co-authors in a paper. Therefore, in the previous example, each of the three authors is credited with one paper. This way of dealing with authors' share of authorships is also known as normal count. It has been argued that complete count is a more suitable method in measuring productivity (Nicholls 1989).
- **Straight count:** Straight or senior count considers the first author as the main author of a published work and ignores the co-authors. Therefore, in a paper with more than one author, only the first author will receive a share for publishing that paper. Measuring productivity using Lotka's law is generally based on this method. Straight count is highly criticised as some journals publish the name of the authors in alphabetical order, and therefore this way of counting can highly disadvantage the main authors in some cases.

2.9.7 Identifying gender

In gender studies of productivity, identifying the gender of the authors can be considerably problematic. This is because the author's name appears as surname and

the given name's initial rather than the author's full name in most bibliographic databases. Discovering the names and therefore the gender of the authors has been tackled by different methods in gender studies of productivity. These methods are as follows:

- **Author's surname:** In some countries such as Iceland and Poland, the gender of the author can be inferred from the author's surname. For example, in Iceland, the surnames ending in *son* represent men and surnames ending in *dottir* indicate women. A gender study of Icelandic academics' publications has been conducted by Lewison (2001) based on this. In Poland, as argues Webster (2001), over sixty per cent of all surnames have endings through which gender can be determined. For example, surnames ending in *–ski*, *-cki* or *–owy* are male and those ending in *–ska*, *-cka* or *–owa* are female. Using these characteristics Webster's research on the status of Polish women in science has been conducted successfully. Both Lewison and Webster have used ISI citation indices as the main source of bibliometric data to identify the academics' publications.
- **Questionnaires and interviews:** Using questionnaires and interviews is another method for identifying the authors' name and gender. This method has been used by Kyvik and Teigen (1996) in Norway. Using a questionnaire, they obtained the academics' bibliographic data as well as their publications history. The publication patterns of South African scientists was investigated by Jacobs (2001) by both using Science Citation Index (SCI) and a questionnaire. Survey study and questionnaire is also used by Prpic (2002) to investigate Croatian female participation in science. Using questionnaires and

interviews, however, is not the most practical way of finding the author's name and gender. On one hand, because normally in bibliometric studies a huge volume of data (publications) is investigated and therefore sending questionnaires to each author is not feasible. On the other hand, the reliability of the data in using questionnaires and interviews depends on the response rate (Mauleon and Bordons 2006).

- **Authors to publications:** In this method, the authors' biographical information is available before searching for their publications. In other words, the researcher starts the research firstly by identifying a group of academics i.e. academics in a certain department or a specific subject areas (Mauleon and Bordons 2006) and then finds their publications by searching in relevant bibliographic or citation databases. In this method, the biographical information of the authors such as their name and gender is available in advance through their institutions, academic societies, or directories. Since the direction of this research in this method is from finding the authors to finding their publications, the method is called authors to publication. The advantage of this method is that it avoids the tedious procedure of finding names and can save time. This method was used by Long (1992) to investigate chemist PhD graduates' productivity in United States. The graduates were identified by using the Directory of Graduate Research (DGR) and American Chemical Society. This method has also been used by Lemoine (1992) in a study of productivity patterns among Venezuelan scientists, and by Goel (2002) in India to study publication productivity of Indian psychologists, and finally by (Mauleon and Bordons 2006) to examine the productivity of male and female academics in the area

of materials science at the Spanish Council of Scientific Research. Other studies that have used this method are Mählck (2003) and Abramo, D'Angelo et al. (2009).

- **Publications to authors:** This method works from identifying publications of a specific group of scientists, either working in a specific institution or a specific area, then identifying the authors' names and genders. As the direction of research is from identifying publications to authors, this method is called publications to authors. In this method, firstly, the publications are normally downloaded from bibliometric databases, such as Thomson Reuter's indices, and then the authors' names and affiliations are searched in other databases or online resources to identify their gender. Bordons, Morillo et al. (2003) have used this method for investigating productivity among Spanish Council for Scientific Research (SCSR) scientists. They first downloaded the publications from Science Citation Index and then matched the names with the SCSR's bibliographic database to discover the authors' names and consequently their genders. Similar method has been applied by Mozaffarian and Jamali (2008) in a gender study of Iranians' academic productivity; that is, the publications of Iranians were first downloaded from ISI databases and then the names of the authors were searched for in both Iranian academics' database published by Iranian Ministry of Science and internet to find the gender of the authors. One limitation of this method is that a time frame should be specified for finding the publications as it is not possible to download all the papers in a subject area. In addition, as the subject categories of bibliometric databases are applied on the journal level

not article level, there is always the chance that some of the retrieved papers are not particularly related to the subject of the study.

Although most studies' methods of identifying gender fall into one of the above categories, other methods such as obtaining authors' information from the journal they have published have also been used as a method to find authors' gender. However, Mauleon and Bordons (2006) argue that this method does not function satisfactorily as the names of the authors can be missed in some journals and some journals only have the initial of the forenames.

2.9.8 H-index and journal impact factor

H-index is a bibliometrics index that is developed to measure scientific performance and achievement (Thompson, Callen et al. 2009). In order to establish an order of ranking, metric enterprises such as Thomson Reuters, Google scholar and Elsevier are routinely identifying and quantifying published work and citations (Gaster and Gaster 2012). One of the interesting performance indicators of the recent years is h-index. It is argued that h-index tries to measure productivity. This index was developed by Jorge E. Hirsch, a physic professor in the University of Chicago. Hirsch developed this index based on the importance of the number of publications and the number of citations in measuring productivity. Hirsch (2005) explains that a scientist has index h if h of his or her N_p papers have at least h citations each and the other $(N_p - h)$ papers have $\leq h$ citations each. Hirsch has used this index to measure productivity among physicists but argued that the index can be used for other scientific disciplines. Gaster and Gaster (2012:830) explain that h-index improves as the number of cited publications and the number of citations per publication increases. It is also argued that h-index increases with the number of the years that

an academic spends in academia. What has made h-index an interesting index to measure performance is that h-index is not dependent on the number of publications of an academic, but rather on how often their publications are cited.

The advantage of the h-index is that it reflects the productivity as well as the importance and the impact of the oeuvre in a discipline. The disadvantage of the h-index is that it cannot always reflect the author's impact as the publications needs time to accrue citations (Hirsch 2005). Therefore, it has been suggested that h-index should be used to compare academics with the same academic age and preferably in the same disciplines as the citation patterns can vary considerably in different disciplines (Gaster and Gaster 2012).

During the past few years, h-index has received a positive feedback among scientists and bibliometricians. This is perhaps because h-index reflects the number of citations which is an important factor in assessing the quality of a written work in bibliometrics. Gaster and Gaster (2012) argue that it is not surprising that h-index has gained such a prominence as it is being used by major citation services such as Web of Knowledge (Thomson Reuters) and Scopus (Elsevier). On the other hand, it is suggested that h-index is now being used as a selection criterion to recruit research staff and is impacting on promotion decisions in some academic institutions (Bornmann and Daniel 2005; Gaster and Gaster 2012). As the result of this recent trend, as well as having an extra index to compare and contrast the academic performance, it was decided to include academics' h-index in this study.

The impact factor was stated first by Eugene Garfield in 1955 and the purpose of it was to have an additional aid in selecting source journals (Garfield 2006). This led to the publication of Science Citation Index in 1961. Impact factor is a bibliometric

parameter based on the average number of times that papers in a particular journal are cited. In other words, the impact factor of journal X in year Y equals the average number of citations in year Y scored in all journals of papers published by journal X in the years (Y-1) and (Y-2) (Opthof 1997). The impact factor has also been considered a parameter to investigate the scientific quality of a journal, and journals with higher impact factor are generally considered more prestigious (Garfield 2000). It should be noted that impact factor is a journal level measure and papers within a given title vary considerably in their citations. Therefore, impact factor should not be used as a tool for quality assessment of individual papers and authors (Opthof 1997). In this research the data related to impact factor of the journals was gathered as a comparison tool for men's and women's publication.

2.10 Methodology review of LIS studies of productivity

Although the two methods 'publications to authors' and 'authors to publications' are classified under identifying gender in the previous section, they are in fact two key methods that determine the direction of the research in some bibliometric studies. Studying the literature shows that, in LIS studies of gender and productivity, the chosen method has been mainly from publications to authors. For example, Olsgaard and Olsgaard (1980) selected five journals based on the following characteristics: journals' age being at least ten years, the journal being in an article format, and finally the journal being nationally known in library science[1]. Excluding book reviews and letters, they chose ten past years of publications of each journal. For handling multi-authorship the researchers applied complete (normal) count

1. These journals were College & Research Libraries, Library Journal, Library Quarterly, and Reference and User Services Quart formerly known as QR.

method, which gives each of the authors in a paper one entry for that paper. They determined the gender of the authors by analysing the forenames and they tagged the unrecognised names and those presented with initials as indeterminable. Since Adamson and Zamora (1981) was based on the Olsgaard and Olsgaard (1980) study, they chose similar methods by finding journals with ten years' publication history. They also eliminated book reviews and letters and handled multi-authorship and identifying genders using similar methods to the Olsgaards' research. However, they argue that analysing authorship characteristics based only on the information provided by the typical library science journal is inherently risky as most author information is sketchy and incomplete (Adamson and Zamora 1981:236).

Other studies that have used 'publications to authors methods' are Cline (1982); Metz (1989); Buttlar (1991); Raptis (1992); Davenport and Snyder (1995); Terry (1996); Cano (1999); Koufogiannakis and Slater et al. (2004); Hakanson (2005); Yazit and Zainab (2007); Mukherjee (2009); and Reece-Evans (2010). Identifying gender of the authors in these studies was based on the forename, and where the gender has not been self evident from the bibliographic reference, lists of professional societies, online databases, university websites and author's online profile have been used. However, some studies such as Davenport (1995) have only noted the gender of the first author, while Hakanson (2005) considered the gender of every author in a paper regardless of whether they were single authors or co-authors. As discussed in the multi-authorship section, considering only the first author in some bibliometric studies is based on the assumption that the first author is the leading author and the co-authors are contributors to the paper; nevertheless, Harsanyi (1993) argues that there is no consensus about this among researchers or publishers even if recommendations do exist in some journals or disciplines.

Researchers are bound to include some inclusion or exclusion criteria for choosing the journals when the 'publications to authors' method is used. For example, Buttlar (1991) selected research-based journals and excluded journals with numerous brief non-research items. The same paper also examined the journals for lists of core publications and narrowed them down to the time frame that was intended for her study. Hakanson (2005) used a similar method of including core journals; however, she only selected those articles that had the authors' forenames spelled out.

In Koufogiannakis and Slater et al.'s study (2004), a set of rules were used for selecting the publications for their study. Based on these rules the selected publications should have been published in peer-reviewed journals in 2001, they should have contained literature related to LIS and should have been published in English. Finally, Reece-Evans (2010) selected two journals of LIBRES and Information Research for a study of citation analysis of gender and authorship. The inclusion criterion was that these two journals have relatively high web impact factor.

'Authors to publications' is another method of data gathering in some gender studies in LIS. Korytnyk (1988) applied this method, in a study of publication patterns among PhD holders in LIS. To identify and select her study's sample, she used American Doctoral Dissertation Database to identify library science PhDs between 1969 and 1979. Then a random sample of thirty men and thirty women was drawn from that selection. Gender of the authors was determined from the author's name and where this was not possible the institution that granted the degree was contacted. After finalising the names, each person's publications for a five-year period after completing the PhD were retrieved using Library Literature. Korytnyk (1988) justified her method by arguing that as educators strive for tenure, the first

five years after receiving the degree is the most productive period. In her method, once the publications were retrieved, book reviews and letters to editors were eliminated from her sample of the study. One criticism about her study is that the sample of the study is very specific and limited in terms of the number of people. Therefore, in terms of validity, the results of such studies can hardly be generalised. One of the studies of the recent years that applies 'authors to publications' method is conducted by Peñas and Willett (2006). Their approach involved identifying the staff in five top LIS departments worldwide and then searching for their publications in the Web of Knowledge database.

Despite the widespread use of 'publications to authors' method in the studies of productivity in LIS, the efficiency of this method in determining the productivity of academics is questionable. Some of the disadvantages of 'Publications to authors' method is that firstly this method requires a definite time frame as it not possible to track and study all the papers that are published in a subject area, whereas it is possible to track down all the publications of an academic in a certain subject area. Secondly, in 'publications to authors' method there is a chance of missing out the publications of those academics in a discipline who publish either in other disciplines' journals or in journals that are not considered as core journals in their own discipline. In bibliometric studies, normally the core journals are identified by using the Journal Citation Report (JCR) database owned by Thomson Reuters. One of the inclusion criteria for JCR is the number of citations a journal receives. Therefore, there is always the chance that a journal is missed out due to the fewer numbers of citations it has. In addition, Testa (2012), Thomson Reuters editorial and publisher, states JCR is "comprehensive but comprehensive does not necessarily means all-inclusive." As a result, it is likely that some journals are missed out in

'publications to authors' method. Finally, this method is not suitable for studies that aim to investigate productivity among a specific group of academics, i.e. academics working in a specific department or discipline as it also retrieves publications of students or retired academics. Therefore, in 'publications to authors' method, not only does the retrieved data require an immense amount of editing, but it also demands an investment of time to find the author's bibliographic information such as name and gender.

2.11 Summary

The first part of this chapter presents an overview of the literature for three main subjects: women in academia, understanding and definition of productivity and studies of productivity within LIS. Different approaches to definitions of productivity are reviewed, in particular the definition of research productivity. This is followed by a comprehensive overview of measuring productivity. Different methods of measuring productivity and the impact of various variables on productivity are examined through the relevant literature. This is done by categorising the variables into four main groups of professional, demographic, family related and social variables. Finally, this chapter reviews the studies related to measuring and understanding productivity within LIS.

The review shows that women's under-representation in productivity is documented in different disciplines during the past four decades. Women's under-representation in productivity has also been documented in LIS despite the fact that LIS is widely considered to be a female-dominated profession. Furthermore, little is known about the productivity of the LIS academics in the UK. Therefore, there is a scope for

further research in this area in order to understand productivity among LIS academics in the UK and investigate whether the disparity observed in previous studies exists within the LIS discipline in the UK.

The second part provides an overview of the literature for research methodology, bibliometrics and methods used in similar studies in LIS. Different approaches to definitions of research methodology, research methods and design are reviewed. The second part explains bibliometrics and discusses techniques and methods involved in bibliometrics. This section also includes an overview of the methods applied in bibliometrics studies to identify gender of the authors. The chapter ends with an overview of the methods that have been used in similar studies in LIS. In total, the second part of this chapter provides invaluable insight to research methodology and the techniques that are used in bibliometrics studies. Also reviewing the methods used in previous studies in LIS identified the advantages and disadvantages of the methods used in each study. Reviewing the methods used in bibliometrics and LIS studies provides a holistic image of the research methodologies and the techniques that can be used for studies of this kind. This section, therefore, plays a crucial role in developing the methodology used in this study.

The next chapter will describe the methodology and the choice of analysis used in this study to address the research questions.

Chapter 3 – METHODOLOGY

3.1 Research design

It was discussed in the literature review chapter that research design is the most important procedure in any research as it incorporates all the issues involved in planning and executing a research project (Miller and Salkind 2002). According to Oppenheim (2000) the term 'research design' refers to a basic plan or strategy of the research, and the logic behind it, which makes it possible to draw valid general conclusions from it. In addition, research design includes all the issues involved in planning and executing a research project and connects research questions to the data (Punch 2005:62). As the result, the major point of reference for deciding on a research design is largely connected to the issue of the study and the research questions (Flick 2011). Punch (2005) states that while research design connects the research questions to the data, it includes four main ideas that shape the design of the research. These are strategy, conceptual framework, concept of the study (who or what will be studies), and finally the tools and procedures to be used for collecting and analysing the data. This is shown in Figure 3-1.

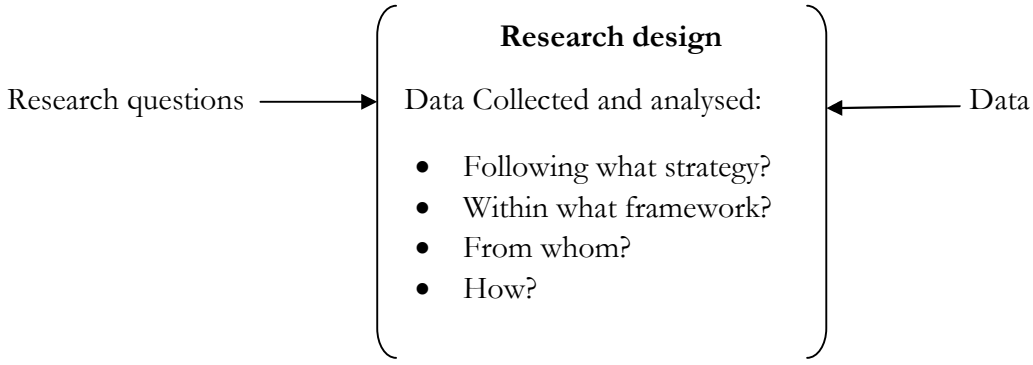

Figure 3-1 Research design connects research questions to the data (Punch 2005:63)

Therefore, it is the research questions that determine the type of the data required for the research and what the appropriate method is to gather these data. On the other hand, the techniques for gathering the data are the research methods which depend on the type of research (Bryman 2004).

Looking at Punch's (2005:64) notion of research design, the strategy in quantitative studies is designed to achieve certain comparisons. In this study, the strategy is to provide current data on productivity among LIS academics in the UK. Punch (2005:64) explains that what is meant by framework is the conceptual framework which is the conceptual status of the things being studied and their relationship to each other. It can also help the researcher to clarify the research questions. Chapter two provided an extensive review of the literature explaining that how productivity has been labelled a puzzle and described the attempts made by previous studies to explain this puzzle. This had lead to the aim of this study which is to discover whether productivity is still puzzling in a so-called female dominant discipline and in an era where the overall presence of women in higher education has improved. Therefore, it can be said the matter of productivity puzzle and the arguments surround it builds the conceptual framework of this study. The third area in the

research design shown in Figure 3-1 relates to concept of the study and covers the question of 'who or what will be studied?' In this research, the LIS academics in the UK and their publication patterns are the subject of the study and, therefore, they form the concept of the study in the research design.

Finally, the tools and procedures used to collect and analyse the data cover the forth area. In this study, the initial background desk research carried out for the development of this research's proposal revealed that productivity of LIS academics in the UK is relatively an unexplored subject. As the result, the research questions in this study are seeking to shed some lights on the productivity status of LIS academics in the UK. The type of questions this study aims to answer requires a quantitative design for this study[1]. On the other hand, this research focuses on productivity among LIS academics in the UK. It was fully discussed in chapter two that studying publications is a prominent method to measure productivity. Studying publications involves measuring the number of publications and their impact through studying citations. Therefore, in this study, the LIS academics' publications in the UK will be measure to understand productivity. To investigate the impact of the papers, as part of the productivity, number of citations and h-index will be measured too. As described in chapter two, this type of research and its associated research method relate to a recognised area in the field of LIS known as bibliometrics[2]. As the result bibliometrics' techniques and methods are the most appropriate tools and procedures to gather the data for this study. Figure 3-2 demonstrates a summary of the above discussion.

1. The quantitative research approach has been discussed in chapter two section 2.7

2. Bibliometrics methods and techniques are explained in chapter two section 2.9

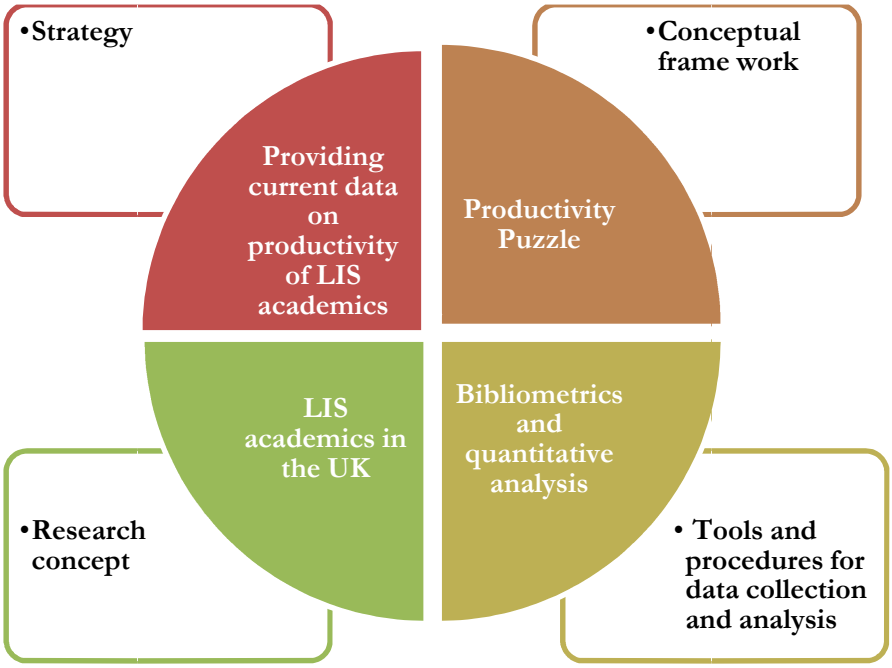

Figure 3-2 Summary of the research design

3.2 Research Process

The research process started with an enquiry into productivity among LIS academics in the UK. The first phase focuses on understanding the background of the research and defining the research questions. The next stage was to conduct a literature review. The literature review, shedding light on the subject and its related arguments, is used to identify the key concepts of this topic as well as reassessing the design of the research questions and objectives. As discussed, research designed is formed by the research questions and the conceptual frame work of the study derived from the literature review. The first practical stage of the research design is to specify the research population. After the research population is defined the research leads to date collection and analysis. Figure 3-3 depicts an overview of the research design

and how different stages of this research are related. The stages of the design including specifying the research population and the choice of statistical analysis will be described in the following sections.

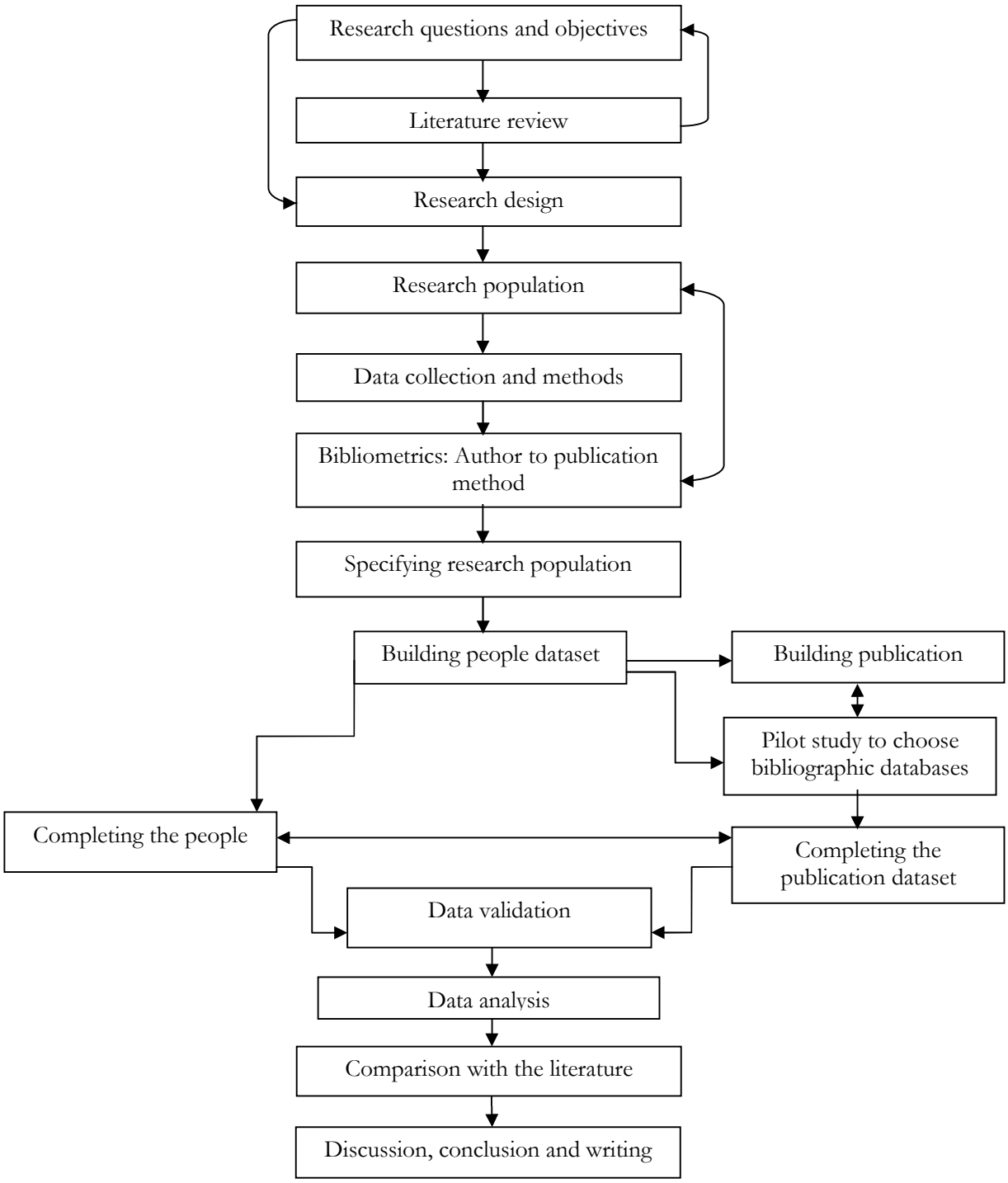

Figure 3-3 Overview of the research design

3.3 Research Population

It was discussed in the literature review that four different methods have been used in previous studies for identifying the authors and their gender.[1] Since academics in LIS departments in the UK are the focus of this study, the most plausible approach to this research is the 'authors to publications' method.[2] Therefore, the first stage is to identify the authors, which in the case of this research are the LIS academics in the UK. This section will explain how the authors have been identified.

The step before identifying the academics is to distinguish LIS departments in the UK. For this purpose, Research Assessment Exercise (RAE) 2008 was used. RAE 2008 was the sixth Research Assessment Exercise for UK research, conducted jointly by the Higher Education Funding Council for England (HEFCE), the Scottish Funding Council (SFC), the Higher Education Funding Council for Wales (HEFCW), and the Department of Employment and Learning, Northern Ireland (DEL). RAE 2008's primary purpose was to determine quality profiles of research activities made by institutions. RAE 2008 demonstrated these quality profiles in two formats: subject Unit of Assessment (UoAs) and institutions. In order to do this, RAE 2008 assigned 1 of 67 Units of Assessment to each academic discipline. An Assigned panel was responsible to overview the subjects in each of the UoAs. Unit of Assessment (UoA) 37 represented library and information management. In Library and Information science, UoA 37, a panel of 13 members of whom 11 were experienced LIS academics and researchers, was responsible for assessing work falling within the published definition of the subject domain. In RAE 2008, there are

1. For more details please refer to Chapter two section 2.9.7 of this research
2. Some of the disadvantages of 'publications to authors' approach and why it is not an suitable method for this study is discussed in Chapter two section 2.10 of this research.

21 universities listed as higher education institutions submitting research under the library and information management subject. In Table 3-1, the 'FTE category A staff' represents the full time equivalent staff that were employed by the submitting university and included in the pay roll system. However, it should be noted that not all these universities had an explicit LIS department but had papers submitted to RAE under LIS category. These universities are those with fewer than ten fulltime equivalent staff. Therefore, these universities, a total of nine, are excluded from the list, as they do not specifically have a LIS department. Of the remaining 11 universities, the four universities of Brunel, King's College, Leeds Metropolitan and Salford are also eliminated for not having a LIS department. Figure 3-4 displays the process of identifying LIS departments.

Table 3-1 RAE 2008 quality profiles, UOA 37 Library and Information Management

Higher education institute	FTE Category A staff submitted
University of Brighton	7
Brunel University	50
City University, London	11.3
Coventry University	5
King's College London	23.5
Leeds Metropolitan University	11.6
Liverpool University	5
London South Bank University	8
Loughborough University	27.7
Manchester Metropolitan University	16.5
University of Salford	29.6
University of Sheffield	22.2
Sheffield Hallam University	24.1
Staffordshire University	3
University College London	11.7
University of Wolverhampton	4
University of Glasgow	6.4
Napier University	5.5
Robert Gordon University	11
University of the West of Scotland	3
Aberystwyth University	11.2

The seven remaining universities are used to identify the population of this study.

These universities are:

- City University
- Leeds Metropolitan University
- Loughborough University
- Manchester Metropolitan University
- Sheffield University
- University College London
- Robert Gordon University
- Aberystwyth University

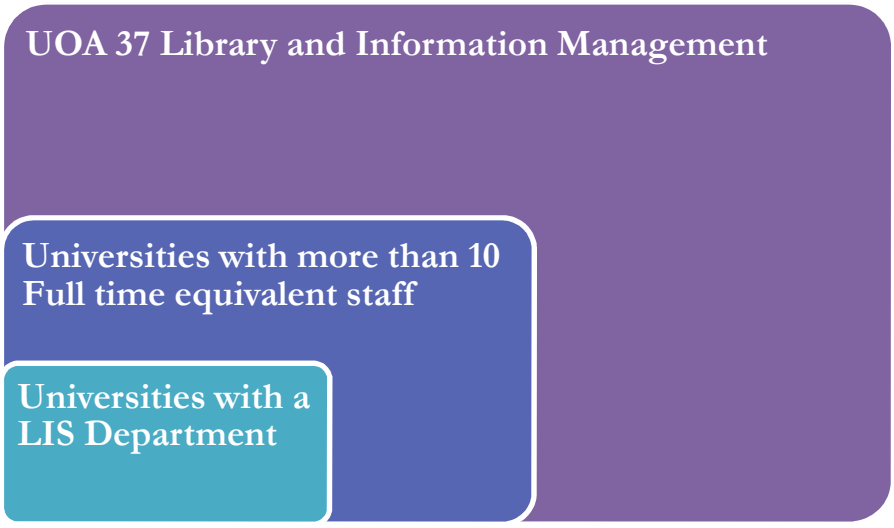

Figure 3-4 Demonstrating of specifying the LIS departments

Identifying and selecting the LIS departments leads to identifying academics working in these departments.

The data related to academics' names and affiliations as well as academic rank and status were retrieved from each department's website. These data provided the initial information needed to build the first dataset of this study which is the 'people dataset'. Other information such as gender and the working status of academics were also added to this dataset with the following procedures. To find academics' working status and to determine whether they are working fulltime or part-time, an email was sent to the head of each department explaining this research and why the working status data were needed. In some cases, a similar email was sent to the department's administrators and the academics individually. However, selected departments at three universities considered revealing the working status of their staff as confidential information governed by the Data Protection Act and were not willing to disclose such information.[1] Therefore, the data related to the working status of academics in these universities are considered missing.

To determine the gender of academics, the first point of reference was the academics' forenames. However, solely relying on forenames can be risky when the names are abbreviated[2] or not common English names. Therefore, to avoid making wrong guesses, academics' WebPages which normally includes an online Curriculum Vitae (CV) and a photo were investigated to verify the gender.

The data needed for completing the rest of the 'people dataset' requires building up another dataset, which would hold the data on the publications of each academic. A pilot study was conducted to compare the coverage of the three main bibliographic

1. These universities are Manchester Metropolitan, Loughborough and Sheffield.
2. For example names such as Alex and Sam, which are abbreviations both for Alexander and Alexandra, and Samuel and Samantha.

databases that index LIS publications. The next section explains how these databases have been identified and chosen in order to search for the academics' publications.

3.4 Pilot study: examining the coverage of bibliographic databases

There are three main bibliographic databases which index publications in the area of library and information science. These databases are Web of Knowledge (WOK) published by Thomson Reuters, Scopus by Elsevier, and Library, Information Science and Technology (LISTA) by EBSCO. It should be noted that Library and Information Science Abstract (LISA) is also a strong indexing and abstracting tool in the area of library and information science. However, after comparing the coverage of LISA and LISTA it was decided to choose LISTA for this study based on the following reasons:

- According to both databases' websites LISA covers 440 journals while LISTA Covers 560 Journals.
- LISTA coverage includes books, research reports and proceedings as well as articles. This is a great advantage as this study is aiming to find any type of publications.
- A study conducted by Caldarone, Freiberg et al. (2010) argues that LISTA has a greater breadth of coverage and includes more records and sources compared to LISA.

Each of the selected databases claims to have a comprehensive coverage, however, in order to pick the database with the best coverage; a pilot study that would compare the coverage of these databases was conducted.

For the purpose of the pilot study, academics at the Department of Information Studies (DIS) at University College London (UCL) were chosen as the sample. The list of the DIS academics staff at UCL was previously retrieved for the 'people dataset'. The list includes twenty members of staff, including professors, readers, senior lecturers, lecturers, teaching staff and research staff. The next step was to search for each academics' publications in the selected databases. The procedure of the search was to search the academic's name and then limit the result to LIS subject area. In terms of time limitation, the strategy of the search was to be as comprehensive as possible. This is because the purpose of the research is to find as many publications as possible for each academic, therefore all publications depending on how the database coverage goes back in time, are retrieved and saved.

All the academics were first searched for in WOK and the results of the search were saved in an EndNote library[1]. Similar search was conducted in Scopus and LISTA and the results of these were saved in separate files (libraries) on the EndNote software. In the next step, the journal titles in each EndNote library were extracted and saved in an Excel spreadsheet. Then journals' titles in each database were compared side by side. This process includes determining the overlapping journals between each and all of the three databases as well as identifying the unique titles in each database.[2] The result of this study is depicted in Figure 3-5 showing the number of unique journals in each database and the number of overlapped journals between them.

1. EndNote is a bibliographic reference management package produced by Thomson Reuters, which is used to manage bibliographies and references. EndNote calls each group of citations on a separate file a library.

2. The list of journals and their relevant databases is presented in appendix 1.

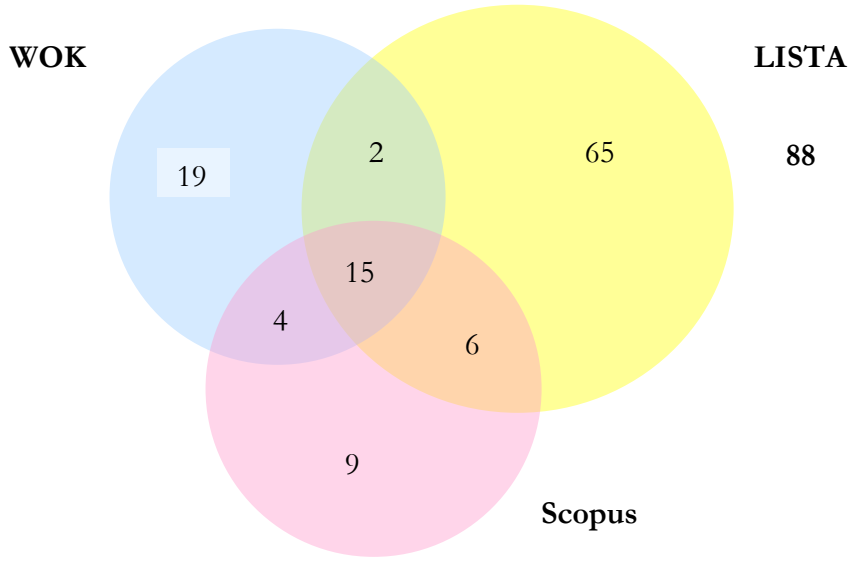

Figure 3-5 Coverage comparison between Web of Knowledge, Scopus and LISTA bases on the Academic publication of DIS staff at UCL in August 2010

Figure 3-5 suggest that LISTA covers nearly twice as many journal titles as WOK and Scopus, including 65 unique titles that are not included in either WOK or Scopus. Scopus has the most limited journal coverage, including 34 journals in total. This could be because Scopus has a limited coverage in Humanities (Gavel and Iselid 2008). Although this study suggests that LISTA has a better coverage, there are still 32 journal titles in total, which are specifically covered between WOK and/or Scopus which are not indexed in LISTA. On the other hand, LISTA is a simpler database in comparison with WOK and Scopus in terms of bibliometric feature and does not include citation analysis or h-index. Therefore, to maximise the efficiency of the results and to find as many publications as possible for each academic, it was decided to use all the three databases for searching the academics' publications.

3.5 Building the 'publications dataset'

This stage involves finding the publications of the research population using the WOK, Scopus and LISTA. The time frame policy was 'as comprehensive as possible'; that is finding publications as old as the data coverage allows in the three bibliographic databases. In terms of the type of publications, the policy was to include all publications (book chapters, book reviews, editorials, conference papers, reports and journal articles).

The EndNote software was used for saving the results of the searches. This is firstly because the results of the searches can be directly downloaded to EndNote software from each of the databases. Secondly, EndNote provides a feature to identify and delete duplicate records. This is an important feature because the bibliographic references are retrieved from three different databases with overlaps, and therefore it is time saving to use this feature to delete the duplicate records. Finally, EndNote provides a feature in which the data can be exported to an Excel Spreadsheet, which is essential for building up the 'publications dataset' in this research.

The procedure for finding the publications of the research population (academics in the people dataset) in each of the three bibliographic databases is as follows:

- **Step one**: Academics' name was searched for in the author's field and the results of the search were limited to the subject area of library and information science.

- **Step two**: Where necessary, the results of the search were narrowed down by including academics' affiliation.[1]
- **Step three:** The result of each search were saved and imported to the EndNote software.

The data collection took place from September 2010 to December 2010 and after deleting the duplicates, a total number of 2910 records was retrieved, in which the oldest paper is published in 1966 and the latest in 2010. The data was then exported to an Excel spreadsheet where each publication built the records and the information related to each publication builds the fields. The fields of this database are:

- Subject of the publication
- Authors' name
- Year of publication
- Publication's age
- Document type
- Length of the document
- Number of authors
- Number of female authors
- Female fraction
- Gender of the leading author
- Number of citations
- Average citations per year
- Journal's impact factor
- 5 years' impact factor
- Immediacy index
- Cited half- life

1. This was done when there were two authors with the same name (author homonyms); by including the subject category and the author affiliation the author homonyms problems were resolved.

- Citing half- life
- Eigenfactor score
- Article factor score

3.6 Completing the 'publications dataset' and the 'people dataset'

In order to complete the 'publications dataset', the next step was to find the missing data in each field of the dataset. Also, as stated earlier, to complete the data related to some of the fields in the 'people dataset', 'publications dataset' has to be completed first. For example, the data related to number of publications for each author and the year of first publication were filled in the 'people dataset' based on the data that was found and stored in the 'publications dataset'. To complete the 'publications dataset' the initial bibliographic information from the publications was used to complete some of the fields such as the year of publication, document type and document's length. The rest of fields such as female fraction were calculated or searched for in relevant databases to complete this dataset. This is explained in depth in the following subsections.

3.6.1 'People dataset'

Since the data related to academics and their affiliation, their gender, academic rank and working status was already stored in this dataset, the remaining data to be completed are related to the fields that hold the information for the number of publications, year of first publication, number of citation, average citation per year and h-index. The process of finding the data for each of these fields is explained separately in the following sub-sections.

Number of publications

This field in the people database represents the total number of publications for each academic that were found in the publications dataset. In order to determine the number of publications for each academic, the complete count method, which was explained in section 2.9.6 of the literature review, is used. This method gives each author a share of the publication despite the number of co-authors. Therefore, the authors' number of publications was determined by counting the number of papers written either solely by the author or in collaboration with other academics. The publications dataset was used for this purpose and this field was completed for each of the authors in the 'people dataset'.

Year of first publication

The year of the first publication for each author was also determined by searching in the 'publications dataset'. The importance of the year of first publication is because it can be used as a measure to understand productivity and to calculate the academic age of the authors. For example, if an author's first publication is in 2008 and they have three publications in total they cannot be considered unproductive in comparison with an author, whose first year of publication is 1980 and has also three publications in total. For each of the academics, the year of their first publication was searched in the publication dataset and was stored in the people dataset.

Number of citations and average citation per year

The number of citations and average citations per year for each author was found by searching the authors in Web of Knowledge and using the citation report analysis for each author. Number of citations represents the total number of the times an

author's publication is cited and the average citation per year represents the average number of citations for each year.

H-index

The academics' h-index were obtained via Web of Knowledge and was crosschecked with the publications dataset to ensure that all the papers contributing to the h-index were, in fact, authored or co-authored by the academics in the people dataset. Similar method to this has been used by Gaster and Gaster (2012) to study the publication of academics in health sciences in Denmark.

3.6.2 'Publications dataset'

Different techniques have been used to complete the remaining fields in the 'publications dataset'. The following sections will explain how the data related to each of these fields has been found and stored.

Number of authors, number of female authors and female fraction

Number of authors represents the total number of authors for each record (publication). It should be remembered that in each publication at least one author is one of the academics in the people database. Some of the publication records include collaborative authors who can be students, retired academics, academics from other disciplines, and academics for the same disciplines in other countries or places. As it was discussed in the multi authorship section in chapter two, different studies have taken a different approach to handle co-authorship in publications.[1] In this study, the complete count method is used to calculate the total number of publications for each of the academics in the people dataset; this means that one publication is considered

1. For example in previous studies Cline (1982) and Metz (1989) have used straight count and have excluded the collaborative authors while Terry (1996) has used complete counts to handle co-authorship.

for an academic whether he/she is the major author or the collaborative author(s). This is because different journals have different policies for publishing the name orders and it is not always practical to determine whether the ordering of names of authors is alphabetical or arbitrary. In addition, as stated by Terry (1996), in LIS, there are no clear norms in which the names of the authors appear in publications. As for the publications dataset, it was decided that all the names of collaborative authors should be found in order to gain a clear perspective of gender participation in this discipline. Therefore, the collaborative authors' names were also searched for. Where the forename of an author was missing, the author's surname and the title of the publication was searched for in Google. The result of this search typically leads to academics' homepages or CVs where the forename and the gender of the author are determined. The same procedure was used to identify the gender of collaborative authors. Once the gender of the authors collaborating in each of the publications were identified, the field related to the number of female authors was completed for each publication.

The female fraction for each publication was calculated by dividing the total number of authors by the number of female authors.

Gender of the leading author

The gender of the leading author is specified by number 1 for females and number 2 for males.

Subject of the publications

According to Peñas and Willett (2006) LIS is a multi-disciplinary subject and the publication and citation behaviour might be different for each gender in different subject domains. Therefore, determining the subject of the publications can reveal

valuable information about productivity of male and female academics in LIS. Subject trends in LIS have been previously studied by Atkins (1988) and Buttlar (1991) both by analysing the articles. However, Peñas and Willett's (2006) strategy to find the sub-subject in LIS was by reviewing the academics' webpages to identify the words or phrases that describe the individual's research interests. Then they grouped the various subject areas and identified eight categories that cover the sub-subject in the area of LIS. As Peñas and Willett's (2006) study is fairly recent compared to Atkins's (1988) and Buttlar's (1991), their subject categories are used as a basis for categorising the subject of publications in this research. However, some of the categories are modified and two new subejct categories have been added to Peñas and Willett's subject areas. This modification was nessessary as this research is conducted in a bigger scale than Peñas and Willett's study (2006) and therefore some subjects are added to their subject category.

Table 3-2 Modification of the subject categories of Peñas and Willett (2006) study

	Peñas and Willett's Broad Subject area	Modification
1	Human and social aspects of information handling, Organisational behaviour, User studies	
2	Digital libraries, E-books, E-publishing	Electronic library, Internet and web, Digital issues
3	Information retrieval	
4	Books, Collection, Record and library management, Literature, Preservation, Printing, Publishing	Documentation, Reference work
5	Automation, Database systems, Systems management, Technical issues	
6	Cataloguing, Classification, Indexing, Knowledge organisation, Taxonomies, Thesaurus construction	
7	Bibliometrics, Citation studies, Informetrics, Webometrics	Log analysis
8	Information literacy, Teaching and Learning	Public libraries
9		Copyright, Legal and ethical issues
10		Reports, Editorial notes, Book reviews

Table 3-2 depicts the Peñas and Willett's subject categories and the modifications added to their category for this study. Using these subject categories, each paper in the publications database was given a subject based on the paper's title, keywords and abstracts.

Number of citations and average number of citations for each paper

Each publication was searched for in WOK for the number of citations it has received to date. Using the citation report feature in WOK, the average number of citations for each paper was found and recorded in the publications database.

Journal impact factor and 5 years' impact factor

The data related to the impact factor of the journals for each of the records (publications) in publications dataset is gathered by using Journal Citation Report (JCR) for the year that the data was collected.[1] The reason why the information on impact factor is collected is that the impact factor is an enabling tool for comparing men's and women's publications and investigating any possible tendency for men and women to publish in journals with high impact factors.

The 5 years' impact factor is the average of the impact factor of the journals in the past five years. The data related to this was also found in JCR.

Cited half-life and citing half- life

Both cited half-life and citing half-life are measurements that are used to estimate the impact of a journal. Cited half-life is the median age of the articles that were cited in the JCR year. According to the Thomson (2012) glossary of terminology cited half-life "is the number of years, going back from the current year, that account for 50%

1. In the first stages of this research, the decision was to collect the impact factors and other journal related factors such as citing half-life and cited-half life for the year the paper was published in the specific journal. However, as some of the papers are fairly old, such information was not available for all the papers. Therefore, in order to have consistent data for all the journals it was decided to collect these data for the year that the data was collected. On the other hand, factors related to the journals are collected as a comparison tool; also, the way impact factor is calculated the variation of the number is not tremendously different, except in a few cases.

of the total citations received by the cited journal in the current year". ISI developed this calculation to provide an indicator as to the long-term value of source items in a single journal publication. Only journals cited 100 or more times in the JCR year have a cited half-life.

Citing half-life is the median age of articles cited by the journal in the JCR year. Only journals that publish 100 or more cited references have a citing half-life. According to Thomson Scientific terminology (2012), "the number of journal publication years, going back from the current year, that account for 50% of the total citations given by the citing journal in the current year" is the citing half-life

ISI developed this calculation to provide an indicator of the subtle changes in scope of a publication over the course of time. Evaluation of this factor can provide information on the cross-disciplinary nature of research in a specific field of interest.

The data related to both cited-half life and citing half-life for each journal was obtained from JCR in 2010.

Eigenfactor score and article influence score

Eigenfactor score and article influence score are other factors related to the journals. The Eigenfactor score, a rating for the total importance of a journal, was developed by Jevin West and Carl Bergstrom at the University of Washington (Bergstrom, West et al. 2008). According to Oxford LibGuides (2012), Eigenfactor Score measures the number of times articles from the journal published in the past five years have been cited in the JCR year. Like the Impact Factor, the Eigenfactor score is essentially a ratio of number of citations to total number of articles. However, unlike the Impact Factor, the Eigenfactor Score:

- counts citations to journals in both the sciences and social sciences;
- eliminates self-citations; every reference from one article in a journal to another article from the same journal is discounted;
- weights each reference according to a stochastic measure of the amount of time researchers spend reading the journal.

Eigenfactor scores are scaled so that the sum of the Eigenfactor scores of all journals listed in Thomson's Journal Citation Reports (JCR) is 100.

"The Article Influence Score measures the relative importance of the journal on a per-article basis. It is the journal's Eigenfactor score divided by the fraction of articles published by the journal. That fraction is normalized so that the sum total of articles from all journals is one" (Oxford LibGuides 2012).

Eigenfactor score and article influence score for each journal was searched for in JCR and the result was saved accordingly.

3.7 Data validation

Chapter two, section 2.9.4, argues that validity in bibliometric studies is determined by ensuring that what is being measured is exactly what we intended to measure. To determine this, after the data was collected and saved, the two datasets were examined to ensure whether the collected data is accurate and error free. Therefore, the two datasets were examined thoroughly for any missing values or duplicates. Additionally, some of the records in both datasets were selected randomly and their accuracy was confirmed.

Another aspect of validity in studies of this kind is reproducibility. In this research, the representativeness of the study's sample ensures reproducibility. In other words,

under similar conditions such as same academics, same time frame and same selected databases similar data and hence similar results are reproducible.

3.8 Data analysis

It was discussed in the beginning of the chapter that the type of research questions in this study requires a quantitative data and the research method explained how this data is collected for this study. Punch (2005:55) states that the key concept in quantitative data is quantity; and numbers are used to express quantity. In other words, quantitative data are numerical. The numeric data are produced either by counting or scaling or both. Counting and scaling are part of measurement and it is variables which are measured and produced by the measurement. The concept of variables are central to quantitative research as the research design shows how the variables are seen and organised with respect to each other It was explained in the research design and data collections process that how the data for this study was found and organised. Part of the quantitative data collection is about how the variables are to be measured and quantitative data analysis is about how the measurements of the variables are to be analysed (Punch 2005). Quantitative data are analysed using statistics and normally involves studying the relationships between variables and comparisons between groups. The decision of which statistical analysis should be chosen are based on the study's research questions and hypothesis but also based on the number of variables, the type of variables i.e. whether they are nominal, ordinal or scale variables and whether they are dependent or independent. The methods are used to analyse the data in this study will be explained here.

3.8.1 Frequency distribution

Frequency distributions are a useful way to summarise and understand the data (Punch 2005). The score in the distributions are tabulated based on the data or they fell into each category. In frequency distributions both absolute numbers and percentages maybe used depending on the study. Sometimes, depending on the overall score range, it is useful to group the scores so that the distribution of the frequencies can be seen more easily. As the data for this research is voluminous, the scores have been recoded into smaller groups for some of the analysis. The process of recoding the data is explained in chapter four. The results of the frequency distributions are displayed either in tables or graphs.

3.8.2 Cross-Tabulations

Cross-tabulation is a simple yet important analytical tool which provides an insight into the relationships between variables (Huizingh 2007). Cross tabulation, also known as contingency table, is applicable to a wide range of situations and is the foundation for more advanced analyses (Punch 2005). In this study, cross tabulation has been used as descriptive tool to show both the distribution and the relationships between variables as part of the analysis.

3.8.3 Correlation

Correlation is another analysis that measures the relationship between two variables. For instance, correlation can determine the association between the variation of one variable and the variation of another variable (Achelis 2013). Punch (2005) explains that conceptually, correlation is the same as co-variation. This means that if two variables are related, positively or negatively, they vary together and they share common variance. This is very important in understanding the relationship between

the variables in the data. Therefore, in this study, where it was needed to determine such relationship between the variables, correlation analysis has been used.

3.8.4 ANOVA

ANOVA is an analysis of variance which determines whether the means of a number of groups are equal (Huizingh 2007). ANOVA is similar to a t-test as it compares the group means of an interval or ration variables. The assumption in the ANOVA analysis is that the cases in the groups belong to independent random samples. Depending on the study, another assumption is that the variances within groups are equal. ANOVA (comparison) test is another analysis that has been used in this study ANOVA has been used to compare independent groups on some dependant variable.

3.8.5 Mann-Whitney U test

Mann-Whitney U test compares differences between two independent groups when the dependent variable is either ordinal or interval (Laerd statistics 2013). Mann-Whitney U test is used when the sample data are not normally distributed. In order to apply Mann-Whitney U test, the data should have certain characteristics. Firstly, as stated earlier, the dependant variable should be either ordinal or interval. Secondly, the independent variables should consist of two categorical independent variables. The third characteristic involves having independent observation, meaning that there should be no relationship between the observations in each group or between the groups themselves. Finally, the test can be used when the two variables being studied are not normally distributed. In this study, Mann-Whitney U test has been used to compare differences between two independent groups (genders) with the other variables in this study.

3.9 Software for the analysis

There are a few computer packages developed for the analysis of quantitative data. The most widely used software in social science research is the Statistical Package for the Social Sciences known as SPSS (Punch 2005). After the data validation process, the two Excel datasets were transferred to version 20 of SPSS software published by IBM statistics. The data were modified in SPSS and variables were defined. The data were labelled for variables, and newly-recorded variables were created for the variables with the large amount of data. The explained statistical analyses were used to analyse the data.

The results of the data analysis are presented in chapter four.

3.10 Summary

This chapter described the methodology of the research. The chapter begins with explaining the research design and the research process. Different methods and procedures employed for data collection are described. The analysis chosen to analyse the data are also defined.

Chapter 4 – Results and discussion

This Chapter presents and discusses the results of the analysis of the bibliometric data of this study's two datasets on people and publications, and is structured in three sections. The initial section, introduction, explains the rationale behind the presentation of the results and reviews the demographic information of the data including the datasets' variables and recoded variables. The purpose of this information is to provide a general picture of the data and related variables. The second section presents the results of the analysis related to the two datasets and includes a separate discussion section for each analysis. The final section summarises the study's findings by briefly answering the research questions.

4.1 Introduction

Finding a suitable way to structure and present the results is an important part of research. In this study, there were several possibilities for this presentation. One of the options was to present the results of each dataset separately. However, this meant that some of the results which are related to a particular concept and are shared between the two datasets, such as number of publications and number of citations, would be presented separately. This would have affected the coherency of the result and would have made further comparisons of the results challenging. Therefore, this option was discarded.

Another option was to have two separate sections for the results and discussion in which the entire results are presented first, followed by a single discussion section for the presented results. Considering that some of the findings in this study are

independent even though they are related, this option was also considered inappropriate.

Finally, in order to gain a comprehensive picture of the findings it was decided to present the results in the order of the research questions and, where applicable, present the findings related to both datasets together. This thematic approach also provides a platform where the results from the two datasets can be compared. Because of the nature of this study, each finding requires its own discussion. Therefore, it was decided to add a discussion section following each of the results' sections. The discussion sections scrutinise the findings and, where the information is available, compare them with the results of previous studies.

Before presenting the results, it is necessary to review some of the characteristics of the data and the variables of the study, and how the variables are prepared for the analysis.

4.2 'People dataset'

The first dataset of this study is the 'people dataset'. This dataset includes the total number of 133 academics who were identified and selected as the population of the study. The process of identifying universities and selecting academics was explained in Chapter three. Of the total number of 133 academics, 66 academics are female and 67 are male. Unlike some older studies of publication patterns in LIS, such as Swisher and Du Mont (1984) and Korytnyk (1988), in which the majority of population were men, this study has the benefit of having an almost equal numbers of male and female academics as the sample of the study. This is an advantage for the study as it provides an unbiased setting for comparison of men's and women's productivity. The variables of this dataset are presented in Table 4-1.

Table 4-1 People dataset variables

LIS academics in the UK
Year of first publication
Number of publications
Number of citations
Average number of citations per publication
H-Index
Average number of publications per year
Gender
Academic rank
Working status
University (Affiliation)
Academic age

The data related to number of publications, year of first publication, and number of citations, were found by searching in the 'publications dataset' which holds information relating to the publications of the study sample (the academics). For multiple authored papers, the complete count method is used. As explained in chapter three, in this method each author receives one share of the published paper. The reason for choosing this method over fractional count is that the focus in the 'people dataset' is the academics and the number of publications they have authored or co-authored rather than their share in each publication. Moreover, since most of the publications are co-authored, using the complete count method ensures that the results are not affected by the number of co-authors in a publication.

The average number of citations was calculated by using the total number of citations divided by the total number of publications for each academic. The h-index for each academic was obtained through Web of Knowledge and it was ensured that all the papers contributing to the h-index were authored or co-authored by the given academics by cross checking with the publication dataset. To work out the average number of publications per year the academic age was calculated. The academic age is the number of years since the first publication of each academic. The total number of publications divided by the academic age makes the average number of publications per year. Data relating to the academics' rank, gender and affiliation were obtained through the universities' websites and the academics' online web pages.

4.2.1 Recoding variables

Recoding variables enables the categorisation of data relating to each variable into smaller groups. This is usually done when the data are too sparse to be analysed. Recoding variables includes making a set of related *If/Then* conditional transformations from the old variables into the new ones (Muenchen 2011). In this dataset, the variables which hold a large range of data are number of publications, number of citations, average publications per year and h-index; therefore, these variables have been recoded into smaller groups. The process of recording was done in SPSS, and a small number of analyses were conducted while recoding the variables in order to determine whether the groups that the variables are grouping into would show similar patterns. The ranges of the new recoded variables for the people dataset are shown Table 4-2.

Table 4-2 Categories of recoded variables in people dataset

Variables	Number of Citations	Number of publications	Average publications per year	H-Index
Ranges of new recoded variables	0-5 citations	0-5 publications	0-0.5 per year	0
	6-20	6-15	0.51- 1.5	1-2
	21-50	10-30	1.51- 2.0	3-4
	51-200	31-100	2.01- 3.0	5-9
	201 or more	101 or more	3.01 or more	H-index of 10 or more

4.3 'Publications dataset'

The second dataset in this study is the 'publications dataset'. This dataset was compiled by searching for the publications of academics in the 'people dataset'. After deleting the duplicates, a total number of 2910 papers were identified for all the academics in the 'people dataset'. For each paper, five variables were selected to monitor gender. The first variable indicates the total number of authors in a paper. The second concerns the total number of female author(s), if any, for that paper. The third variable indicates the gender of the leading author, and the fourth variable assigns a paper to one of three gender categories of male only, female only and mixed gender authors. Finally, the fifth variable indicates whether the paper is written by a solo author or by collaborative authors. Other variables in this dataset apart from document type and total number of pages are shown in Table 4-3.

Table 4-3 Publications dataset variables

Academic Publications
LIS Sub-discipline
Publication year
Number of pages
Number of authors
Number of female authors
Number of citations
Average citations per year
Impact factor
5 years' Impact factor
Immediacy index
Cited half-life
Citing half-life
Eigenfactor score
Article influence score
Journal's name

4.3.1 Recording variables

As explained previously, recoding groups old variables into new variables within smaller groups. While still holding accurate data, the new recoded variables present a range of variation within each variable. Within the 'publications dataset', the variables with a large range which required to be recoded were: number of publications, impact factor, cited half-life, citing half-life and 5 years' impact factor. Gender was

also recoded into three categories of male only, male and female, female only for the purpose of analysis relating to gender. The recoded variables and the range they have been assigned to, are shown in Table 4-4. After recoding the variables, the data is ready for analysis. It is worth noting that in the Mann-Whitney U test analyses, to ensure accuracy of the results, the original variables were used rather than the recoded variables.

Table 4-4 Categories of recorded variables in publication dataset

Variables	Number of Citations	Impact factor	Immediacy Index	Cited half-life	Citing half-life	5 years' Impact factor	Gender mixed
Ranges of new recoded variables	0 citations 1-3 4-10 11-50 51 or more	0 0.01-0.6 0.61-1.2 1.21-2 2.01 or higher	0 0.0001-0.1 0.1001-0.2 0.2001-0.5 0.5001 and higher	0 0.1-6 6.1-7 7.1-9.9 0	0 0.1-6 6.1-7.5 7.6-8 8.1-10	0 0.0001-1 1.0001-1.6 1.6001-2 2.0001 or higher	Male Female and male Female

4.4 Results and discussion

As explained in the introductory part of this chapter, this section forms the main body of the chapter. Each sub-section in this part presents the results of the related analysis followed by a discussion section. Each discussion section discusses the results and compares them with the results of previous studies.

4.4.1 Gender and academic rank (academic professional category)

To understand the distribution of male and female academics in different academic rank positions, gender and academic rank positions have been compared side-by-side using the crosstabs procedure in SPSS. Figure 4-1 suggests that the proportion of male and female academics is relatively balanced in the lower ranks (teaching fellows

and researchers), as well as in upper-middle ranks (senior or principal lecturers and readers). However, at the very top level, the number of male professors is more than double that of female professors. In addition, in the middle category of lecturers, there are a disproportionately large number of females, compared to the number of males. This seems to indicate that, while it is not impossible for women to make it to the top academic rank positions in LIS in the UK, many female academics get stuck in the middle of the academic ladder.

A Mann-Whitney U test was run to determine whether there are differences in academic levels[1] between male and female academics. Before running the test it should be established that the distribution of scores for both categories (men and women) for the independent variable (academic rank positions) has the same shape. The visual inspection of this, Figure 4-2, suggests that both distributions do have the same shape.

1. Since the Mann-Whitney U test uses the term 'rank' to compare differences between two groups, to avoid confusion, 'academic professional category' is used instead of academic rank in the analysis related the Mann-Whitney U test .

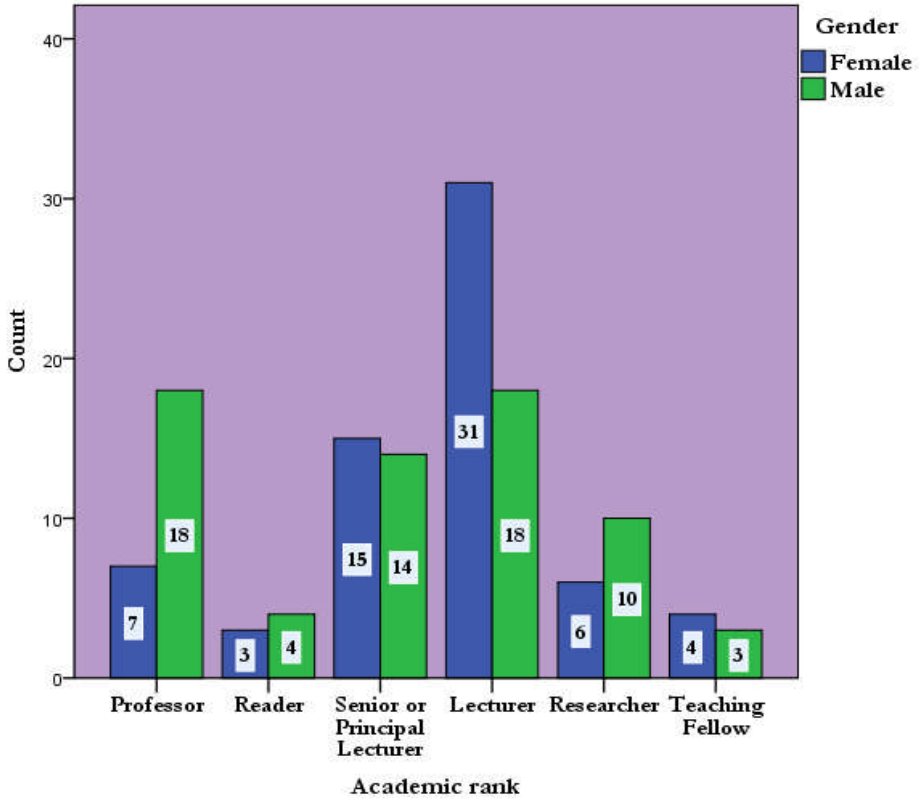

Figure 4-1 Academic rank and gender

The Mann-Whitney U test produces two tables of Ranks and Test Statistics. The mean rank value in the rank table indicates which group (men or women) are working in the higher academic professional category. Table 4-5 shows that the mean value for men is higher than for women suggesting that men are working in higher academic professional categories. However, the next table (Table 4-6), which shows the actual significance value of the test, suggests that there is no statistically significant difference between men and women in terms of the professional academic category they work in (U=1969, z=-1.129, p=.206 using an exact sampling distribution for U^{1}).

[1] . For a statistically significant result the p value should be smaller than .05

Table 4-5 Mann-Whitney U test, rank table for academic grade

Ranks				
		N	Mean Rank	Sum of Ranks
Academic level	Female	66	63.33	4180.00
	Male	67	70.61	4731.00
	Total	133		

Table 4-6 Mann-Whitney U test, Test Statistics for academics

Test Statistics	
	Academic rank
Mann-Whitney U	1969.000
Wilcoxon W	4180.000
Z	-1.129
Asymp. Sig. (2-tailed)	.259
Exact Sig. (2-tailed)	.260
Exact Sig. (1-tailed)	.130
Point Probability	.000
Grouping Variable: Gender	

Group variable: gender

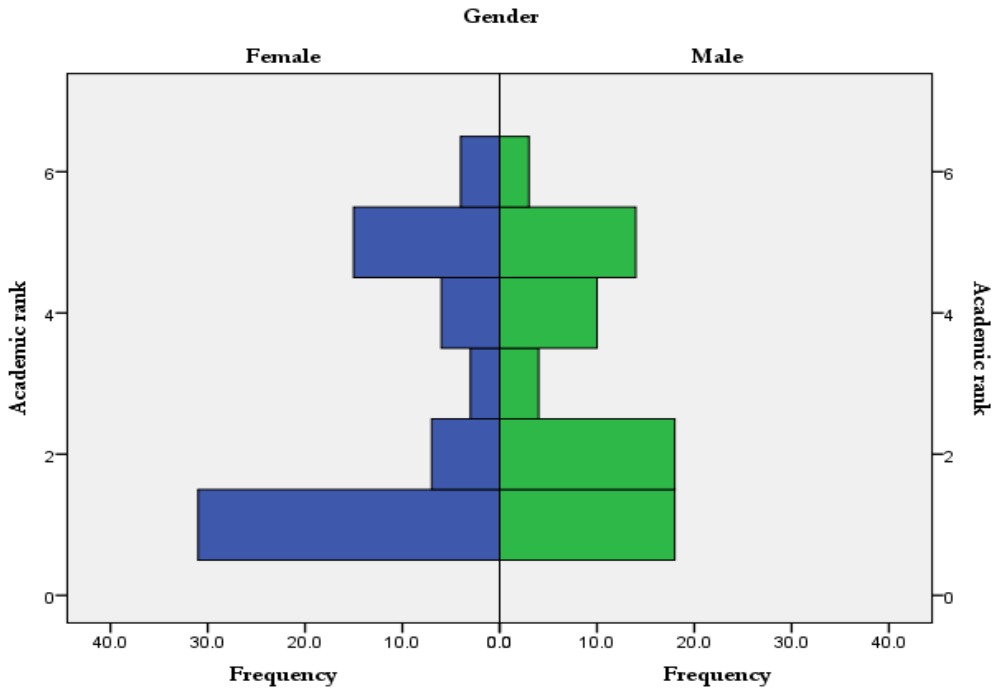

Figure 4-2 Distribution of academic grades for male and female

Therefore the result of Mann-Whitney U test confirms that, although there are more male academics working in the highest academic professional rank, there is not a statistically significant difference between men and women in terms of academic grading.

Gender and productivity

4.4.2 Number of publications

As discussed in the literature review chapter, the number of publications is one indicator of productivity. This section compares number of publications for both genders in the two datasets of this study.

In the publications dataset, a total of 2910 publications were identified by searching for publications of the 133 academics in the 'people dataset'. However, the total number of authors in this dataset reached 5436 due to the collaboration of academics in the 'people dataset' with other authors outside the 'people dataset'. On the other hand, in the 'people dataset', the total number of papers found amounted to 3303 for the 133 academics. Since the complete count method is used to handle multi-authorship, the total number of publications in the 'people dataset' is higher than the 'publications dataset'. In other words, if a paper is written collaboratively by two of the academics in the people dataset, each has received a credit for that paper. Figure 4-3 shows the comparison between the total number of authors and total number of publications in each dataset, and depicts schematic display of the two datasets. Looking at the 'people dataset' might suggest that men have published twice as many papers as women have. However, such a conclusion is unjustified when the number of authors within each range of publication is considered (Table 4-7).

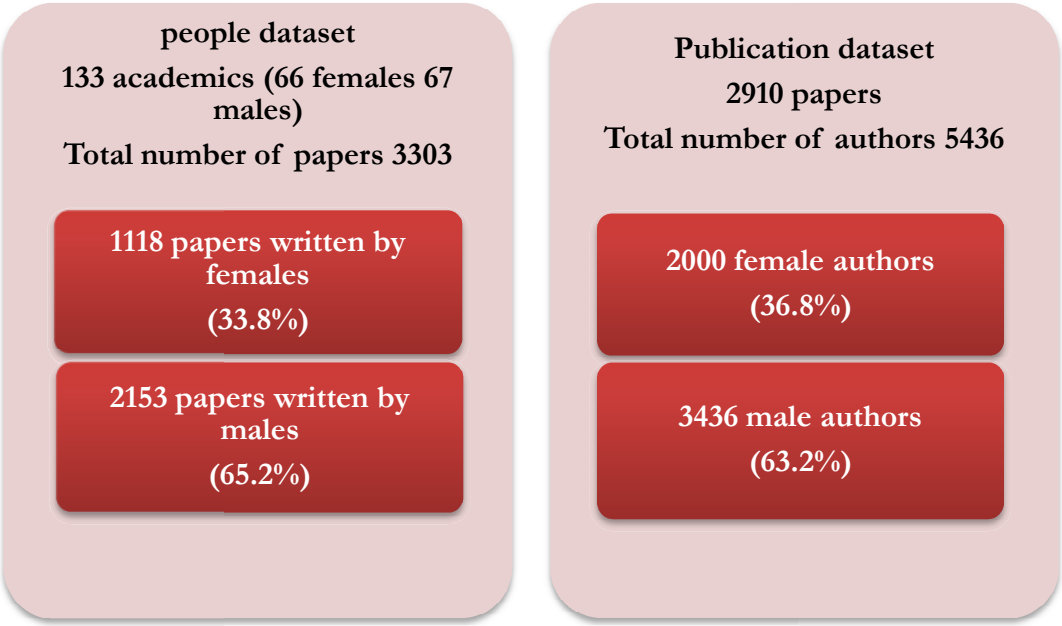

Figure 4-3 A schematic display of the two datasets and the number of authors and publications in each dataset

Table 4-7 Distribution of academics' publications by gender

Number of publications	Gender		Total
	Female	Male	
0-5 publications	23.00	24.00	47.00
	48.90%	51.10%	100.00%
6-15 publications	24.00	15.00	39.00
	61.50%	38.50%	100.00%
16-30 publications	10.00	9.00	19.00
	52.60%	47.40%	100.00%
31-100 publications	7.00	13.00	20.00
	35.00%	65.00%	100.00%
101 or more publications	2.00	6.00	8.00
	25.00%	75.00%	100.00%
Total	66.00	67.00	133.00
	49.60%	50.40%	100.00%

Table 4-7 reveals that there are more or less equal numbers of male and female academics who have published up to five items during their academic careers. In the next category, there are noticeably more women publishing between 6 to 15 publications. Women also take priority in the next category of 16 to 30 publications. However, men dominate the categories with large and very large numbers of publications, with 19 individuals having 31 or more publications, as compared to 9 women. To determine whether these differences are statistically significant, Mann-Whitney U test was carried out on the uncategorised data. The results in Table 4-8 and Table 4-9 suggest that although the mean rank score for men's publications is higher than women, there is not a statistically significant difference in the overall number of publications between men and women (p=.345 > .05).

Table 4-8 Mann-Whitney U test, Ranks table for number of publications

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	66	63.82	4212.00
	Male	67	70.13	4699.00
	Total	133		

Table 4-9 Mann-Whitney U test, Test Statistics table for number of publications

Test Statistics	
	Number of publications
Mann-Whitney U	2001.000
Wilcoxon W	4212.000
Z	-.947
Asymp. Sig. (2-tailed)	.344
Exact Sig. (2-tailed)	.345
Exact Sig. (1-tailed)	.173
Point Probability	.001
a. Grouping Variable: Gender	

The reason for the high mean rank score for men's publications can be explained by looking at the data. Investigation of the data reveals that there are two men in the people dataset who have the largest number of publications, having published 268 and 293 papers respectively. The presence of these two individuals with such a high number of publications can be the reason for the high mean rank score for men's publications. It could also be argued that because the total number of men and women's publications is approximately equal (Table 4-7), the results of the Mann-Whitney U test shows no significant difference between the publications of men and women academics.

4.4.3 Publications within each academic professional category (rank)

The analyses in this section are conducted to determine whether there are differences between the number of publications of men and women academics in different academic professional categories (rank categories). The first category is the professorial level. This analysis is shown in Table **4-10** and Table **4-11**. The rank table (Table **4-10**) shows that the mean rank of publications for male professors is higher than for female professors. However, as shown in Table **4-11** these means are not statistically significantly different. Therefore, although there are a couple of male professors in the sample with a high number of publications, the general difference between the publications of male and female professors is not statistically significant.

Table 4-10 Mann-Whitney U test, Ranks table for number of publications of academics at professor level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	7	10.29	72.00
	Male	18	14.06	253.00
	Total	25		

Table 4-11 Mann-Whitney U test, Test Statistics table for number of publications of academics at professor level

Test Statistics	
	Number of publications
Mann-Whitney U	44.000
Wilcoxon W	72.000
Z	-1.150
Asymp. Sig. (2-tailed)	.250
Exact Sig. (2-tailed)	.263
Exact Sig. (1-tailed)	.132
Point Probability	.006
Grouping Variable: Gender	

The second category is academic readers. The results of the Mann-Whitney U test suggests that number of publications for male academics at reader level (mean rank=4.5) and female readers (mean rank=3.33) were not statistically significantly different, U=4, Z=-.707, p=.629 (Table 4-12 and Table 4-13).

Table 4-12 Mann-Whitney U test, Ranks table for number publications of academics at reader level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	3	3.33	10.00
	Male	4	4.50	18.00
	Total	7		

Table 4-13 Mann-Whitney U test, Test Statistics table for number of publications of academics at reader level

Test Statistics	
	Number of publications
Mann-Whitney U	4.000
Wilcoxon W	10.000
Z	-.707
Asymp. Sig. (2-tailed)	.480
Exact Sig. (2-tailed)	.629
Exact Sig. (1-tailed)	.314
Point Probability	.114
Grouping Variable: Gender	

At senior or principal lecturer level, the mean rank score for the publications of female senior lecturers is slightly higher than for men (Table 4-14). However, there is not a statistically significant difference between the publications of male and female academics in this academic rank category (Table 4-15).

Table 4-14 Mann-Whitney U test, Ranks table for number publications of academics at senior or principal lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	15	15.03	225.50
	Male	14	14.96	209.50
	Total	29		

Table 4-15 Mann- Whitney U test, Test Statistics table for number of publications of academics at senior or principal lecturer level

Test Statistics	
	Number of publications
Mann-Whitney U	104.500
Wilcoxon W	209.500
Z	-.022
Asymp. Sig. (2-tailed)	.983
Exact Sig. (2-tailed)	.991
Exact Sig. (1-tailed)	.496
Point Probability	.009
Grouping Variable: Gender	

Table 4-16 Mann-Whitney U test, Ranks table for number of publications of academics at lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	31	26.77	830.00
	Male	18	21.94	395.00
	Total	49		

Table 4-17 Whitney U test, Test Statistics table for number of publications of academics at lecturer level

Test Statistics	
	Number of publications
Mann-Whitney U	224.000
Wilcoxon W	395.000
Z	-1.150
Asymp. Sig. (2-tailed)	.250
Exact Sig. (2-tailed)	.255
Exact Sig. (1-tailed)	.127
Point Probability	.002
Grouping Variable: Gender	

At lecturer level also, despite the higher mean rank score for publications of female academics compared to male (Table 4-16), the Mann-Whitney U test shows that there is not a statistically significant difference between the publications of male and female academics at this level (Table 4-17).

At the two levels of researcher and teaching fellow, the results are similar to other levels. Despite the differences in the mean score rank for publications, there is not a statistically significant difference between the publications of male and female academics at these two levels (Table 4-18 and Table 4-19 for teaching fellows and Table 4-20 for Table 4-21 for researchers).

Table 4-18 Mann-Whitney U test, Ranks table for number of publications of academics at teaching fellow level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	4	5.00	20.00
	Male	3	2.67	8.00
	Total	7		

Table 4-19 Whitney U test, Test Statistics table for number of publications of academics at teaching fellow level

Test Statistics	
	Number of publications
Mann-Whitney U	2.000
Wilcoxon W	8.000
Z	-1.440
Asymp. Sig. (2-tailed)	.150
Exact Sig. (2-tailed)	.229
Exact Sig. (1-tailed)	.143
Point Probability	.114
Grouping Variable: Gender	

Table 4-20 Mann-Whitney U test, Ranks table for number of publications of academics at researcher level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of publications	Female	6	7.83	47.00
	Male	10	8.90	89.00
	Total	16		

Table 4-21 Whitney U test, Test Statistics table for number of publications of academics at researcher level

Test Statistics	
	Number of publications
Mann-Whitney U	26.000
Wilcoxon W	47.000
Z	-.438
Asymp. Sig. (2-tailed)	.662
Exact Sig. (2-tailed)	.687
Exact Sig. (1-tailed)	.345
Point Probability	.017
Grouping Variable: Gender	

4.4.4 Average number of publications

An alternative method of comparing male and female academic productivity is by comparing the average number of publications per year for each academic. Average number of publications per year can be calculated by dividing the total number of publications by the number of years since the academic's first item was published. To determine whether there are statistical significant differences between the average number of publications of male and female academics, a Mann-Whitney U test was carried out (Table 4-22 and Table 4-23). The results show that, although the mean rank score for average number publications for male authors is slightly higher, the difference between the average number of publications of male and female academics is not statistically significant (Table 4-23).

Table 4-22 Mann-Whitney U test, Ranks table for average number of publications

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average publications per year	Female	57	55.99	3191.50
	Male	56	58.03	3249.50
	Total	113		

Table 4-23 Mann-Whitney U test, Test Statistics table for average number of publications

Test Statistics	
	Average publications per year
Mann-Whitney U	1538.500
Wilcoxon W	3191.500
Z	-.330
Asymp. Sig. (2-tailed)	.741
Exact Sig. (2-tailed)	.743
Exact Sig. (1-tailed)	.372
Point Probability	.001
Grouping Variable: Gender	

To investigate whether there are differences between men and women's average number of publications in each academic professional category (rank), a Mann-Whitney U test was run for each of the academic professional categories.

At professor level, the mean rank for average number of publications is in favour of male professors (Table 4-24); however, there is not a statistically significant between males and female average number of publications (Table 4-25).

Table 4-24 Mann-Whitney U test, Ranks table for average number of publications of academics at professor level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average publications per year	Female	7	11.57	81.00
	Male	18	13.56	244.00
	Total	25		

Table 4-25 Mann-Whitney U test, Test Statistics table for average number of publications for academics at professor level

Test Statistics	
	Average publications per year
Mann-Whitney U	53.000
Wilcoxon W	81.000
Z	-.605
Asymp. Sig. (2-tailed)	.545
Exact Sig. (2-tailed)	.574
Exact Sig. (1-tailed)	.287
Point Probability	.020
Grouping Variable: Gender	

At reader level also, the mean rank score for average number of publications per year for female academics is higher than males; however, this difference is not statistically significant (Table 4-26 and Table 4-27).

Table 4-26 Mann-Whitney U test, Ranks table for average number of publications of academics at reader level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average publications per year	Female	3	4.33	13.00
	Male	4	3.75	15.00
	Total	7		

Table 4-27 Mann-Whitney U test, Test Statistics table for average number of publications for academics at reader level

Test Statistics	
	Average publications per year
Mann-Whitney U	5.000
Wilcoxon W	15.000
Z	-.354
Asymp. Sig. (2-tailed)	.724
Exact Sig. (2-tailed)	.857
Exact Sig. (1-tailed)	.429
Point Probability	
Grouping Variable: Gender	

At senior lecturer level, despite having more or less equal numbers of men and women, the mean rank score for average number of publications is higher for women (Table 4-28). However, this difference is not statistically significant (Table 4-29). At lecturer level, the number of women is almost twice the number of men. However, Table 4-30 shows that the mean rank score for both male and female is almost the same and therefore, they are not statistically significantly different (Table 4-31).

Table 4-28 Mann-Whitney U test, Ranks table for average number of publications of academics at senior lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	15	16.27	244.00
	Male	14	13.64	191.00
	Total	29		

Table 4-29 Mann-Whitney U test, Test Statistics table for average number of publications for academics at senior lecturer level

Test Statistics	
	Average number of citations
Mann-Whitney U	86.000
Wilcoxon W	191.000
Z	-.835
Asymp. Sig. (2-tailed)	.404
Exact Sig. (2-tailed)	.422
Exact Sig. (1-tailed)	.211
Point Probability	.012
Grouping Variable: Gender	

Table 4-30 Mann-Whitney U test, Ranks table for average number of publications of academics at lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	31	24.82	769.50
	Male	18	25.31	455.50
	Total	49		

Table 4-31 Mann-Whitney U test, Test Statistics table for average number of publications for academics at lecturer level

Test Statistics	
	Average number of citations
Mann-Whitney U	273.500
Wilcoxon W	769.500
Z	-.121
Asymp. Sig. (2-tailed)	.903
Exact Sig. (2-tailed)	.909
Exact Sig. (1-tailed)	.452
Point Probability	.004
Grouping Variable: Gender	

Table 4-32 Mann-Whitney U test, Ranks table for average number of publications of academics at researcher level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	6	8.17	49.00
	Male	10	8.70	87.00
	Total	16		

At both researcher and teaching fellow level, the mean rank score for number of publications of men and women academics is more or less the same (Table 4-32 and Table 4-34). Therefore, the average number of publications is not statistically significantly different between men and women at these two levels (Table 4-33 and Table 4-35).

Table 4-33 Mann-Whitney U test, Test Statistics table for average number of publications for academics at researcher level

Test Statistics	
	Average number of citations
Mann-Whitney U	28.000
Wilcoxon W	49.000
Z	-.223
Asymp. Sig. (2-tailed)	.824
Exact Sig. (2-tailed)	.858
Exact Sig. (1-tailed)	.429
Point Probability	.024
Grouping Variable: Gender	

Table 4-34 Mann-Whitney U test, Ranks table for average number of publications of academics at teaching fellow level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	4	4.38	17.50
	Male	3	3.50	10.50
	Total	7		

Table 4-35 Mann-Whitney U test, Test Statistics table for average number of publications for academics at teaching fellow level

Test Statistics	
	Average number of citations
Mann-Whitney U	4.500
Wilcoxon W	10.500
Z	-.866
Asymp. Sig. (2-tailed)	.386
Exact Sig. (2-tailed)	1.000
Exact Sig. (1-tailed)	.571
Point Probability	.571
Grouping Variable: Gender	

Discussion

This section compared the productivity of LIS academics within each academic professional category by looking at the number of publications and the average number of publications. The results indicate that there are more male academics working at top professional level rank while women are concentrated in middle rank categories. This is consistent with previous studies which found that fewer women occupy higher academic professional rank positions at universities (Leibenluft, Dial et al. 1993; Bordons, Morillo et al. 2003; Malouff, Schutte et al. 2010; Abramo, D'Angelo et al. 2011; D'Amico, Vermigli et al. 2011). However, in terms of the number of publications and the average number of publications, there is not a statistically significant difference between men's and women's productivity in LIS. This is an important finding compared to previous studies which reported that in general women are less productive than men (Cole and Zuckerman 1984; Long 1992; Abbott 2000; Bordons, Morillo et al. 2003). Productivity of academics at each academic professional category was investigated by comparing number of publications and average number of publications. The results show that the mean rank score for number of publications and average number of publications for male and female academics at each level is very competitive. Although the mean rank score of publications and average publications per year is slightly higher for male academics at the top level of professor, the difference is not statistically significant. This suggests that although there are fewer females working at professorial levels, they are as productive as male academics in this level. Previous studies such as D'Amico, Vermigli et al. (2011) and Mauleon and Bordons (2006) have also reported no difference in the productivity of men and women once the academic professional rank was considered.

Similarly, there are more female academics employed in middle rank categories, and, despite the slight difference in the mean rank score of publications and average number of publications in favour of them, the difference in productivity is not statistically significantly different. In previous studies such as Bordons, Morillo et al. (2003), it was suggested that lower productivity of women is the result of working at lower professional rank compared to men. The results of this research clearly challenge this argument as no significant difference was observed in the productivity of academics in general or in each academic rank category. These results, however, cannot explain why women with performance compatible with their male counterparts, are concentrated in middle academic rank positions and have not made their way to higher levels in the same way as men have done.

Some previous studies of gender and productivity in LIS such as Olsgaard and Olsgaard (1980), Cline (1982), Metz (1989), Raptis (1992), Buttlar (1991) and Terry (1996) have suggested that women's share in publications is lower than the general population of women in the discipline. It is worth considering that these studies have mainly taken a 'publications to authors' approach, and looking at the schematic display of the two datasets in this study (Figure 4-3) confirms that the approach to the research, whether from publications to authors or authors to publications, can affect the interpretation and understanding of the results. In the case of this study for example, looking solely at the number of men and women in the 'publications dataset' would suggest that men outnumber women. However, when the total number of men and women in the LIS discipline and their productivity within each academic level is compared, no statistically significant difference can be found between men's and women's productivity. The greater number of men in the

'publications dataset' is the result of collaboration among men (which will be discussed further on in this section). It is therefore fair to assume that the approach to the research can influence how the results should be understood. It is worth mentioning that Korytnyk (1988), who also found no difference between men's and women's publication pattern, had also used 'authors to publications' approach.

The question that arises here is why the total number of publications is in favour of men in the 'publications dataset'. This can be explained by looking at collaboration patterns among academics. A descriptive analysis of the 'publications dataset' reveals that nearly half of the papers have been written solely by male authors while a quarter of the papers are written solely by females. To understand the collaboration pattern in the category where men and women have collaborated, the female and male category is divided into two categories of female-male collaboration and male-female collaboration, based on the leading author. The result indicates that out of the total percentage of 25.3 for mixed gendered collaborated publications, 13.6 per cent of the publications are written by female-male collaboration and 11.8 per cent by male-female collaboration. This suggests that men are involved in three quarters of the total number of publications whereas women are participants in half of the papers. It is also evident that a great number of men only collaborate with other men, while it seems that women collaborate almost equally with both men and other women. Since the collaboration between the academics is not just limited to the LIS discipline and might be inter-disciplinary, nationally or internationally the total number of men in the 'publications dataset' is noticeably more than women. Therefore, the greater number of men authors in the 'publications dataset' is the outcome of male collaboration with other male authors, and not men's productivity. However, it should be noted that since the complete count method is used for

counting the number of the publications for each academic, the effect of multi-authorship has been eliminated from the total number of publications of each author. In other words, the fractional counting method would have favoured men in this study as the results demonstrate that men collaborated more than women, and with other men.

It is worth remembering that Long (1992) considered collaboration as a dimension of productivity, as he believed that gender differences in the number of papers could be distorted by the effects of collaboration. This could be generally the case in studies that take 'publications to authors' approach. In this study in which 'authors to publications' and complete count method has been used, the results suggest that men and women are equally productive. It is therefore fair to say that, while it seems collaboration does not have a direct impact on productivity, the behavioural difference between males and females collaborations is potentially an interesting topic for further research.

Table 4-36 Collaboration of male and female academics with other academics based on gender

		Frequency	Percent	Valid Percent	Cumulative Percent
	Male only	1415	48.6	48.9	48.9
	Female and Male	737	25.3	25.4	74.3
	Female only	744	25.6	25.7	100
Valid	Total	2896	99.5	100	
Missing	System	14	0.5		
Total		2910	100		

4.4.5 Number of citations

The number of citations as indicative of productivity (Harris 1990; Hakanson 2005) has been collected for each LIS male and female academic. In order to get a clear

picture of the data and see how male and female academics are distributed in each citation range, the number of citations was recoded into five new categories. This is shown in Table 4-37. As indicated in Table 4-37, in the category with the lower number of citations, the two genders are relatively equally balanced and have similar numbers of citations. In the middle categories, 6 to 50 citations, women are clearly dominant. In contrast, there is a clear male domination in the extremely high number of citations category. However, it seems that these two categories are compensated for in the total number of citations for both male and female academics, as the numbers are approximately equal for both.

Table 4-37 Distribution of the number of citations for academics by gender

Number of Citations	Gender		
	Female	Male	Total
0-5 citations	26	29	55
	47.30%	52.70%	100.00%
6-20 citations	12	7	19
	63.20%	36.80%	100.00%
21-50 citations	11	7	18
	61.10%	38.90%	100.00%
51-200 citations	15	13	28
	53.60%	46.40%	100.00%
201 or more citations	2	11	13
	15.40%	84.60%	100.00%
Total	66	67	133
	49.60%	50.40%	100.00%

To investigate whether any of these differences are statistically significant or not, a Mann-Whitney U test was carried out using the uncategorised data. To determine whether there are significant differences between the total number of citations of male and female academics' publications Table 4-38 and Table 4-39 were developed. The results show that, although the number of citations mean rank score is higher

for male academics (Table 4-38), there is not a statistically significant difference between the number of citations score for men and women.

Table 4-38 Mann-Whitney U test, Rank table for number of citations

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of citations	Female	66	63.42	4186.00
	Male	67	70.52	4725.00
	Total	133		

Table 4-39 Mann-Whitney U test, Test Statistics table for number of citations

Test Statistics	
	Number of citations
Mann-Whitney U	1975.000
Wilcoxon W	4186.000
Z	-1.082
Asymp. Sig. (2-tailed)	.279
Exact Sig. (2-tailed)	.281
Exact Sig. (1-tailed)	.140
Point Probability	.001
Grouping Variable: Gender	

To compare the number of citations of academics in each professional academic category, the Mann-Whitney U test was repeated for each academic level. At professor level, the number of male academics is almost twice the number of female academics; however, surprisingly, the mean rank score for the number of citations is higher for women (Table 4-40). But since there is not much difference between the mean rank scores of men and women, as Table 4-41 shows, there is not a statistically

significant difference between the number of citations of males and females professors.

Table 4-40 Mann-Whitney U test, Rank table for number of citations at professor level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of citations	Female	7	13.21	92.50
	Male	18	12.92	232.50
	Total	25		

Table 4-41 Mann-Whitney U test, Test Statistics table for number of citations at professor level

Test Statistics	
	Number of citations
Mann-Whitney U	61.500
Wilcoxon W	232.500
Z	-.091
Asymp. Sig. (2-tailed)	.928
Exact Sig. (2-tailed)	.939
Exact Sig. (1-tailed)	.470
Point Probability	.010
Grouping Variable: Gender	

At reader level, the number of citations scores for males is higher than for females (Table 4-42), and, as shown in Table 4-43, there is a statistically significant difference in the number of citations score between males and females readers.

Table 4-42 Mann-Whitney U test, Rank table for number of citations at reader level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Number of citations	Female	3	2.00	6.00
	Male	4	5.50	22.00
	Total	7		

Table 4-43 Mann-Whitney U test, Test Statistics table for number of citations at reader level

Test Statistics	
	Number of citations
Mann-Whitney U	0.000
Wilcoxon W	6.000
Z	-2.121
Asymp. Sig. (2-tailed)	.034
Exact Sig. (2-tailed)	.057
Exact Sig. (1-tailed)	.029
Point Probability	.029
Grouping Variable: Gender	

As senior lecturer level, the mean rank score for average number of citations is higher for female academics (Table 4-44). However, this difference is not statistically significant (Table 4-45).

Table 4-44 Mann-Whitney U test, Rank table for number of citations at senior lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	15	16.27	244.00
	Male	14	13.64	191.00
	Total	29		

Table 4-45 Mann-Whitney U test, Test Statistics table for number of citations at senior lecturer level

Test Statistics	
	Average number of citations
Mann-Whitney U	86.000
Wilcoxon W	191.000
Z	-.835
Asymp. Sig. (2-tailed)	.404
Exact Sig. (2-tailed)	.422
Exact Sig. (1-tailed)	.211
Point Probability	.012
Grouping Variable: Gender	

At the lecturer level, the number of female academics is almost twice the number of male academics. However, there is not much difference between the mean rank score for the number of citations and hence the difference is not statistically significant (Table 4-46 and Table 4-47).

Table 4-46 Mann-Whitney U test, Rank table for number of citations at lecturers level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	31	24.82	769.50
	Male	18	25.31	455.50
	Total	49		

Table 4-47 Mann-Whitney U test, Test Statistics table for number of citations at lecturer level

Test Statistics	
	Average number of citations
Mann-Whitney U	273.500
Wilcoxon W	769.500
Z	-.121
Asymp. Sig. (2-tailed)	.903
Exact Sig. (2-tailed)	.909
Exact Sig. (1-tailed)	.452
Point Probability	.004
a. Grouping Variable: Gender	

At both researcher level and teaching fellow level, the difference between the mean rank score for average number of citations is more or less the same for both male and female academics (Table 4-48 and Table 4-50). Therefore, the difference in the number of citations scores for male and female academics at both researchers' and teaching fellows' levels are not statistically significant.

Table 4-48 Mann-Whitney U test, Rank table for number of citations at researcher level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	6	8.17	49.00
	Male	10	8.70	87.00
	Total	16		

Table 4-49 Mann-Whitney U test, Test Statistics table for number of citations at researcher level

Test Statistics	
	Average number of citations
Mann-Whitney U	28.000
Wilcoxon W	49.000
Z	-.223
Asymp. Sig. (2-tailed)	.824
Exact Sig. (2-tailed)	.858
Exact Sig. (1-tailed)	.429
Point Probability	.024
Grouping Variable: Gender	

Table 4-50 Mann-Whitney U test, Rank table for number of citations at teaching fellow level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
Average number of citations	Female	4	4.38	17.50
	Male	3	3.50	10.50
	Total	7		

Table 4-51 Mann-Whitney U test, Test Statistics table for number of citations at teaching fellow level

Test Statistics	
	Average number of citations
Mann-Whitney U	4.500
Wilcoxon W	10.500
Z	-.866
Asymp. Sig. (2-tailed)	.386
Exact Sig. (2-tailed)	1.000
Exact Sig. (1-tailed)	.571
Point Probability	.571
Grouping Variable: Gender	

In the 'publications dataset', the number of citations that each paper received was compared with the gender of the leading author of that paper. The results presented in Table 4-52 indicate that more than half of the publications have received no citations. In the middle categories (one to three and four to ten citations), there are slightly more papers with a female leading author than a male. However, there are considerably more papers with more than 11 citations with a male leading author. Previously, it was considered whether there is any statistically significant difference between the number of citations for male and female academic readers. This might be explained by looking at the length of career of academics and the age of the publications.

Table 4-52 Number of citations for each article based on the gender of leading author

	Gender of lead author		
	Female	Male	Total
	775	1177	1952
0 citation	68.20%	66.70%	67.30%
	182	263	445
1-3 citations	16.00%	14.90%	15.30%
	116	182	298
4-10 citations	10.20%	10.30%	10.30%
	59	123	182
11-50 citations	5.20%	7.00%	6.30%
	4	20	24
51 or more citations	0.40%	1.10%	0.80%
	1136	1765	2901
Total	100.00%	100.00%	100.00%

The length of career for male and female academics was compared by looking at the year that their first publication was published (Table 4-53).

Table 4-53 Male and female LIS academics length of career based on the first year of publication

	Gender		
Year of first publication	**Female**	**Male**	**Total**
	10	20	30
1966-1980	33.30%	66.70%	100.00%
	14	11	25
1981-1990	56.00%	44.00%	100.00%
	14	14	28
1991-2000	50.00%	50.00%	100.00%
	20	13	33
2001 or later	60.60%	39.40%	100.00%
	58	58	116
Total	50.00%	50.00%	100.00%

These figures indicate that the LIS academics started their careers at different periods of time. It is also noticeable that the number of female academics has increased in recent years. On the other hand, the number of male academics is clearly twice the number of females in earlier years (from 1966 to 1980). Therefore, it can be concluded that academic posts in the LIS discipline in the UK have become more open to women in recent years, while there was male domination three decades ago. Therefore, it is reasonable to assume that the male domination in the early years has had an impact on the number of citations their papers have received, because they have been in the profession for longer. Earlier, it was argued that an equal number of men and women work at reader level and while there is not a statistically significant difference in their number of publications, there is a statistically significant difference in the number of citations they receive. The number of citations is an indicator of the quality and impact of a publication, while the importance of the time needed for a publication to accumulate citations cannot be ignored. Therefore, the male domination in the early years could be the reason why male readers' publications have received more citations as compared to women. On the other hand, the investigation of the length of career reveals that, although the LIS profession has opened up to women in recent years (having more women at lecturer level), the number of men's citations are still bigger as they have been in the profession for longer.[1]

Comparing the numbers of citations and the numbers of publications suggests that the pattern for number of citations corresponds with the model observed for the

1. The subject analysis of the publications, which is done in further sections, shows that men are publishing in quantitative areas where normally high publications and citations are expected. Therefore, while the length of career plays an important part in the higher number of citations for men at reader level, it is likely that the subject area they have published in has also influenced the number of citations they received.

number of publications; that is, women are dominant in middle professional rank categories. Having similar patterns for number of publications and the number of citations for male and female academics, suggests that there might be a possible relationship between these two variables. To put this to test, a correlation test was conducted. The result of the correlation test (Table 4-54) shows that number of citations and number of publications are strongly correlated (.707 correlation at a significance level of 0.000), which means that, as a tendency, the more an author has published, the more citations he or she is likely to have.

Table 4-54 The correlation between publications and citations

		Number of publications	Number of citations
Number of publications	Pearson Correlation	1	.707**
	Sig. (2-tailed)		0
	N	133	133
Number of citations	Pearson Correlation	.707**	1
	Sig. (2-tailed)	0	
	N	133	133

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion

This section analysed the number of citations received by each male and female academic and compared the number of citations for men and women at each professional rank category. The findings show that there is a correlation between the publication pattern and citation pattern in LIS publications in the UK and that there are more women in middle categories and more men in the high citation category. However, the total number of citations for each male and female academic is almost the same. The results of the Mann-Whitney U test showed that there is not a

statistically significant difference between the number of citations for men and women academics in LIS. However, when the number of citations was compared at each professional rank category, a statistically significant difference was found in favour of men at reader level. Looking at the length of career of the LIS academics confirmed that male academics have been in the profession for longer and therefore, it is likely that their publications had more opportunity to accumulate citations over the years. The investigation of the LIS academic length of career also reveals that the LIS profession has opened up to women in recent years, and that there is chance that the observed pattern will change in favour of women in future years.

The findings on citation in this study confirm Hakanson (2005) and Reece-Evans' (2010) results, as in general no statistically significant difference was observed between the number of citations that men's and women's publications have received. However, Hakanson's (2005) study included a citation analysis of the papers which revealed that gender affects the share of citations accumulated by male and female authors. In other words, depending on whether the author publication is mostly female or mostly male, publications by women and men receive different shares of citation. As the present study does not include a gender analysis of the citations that each paper receives, it is hard to make any links between Hakanson's results on citation analysis and the results of this study. Nevertheless, Hakanson (2005), as well as Davenport and Snyder (1995) and Reece-Evans (2010), confirm that citation levels for men and women are equal where the number of male and female academics are approximately the same. Therefore, since the number of male and female academics in this study is about the same, it can be said that the result of this study is compatible with their conclusion.

Previous studies in other disciplines have suggested that women publish more highly cited articles in comparison with men (Long 1992). In this study, except at reader level where there is a significant difference in favour of men, at other professional levels, and in general, there is no statistically significant difference between the number of citations for LIS men and women. However, although the number of female professors is less than half the number of male professors in this study, there is not much difference between the mean rank score for their number of citations compared to men (Table 4-40). This, together with the fact that men have been in the profession for longer, suggests that women's publications are of sufficient quality to receive compatible numbers of citations to men.

Some studies have also found that academics who hold the highest professional rank such as professor have greater numbers of citations than other academic ranks (Ventura and Mombrú 2006; Abramo, D'Angelo et al. 2011). In this study, while there was not a statistically significant difference between men and women at professor level, the number of male readers' citations was statistically significant. Previous studies have argued that high ranked academics generally have greater experience, personal knowledge and competencies as well as having the chance to develop an effective social network which provides a wider pool of resources for research (Abramo, D'Angelo et al. 2011). To confirm whether this is the case for the academics in this study would require a further qualtative approach. However, the data in this study confirmed that male LIS academics have been active in the profession for longer, and that this has worked in their favour in the accumulation of more citations than women at reader level.

4.4.6 H-Index

H-index is another aspect of productivity that was investigated in this study. The data related to the h-index of each academic in this study was obtained by searching in the Web of Knowledge database. It was established that all papers contributing to the h-index were authored or co-authored by the given academics by cross-checking with the publications list in the publications dataset.

The data show that the highest value of h-index for female academics is nine, while for males it increases to 19. The mean value of h-index for male and female academics as shown in Table 4-55 is not dissimilar; however, the standard deviation value for male academics is more than twice as high as for female academics. This means that the h-index spreads over a larger range of values for men as compared to women.

Table 4-55 H-Index statistical description

H-index	Number	Minimum	Maximum	Mean	Std. Deviation
Male	67	0	19	3.74	4.814
Female	66	0	9	2.21	2.284

A Mann-Whitney U test was carried out to investigate any statistically significant differences between men and women academics in terms of the h-index value. The results (Table 4-56 and Table 4-57) suggest that although the mean rank score of h-index is higher for men, this difference is not statistically significant.

Table 4-56 Mann-Whitney U test, Rank table for h-index

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	66	62.81	4145.5
	Male	67	70.19	4632.5
	Total	132		

Table 4-57 Mann-Whitney U test, Test Statistics table for H-index

Test Statistics	
	H-index
Mann-Whitney U	1934.5
Wilcoxon W	4145.5
Z	-1.132
Asymp. Sig. (2-tailed)	.258
Exact Sig. (2-tailed)	.259
Exact Sig. (1-tailed)	.13
Point Probability	0
Grouping Variable: Gender	

To investigate whether there are any differences between men and women academics' h-index, the Mann-Whitney U test was repeated for each academic professional level. At professor level, the mean rank score of h-index is the same for both men and women and therefore there is not a statically significant difference between men and women at this level (Table 4-58 and Table 4-59)

Table 4-58 Mann-Whitney U test, Rank table for h-index at professor level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	7	13	91
	Male	18	13	234
	Total	25		

Table 4-59 Mann-Whitney U test, Test Statistics table for h-index at professor level

Test Statistics	
	H-index
Mann-Whitney U	63
Wilcoxon W	234
Z	0
Asymp. Sig. (2-tailed)	1
Exact Sig. (2-tailed)	1
Exact Sig. (1-tailed)	.506
Point Probability	.012
Grouping Variable: Gender	

At reader level, despite the difference in the mean rank score in favour of male academics, this difference is not statistically significant (Table 4-60 and Table 4-61).

Table 4-60 Mann-Whitney U test, Rank table for h-index at reader level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	3	2.67	8
	Male	4	5	20
	Total	7		

Table 4-61 Mann-Whitney U test, Test Statistics table for h-index at reader level

Test Statistics	
	H-index
Mann-Whitney U	2
Wilcoxon W	8
Z	-1.414
Asymp. Sig. (2-tailed)	0.157
Exact Sig. (2-tailed)	0.229
Exact Sig. (1-tailed)	0.114
Point Probability	0.057
Grouping Variable: Gender	

Table 4-62 Mann-Whitney U test, Rank table for h-index at senior lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	15	15.3	229.5
	Male	14	14.68	205.5
	Total	29		

Table 4-63 Mann-Whitney U test, Test Statistics table for h-index at senior lecturer level

Test Statistics	
	H-index
Mann-Whitney U	100.5
Wilcoxon W	205.5
Z	-0.2
Asymp. Sig. (2-tailed)	.842
Exact Sig. (2-tailed)	.848
Exact Sig. (1-tailed)	.423
Point Probability	.012
Grouping Variable: Gender	

At both senior lecturer and lecturer level, the results of the Mann-Whitney U test suggest that there are no statistically significant differences between men's and women's h-index at these two levels (Table 4-62 and Table 4-63 for senior lecturers and Table 4-64 and Table 4-65 for lecturers)

Table 4-64 Mann-Whitney U test, Rank table for h-index at lecturer level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	31	24.95	773.5
	Male	17	23.68	402.5
	Total	48		

Table 4-65 Mann-Whitney U test, Test Statistics table for h-index at lecturer level

Test Statistics	
	H-index
Mann-Whitney U	249.5
Wilcoxon W	402.5
Z	-0.321
Asymp. Sig. (2-tailed)	.748
Exact Sig. (2-tailed)	.757
Exact Sig. (1-tailed)	.38
Point Probability	.005
Grouping Variable: Gender	

The comparison between men and women academics' h-index at both researcher and teaching fellow levels show a similar pattern to the other academic professional categories. At researcher level (Table 4-66 and Table 4-67), the h-index mean rank score for males and females is more or less similar and therefore there is not a statistically significant difference between men and women. This is the same for teaching fellow level, as the results show no significant difference between the h-index score for men and women at this level (Table 4-68 and Table 4-69).

Table 4-66 Mann-Whitney U test, Rank table for h-index at researcher level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	6	7.83	47
	Male	10	8.9	89
	Total	16		

Table 4-67 Mann-Whitney U test, Test Statistics table for h-index at researcher level

Test Statistics	
	H-index
Mann-Whitney U	26
Wilcoxon W	47
Z	-.448
Asymp. Sig. (2-tailed)	.654
Exact Sig. (2-tailed)	.696
Exact Sig. (1-tailed)	.36
Point Probability	
Grouping Variable: Gender	

Table 4-68 Mann-Whitney U test, Rank table for h-index at teaching fellow level

Ranks				
	Gender	N	Mean Rank	Sum of Ranks
H-index	Female	4	4.38	17.5
	Male	3	3.5	10.5
	Total	7		

Table 4-69 Mann-Whitney U test, Test Statistics table for h-index at teaching fellow level

Test Statistics	
	H-index
Mann-Whitney U	4.5
Wilcoxon W	10.5
Z	-.866
Asymp. Sig. (2-tailed)	.386
Exact Sig. (2-tailed)	1
Exact Sig. (1-tailed)	.571
Point Probability	.571
Grouping Variable: Gender	

The effect of gender on h-index was also tested with ANOVA (comparison) test.[1] The result confirms the Mann-Whitney U tests' results, suggesting that the effect of gender on h-index is not significant given that the level of significance (*p* value) for gender is 0.215 (*p* <0.001, ANOVA).

The relation between h-index and number of publications was investigated by running a correlation test. The result of the test (Table 4-70) shows that h-index and the number of publications are strongly correlated (.728 correlation at significance level of 0.000). This suggests that, as a tendency, it is likely that the value for h-index increases as the number of publication increases.

Table 4-70 Correlation between h-index and academic publication

		H-index	Number of publications
H-index	Pearson Correlation	1	.728**
	Sig. (2-tailed)		.000
	N	132	132
Number of publications	Pearson Correlation	.728**	1
	Sig. (2-tailed)	.000	
	N	132	133

Discussion

It was proposed that h-index is increasingly becoming an index of evaluation of academics' performance (Ball 2005). Based on the definition of h-index, h-index depends on both the number of academic publications and the impact of the publications on other academics' publications in the form of citations[2] (Bornmann

1. . The analysis related to test is presented in appendix 2

2 . The definition of h-index suggest that an academic has index *h* if *h* of his or her number of papers (Np) have at least *h* citations each, and the other papers (Np - h) have equal or fewer than *h* citations each.

and Daniel 2005). It has been argued that h-index is a promising coarse measurement of the quality of an academic's work, which is based not only on the number of citations but also on the number of publications. Therefore, in this study, the impact of gender on h-index as an aspect of productivity was measured. In addition, it was investigated whether there are statistically significant differences in the h-index score of males and females academics in general, and in each professional academic level. The results suggest that the differences in the h-index score for men and women academics are not statistically significantly different. This pattern is similar to what was observed for the number of publications. Therefore, the study looked at the possible relation between the number of publications and the value of h-index. The result shows that there is a correlation between these two suggesting that the value of h-index can increase as the number of publications increases. This confirms the result of Gaster and Gaster's (2012) study, in which the association between h-index and the number of publications is presented. The correlation between the number of publications and h-index in this study also confirms the argument of Bornmann, Mutz et al. (2008) that unlike the general assumption, h-index also indicates the number of publications as well as the number of citations.

In terms of productivity, despite fewer numbers of female professors, their h-index mean rank score is similar to men. This cofirms the previous arguments in this study by showing that women who have reached the highest rank are as productive as their male counterparts. The results also suggest that LIS academic men and women are as productive as each other in this discipline generally and across different professional rank categories.

4.5 Subject analysis of the publications

Previous researchers have shown that productivity and publication patterns can be different in different subject domains (van Raan 2003). Arguably, library and information science is a multi-disciplinary profession that includes a diverse variety of subjects. This implies that it is likely to have a different productivity pattern in different areas of LIS research (Peñas and Willett 2006). Therefore, in this study, the publications are analysed on the basis of subfields in order to gain a meaningful picture of the areas in which LIS male and female academics are productive. The inclusion of the ten-selected subjects for this study was explained in section 3.6.2 of the methodology chapter. To determine the subject of each paper, the paper's title, abstract and keywords were examined. While there were a number of papers with only one single main topic, a great number of papers covered more than one subject. These types of papers were categorised under the subject that seemed more relevant to the entire purpose of the paper. The problem of determining the subject of a paper is also addressed by Atkins (1988). Atkins states that subject identification and dealing with multiple subject trends are two major problems in subject trend studies.

In this study, the subject analysis of publications reveals that the top three subject categories that incorporate most of the publications of the LIS academics in the UK are:

- Digital issues including digital libraries, electronic books, electronic publishing, digital age and internet;
- Organisational, behavioural and user studies, human and social aspect of information handling;

- Books, collection, record and library management, literature, preservation, printing, publishing, documentation and reference work.

The intermediate categories include:

- Editorial notes, reports, book reviews and general articles;
- Library automation, database and system management and technical issues;
- Information literacy, teaching and learning and public libraries issues.

Finally, the categories with the fewest number of publications are:

- Information retrieval;
- Bibliometrics, webometrics, citation and log analysis;
- Cataloguing and classification, indexing and taxonomies and thesaurus construction;
- Copyright and legal and ethical issues.

Figure 4-4 depicts the LIS sub-disciplines based on the percentage of publications in each category. It should be noted that in order to have a clear display, the title of each sub-discipline is shortened to the main subject. (The frequency and the percentage of publication in each subject category can be seen in Appendix 4)

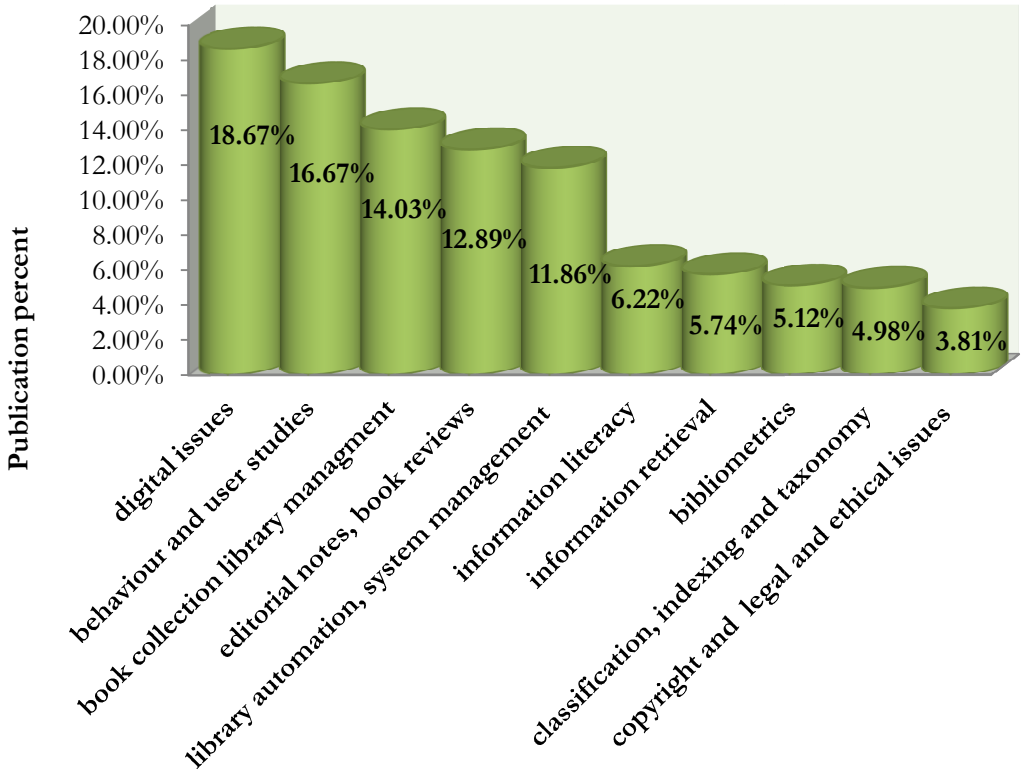

Figure 4-4 Demonstration of percentage of the publications in each of LIS sub-disciplines

Comparing the results of this study with the results of Atkins (1988) shows how subject trends in the library profession have changed. The popular subjects in Atkins's study respectively were library management, information retrieval, and cataloguing. In this study, while library management has moved to the third level, information retrieval and cataloguing have moved further down in terms of popularity. The least popular topics in Atkins's study are library fund raising or library finances, which seem to have disappeared after nearly two decades. Buttlar (1991) also investigated the subject coverage in sixteen LIS journals. She identified twenty-five subjects within LIS, in which library automation, library management and cataloguing were the most popular subjects. Her study partly supports Atkins's

results, as both identified library management and cataloguing as the most popular subjects. However, the results of this study show that as well as library management, (third in popularity), two new subjects of digital issues, and behavioural and user studies, are coming into trend. This is not surprising in the light of the continued rapid rise in the use of digital technologies in any area included in LIS and the need to investigate how users respond to these changes.

4.6 Subject analysis based on the gender of the leading author

Subject analysis of the publications based on the gender of the leading author is displayed in Table 4-71. Three numbers are displayed for male and female academics under each category. The first number indicates the number of academics who have a publication in that subject category. The middle number represents the expected value. The expected value is the weighted average or a central value of the number of academics that is expected to be seen in each subject category based on the whole data. The third number shows the percentage of male and female academics in each subject category. In subject numbers two, three, five, six, and nine (respectively digital issues, behavioural and user study, documentation and reference work, and information literacy) the number of female leading authors is greater than the number of the expected value. This indicates the areas of interest among LIS academic women in the UK.

Table 4-71 Publication by male and female academics in ten broad sub-disciplines based on the gender of the leading author

		Gender of lead author		
		Female	Male	Total
1	Reports, editorial notes, book reviews, general articles	113	262	375
		146.8	228.2	375
		30.10%	69.90%	100.00%
2	Digital libraries, e-books, e-publishing, digital issues, digital age, internet	249	293	542
		212.2	329.8	542
		45.90%	54.10%	100.00%
3	Human and social aspects of information handling, organisational behaviour, user studies	205	280	485
		189.9	295.1	485
		42.30%	57.70%	100.00%
4	Information retrieval	35	132	167
		65.4	101.6	167
		21.00%	79.00%	100.00%
5	Books, collections, records and library management, literature, preservation, publishing , documentation, reference work	155	253	408
		159.7	248.3	408
		38.00%	62.00%	100.00%
6	Automation, database systems, systems management, technical issues	150	195	345
		135.1	209.9	345
		43.50%	56.50%	100.00%
7	Cataloguing, classification, indexing, knowledge organisation, taxonomies, thesaurus construction	57	88	145
		56.8	88.2	145
		39.30%	60.70%	100.00%
8	Bibliometrics, citation studies, Informetrics, Webometrics, log analysis	54	94	148
		57.9	90.1	148
		36.50%	63.50%	100.00%
9	Information literacy, teaching and learning, public libraries and services	83	98	181
		70.9	110.1	181
		45.90%	54.10%	100.00%
10	Copyright, legal issues, e-copyright, ethical issues	37	74	111
		43.5	67.5	111
		33.30%	66.70%	100.00%
	Total	1138	1769	2907
		1138.0	1769.0	2907.0
		39.1%	60.9%	100%

* In each row, the first number represents the actual number of academics in that subject category, the second number is the expected value and the third number is the percentage of the number of academics in that category.

In subject category 2 (organisational, behavioural and user studies) and subject category 9 (information literacy, teaching and learning and public libraries and services) particularly, the percentage of female leading authors is very close to half of the population in that category. Therefore, it can be concluded that subjects related to these two subject categories have attracted more female LIS academics in the UK. For male academics, the most popular three subjects are information retrieval, copyright and legal issues, and bibliometric studies. In addition, men are more likely to have written reports, editorial notes and book reviews compared to women. A similar table to Table 4-71 is developed for collaborative authors (see appendix 5). The result of this analysis also corresponds with Table 4-71 results; showing male authors are more dominant in writing reports, information retrieval and copyright and legal issues. To compare the popular subjects among male and female academics in this study with two previous studies of the similar kind, Table 4-72 is developed.

Table 4-72 Comparison of three popular subject among LIS academics with Buttlar (1991) and Peñas and Willett (2006)

Buttlar (1991)		Peñas and Willett (2006)		Present study	
Men	Women	Men	Women	Men	Women
Information retrieval 100%	Children and young adult services 90.91%	Book collection, Library management 8.5 (mean value)	Book collection, Library management 3.00	Information retrieval 79.00 %	Digital libraries, e-publishing 45.90 %
Library history 88.88 %	Bibliographic instruction 83.67%	Cataloguing, classification 5.60	Information literacy 3.00	Copyright and Legal issues 66.70 %	Information Literacy 45.90 %
International librarianship 75.76%	Library standards 78.95%	Bibliometrics studies 5.56	Automation, Database management 3.00	Bibliometric studies 63.50	Automation, Database management 43.50%

Table 4-72 shows that in terms of the most popular subject for men, the result of this study is compatible with Buttlar (1991), and in terms of the third most popular subject the result is compatible with Peñas and Willett (2006). In terms of women's interests, the second and the third most popular subjects in this study are compatible with Peñas and Willett (2006). This indicates that while women's main interest has changed and moved towards the most popular subject in LIS discipline as discussed above, it has remained unchanged for the second and third most popular subjects since Peñas and Willett's study. Table 4-72 also indicates a massive change in the subject trend in general and especially for women since Buttlar's study.

The results also indicate that men are more dominant in quantitative areas such as bibliometrics and information retrieval where normally high number of publications and citations are expected. This also could be the reason for the observed statistically significant difference in the number of citations for male readers as well as the length of career.

In general, it should be noted that the present study only provides a general understanding of publishing trends in the LIS profession in the UK, rather than the subject interests of individuals. Also, unlike the Peñas and Willett's (2006) study, the result of this study does not show an enormous difference between LIS male and female academics in terms of the number of publications, but highlights the existing subject trends among male and female academics.

The results of this study are hardly comparable with Koufogiannakis, Slater et al. (2004) as they completed a one-year content analysis of selected journals in 2001. Nevertheless, information retrieval, which is the most popular among men in this study, was also the dominant subject area in their study.

Finally, comparing this study to a study conducted more than twenty years ago by Atkins (1988), shows how subject trends in LIS have evolved and embraced new concepts such as digital issues and electronic publishing, as well as automation and database and records management. Moreover, sub-subjects such as library finances and library buildings that were observed in Atkins's study seem to be significantly diminishing after nearly two decades. Hence, Atkins's prediction that library science has the potential to embrace new topics in future, and that some topics might be isolated seems to be correct (Atkins 1988:654).

4.7 Gender and type of publications

Determining the most common type of publication written by men and women is only achievable in studies that take the 'authors to publications' approach. This is because most of the studies that have taken 'publications to authors' approach consider journal articles as the main or only type of publication for their study. For example, studies such as Cline (1982), Metz (1989), and Terry (1996) have excluded other types of publications and only considered journal articles.

In this study, to determine which type of publication is more commonly written by men and women, seven categories were identified: journal articles, books, book chapters, book reviews, editorials, conference papers and reports.

In Total, 2908 publications were found, of which 1139 publications are led by female author and 1769 by male. Contribution to journals accounted for 94.6% of LIS academics' publications, followed by 2.70% in conference papers, and a much smaller percentages in books, book reviews and so on.

Table 4-73 suggests no great difference between men and women in terms of the type of material they publish, as the figures are very similar for both men and women.

Table 4-73 Comparison of the types of publication based on the gender of leading author

	Gender of lead author		
	Female	Male	Total
Journal article	1074	1676	2750
	94.30%	94.70%	94.60%
Book	6	9	15
	0.50%	0.50%	0.50%
Book chapter	3	4	7
	0.30%	0.20%	0.20%
Book review	13	18	31
	1.10%	1.00%	1.10%
Editorial	6	17	23
	0.50%	1.00%	0.80%
Conference paper	36	42	78
	3.20%	2.40%	2.70%
Report	1	3	4
	0.10%	0.20%	0.10%
Total	1139	1769	2908
	100.00%	100.00%	100.00%

Furthermore, journal articles are the most written means of communications, with an immense gap between journal articles and other types of publication. There are two possible explanations for this; firstly, it can be argued that the databases that index publications are more interested in journal articles than other type of publications; secondly, it is likely that LIS academics in the UK prefer journal articles to other types of publication as a means of scholarly publication. Although in a similar study led by Garland (1991) it was concluded that journal articles are the most popular type

of publication, it is difficult to make such a judgement, as there might be reasons why academics publish journal articles apart from popularity. One possible reason could be that the procedure of publishing a paper in a journal is perhaps less time consuming than publishing a book or a book chapter. Conference papers, on the other hand, are tied to the conference schedules, which may limit numbers. Although it can be argued that such reasons can make publishing journal articles popular, to fully investigate the reasons and the academics' opinions on this matter, further studies should be pursued.

4.8 Summarising the results

This section summarises the findings of this research by matching the results with research questions.

RQ1: Does gender have any impact on the rank and academic status of academics in LIS?

The results of this study showed that there are a balanced number of men and women in the lower rank categories (researchers and teaching fellows) as well as upper middle categories including senior lecturers and readers. However, in the top rank of professor a clear bias in favour of men was observed while similar bias exists in favour of women in the middle category of lecturer. What this suggests is that while it is not impossible for women to reach the top rank in the LIS profession, many of them get stuck in the middle of the academic ladder. Therefore, the answer to this question is partially no, because of the bias in favour of men in top ranks and in favour of women in the middle rank.

In terms of the number of publications within each professional category, the results suggest that there is not a statistically significant difference between LIS male and female academics, and that women are well matched with their male counterparts in terms of the number of papers they publish. This indicates that women are working equally well as men, and therefore it is hard to accept that women's under-representation in the top ranks is related to weaker performance (D'Amico et al. 2011).

There is a need for further investigation to determine why women in LIS are not moving up the academic ladder as easily and quickly as men do while their performance is compatible. What is the impact of organisational policies on this? Alternatively, is this a matter of personal choice or family related obligations?

RQ2: Considering gender, what is the distribution of LIS academics across LIS departments in the UK universities?

This study identified seven universities with a LIS department. In three universities, the gender distribution of male and female academics is about equal. These universities are Loughborough University, Robert Gordon University and University College London (UCL). There are clearly more female academics working in Aberystwyth and Manchester Metropolitan University, while in City University and the University of Sheffield the male academics outnumber women.

The distribution of male and female academics in LIS departments corresponds with the rank model, suggesting that fewer top rank positions are held in the universities with more employed female academics. Conversely there are four professors employed at City University which has fewer numbers of women. This may also suggest that in male dominant departments, men somehow have the

opportunity to move up to higher professional positions while this is not necessarily the case in universities with more women. This brings up questions such as whether promotion within departments is affected by the number of men and women working in that department.

RQ3: Does gender have any impact on the productivity of LIS academics in the UK in terms of the number of publications, citations and h-index?

Number of publications was the first aspect of productivity investigated in this study. The outcome of the number of publications analysis revealed that there are not statistically significant differences between male and female academics in terms of the number of publications they publish. The approach in this study was from 'authors to publications', which means the authors (academics) were first identified and their publications were then searched for in relevant databases. This fed into a database with all the publications of the authors. The number of the authors in the publication dataset was undoubtedly more than the number of academics (authors) in the initial dataset (people dataset) which represents the collaboration of academics in the people dataset with other authors. Therefore, the result of the Mann-Whitney U test which compared men's and women's number of publications shows no significant difference between men and women in terms of their publications output. However, examining the total number of men and women in publications dataset showed that men outnumber women. Despite this disparity in number, it is hard to accept that LIS women are less productive than men, as the result of the Mann-Whitney U test clearly suggests that women and men are equally productive. This disparity was explained by looking at the collaboration pattern amongst LIS academics. The result of this comparison shows that while men tend to collaborate

more with other men, women collaborate with both men and women. Therefore, the number of men is more than women in the publications dataset.

In terms of the number of citations, the results of Mann-Whitney U test showed that there is not a statistically significant difference between the number of citations of men and women academics in LIS. However, when the number of citations was compared at each professional rank category, a statistically significant difference was found in favour of men at reader level. Looking at the length of career of LIS academics confirmed that male academics have been in the profession for longer, and therefore it is likely that their publications had the opportunity to accumulate citations over the years. Another explanations for this was offered when the subject of the publications were compared. The subject analysis of the publications shows that men are dominant in quantitative areas where high number publications and citations are expected. Therefore, another explanation for the difference in the number of citations for male readers is because of the subject areas that men are publishing in. The investigation of the LIS academic length of career also reveals that the LIS profession has opened up to women in recent years and there is chance that observed patterns would change in favour of women in future years.

To determine whether there are statistically significant differences between the h-index score of LIS male and female academics, a Mann-Whitney U test was carried out. The results suggest that in general and at each professional academic level there are not statistically significant differences between men's and women's h-index score. This pattern is very similar to the number of publications of the academics and the results also suggest that h-index positively correlates with the number of publications.

In summary, it is arguable that gender does not have any impact on productivity in terms of numbers of publications, but has an impact on collaboration. Gender also does not impact on the total number of citations or h-index for male and female academics in this study but creates some disparities within different ranks.

RQ4: What is the gender distribution of the LIS academics across specialisms that make up the LIS discipline?

The subject analysis of the papers published by LIS academics confirmed a change in the subject trend in Library and Information Science discipline in comparison with previous studies. The first three popular subjects that attracted more publications are related digital issues, behavioural studies and library management. As for women's interests, the top three subjects are digital issues and libraries, electronic publishing and internet; followed by information literacy, teaching and learning, public libraries and services; and finally automation and database management. In contrast, men are more interested in information retrieval as the first popular subject, copyright and legal issues as second and finally bibliometrics.

RQ5: Considering gender, what are the differences between LIS academics in terms of the type of materials they publish?

This study found seven categories that sum up the type of publications that academics in LIS publish. These categories are journal articles, books, book chapters, book reviews, editorials, conference papers and reports. The result of the study suggests no difference between men and women in terms of the type of material they published. Both men and women publish journal articles considerably more than other materials. Conference papers are the second most popular type of publication followed by book reviews, books, and book chapters. As previous studies have

suggested that journal articles are the most popular type of publication, further qualitative analysis is needed to investigate this. However, it should be considered that other factors might be influencing with the popularity of journal articles. As argued earlier in this chapter, it is likely that writing a journal article is less time consuming than other types of publication. Another matter to consider is that journal articles are easier to find and track because of the way they are selected and indexed by bibliographic databases and therefore they are more easily found compared to other types of publications.

4.9 Summary

This chapter presented and discussed the results of this study. The results were produced by performing different statistical analysis using SPSS. The chapter analysed bibliometric characteristics of authorship among LIS academics. Academics and their publications were compared within different academic rank positions as well as different universities.

The LIS academics' publications were also analysed. Academic productivity of LIS academics was described by comparing the number of publications, average number of publications, number of citations and h-index. The gendered comparison of the study showed no statistically significant differences between men and women in terms of productivity.

Chapter 5 – Conclusions

5.1 Introduction

This chapter discusses the main findings of this thesis in relation to the aims and objectives, and presents the study's conclusions. The main goal of the study was to investigate the impact of gender on the research productivity of academics in LIS in the UK. The objectives of the study were to uncover the differences between male and female academics' productivity and investigate the impact of institutional factors such as affiliations, academic rank, length of career, co-authorships, and the subject areas that LIS academics publish in. This chapter pulls together the results and draws conclusions in the light of the study's objectives. This chapter also points out the limitations of the study and discusses the possibilities for further research in this area. Finally, the chapter reviews the contribution of this research in the area of gender and productivity.

5.2 Impact of gender on research productivity

Productivity in this study was measured by examining the number of publications, number of citations and the h-index value for both male and female LIS academics in the UK. Reviewing previous studies showed that there are two approaches that have mainly been used to measure the number of publications in gender studies of productivity. The most common approach, used mostly in previous studies for this purpose, especially in the area of LIS, is 'publications to authors'. In this method, the publications are identified in the first stage and then each paper is examined to specify the gender ratio of the authors. However, as discussed in the third chapter,

since this method normally involves finding a bulk of publications within a time period, the results would only include the publications of those authors who happened to publish in that time period. Therefore, if the purpose of the study is to examine the publications of a specific group of researchers or academics within a discipline, 'authors to publications' method should be used. Therefore, the best method for the purpose of this study was moving from authors to their publications. As a result of taking the 'authors to publications' approach, first academics in the LIS departments in the UK were identified and then the two datasets of people and publications were built accordingly. Comparing the results of the two datasets in this study provided a comprehensive picture of publication pattern and productivity among LIS academics in the UK. The comparison of the two datasets highlighted a difference between the total number of publications for male and female authors in the 'publications dataset' and the 'people dataset' with more male authors in the 'publications dataset'. However, this disparity was explained by considering multi-authorship and collaboration among authors. As stated in the fourth chapter, the impact of collaboration can create a bias in the results; there are two possible reasons for this phenomenon. Firstly, this study showed that there is a tendency for male academics to collaborate mostly with other men while women collaborate equally with both men and women. It is worthwhile stating that Hakanson (2005) also discovered that men tend to cite other men's publications while women cite both men and women equally. The reasons why such tendencies exist among male academics are beyond the scope of this research to explain but provides plenty of opportunity for further research in this area. For whatever the underlying reasons for this pattern, the outcome of men's collaboration with other men, is that the total number of men in the publications dataset is more than the total number of women.

Furthermore, when the total number of publications for both men and women in the 'people dataset' was tested by a Mann-Whitney U test, no significant difference were observed, suggesting that LIS men and women were equally productive. Secondly, the way multi-authorship is handled and depending on whether fractional, complete or straight count is used, the results of bibliometric gender studies can demonstrate a significant difference between men and women in terms of the total number of publications. Studying the literature suggested that studies of gender and productivity in the area of LIS that have reported gender differences among male and female academics have mainly used 'publications to authors' approach (Olsgaard and Olsgaard 1980; Adamson and Zamora 1981; Cline 1982; Metz 1989; Buttlar 1991; Raptis 1992; Davenport and Snyder 1995). Perhaps the reasons for the gender disparity that was observed and reported in previous studies are the collaboration patterns as well as the way multi-authorship has been handled in these studies. To make sure of this, Table 5-1 has been developed to compare the multi-authorship approach in the previous studies. As displayed in Table 5-1, while the approach to multi-authorship is unknown in a few of the previous studies, in some of the studies the straight count[1] approach is used to deal with multi-authorship. This corresponds with the review conducted by Prozesky and Boshoff (2012) in which 32 studies were investigated and more than a third had made no reference as to how credit was assigned in the case of multi-authored publications and the majority of the studies had used straight counts. Moreover, studies such as Harsanyi (1993) have shown that different disciplines interpret the order of the authorship differently. In some disciplines, the list of authors appears alphabetically while in some disciplines the list

[1] . These methods are explained in chapter three under multi-authorship section.

of the authors appears by the order of contribution. Terry (1996) claims that in library and information science there is no established norm for the order of the names. Therefore, the interpretation of this could be that in the studies that have only considered the first author by using the straight count, women's share and participation in publications have not been fairly illustrated. In this study, however, while the straight count method is used as a comparison technique, the main method to handle multi-authorship and determine the gender differences among LIS academics has been complete count and fractional count. Such results testify that research method and the approach to multi-authorship can affect the way the results are interpreted and reported.

In this study, the number of citations of male and female academics was compared by running a Mann-Whitney U test. The results reveal that while there is not a statistically significant difference between men's and women's number of citations at most academic professional categories, the number of citations of the male academics at reader level are statistically significant compared to females at this level. This was rationalised by comparing the length of career of men and women in LIS. The investigation of the length of the career of LIS academics suggests that male academics have been more dominant, in comparison to women, in the early years. Therefore they have been working in this profession for longer. There is a possibility that this has positively affected the number of citations that their publications have received. On the other hand, women's publications have received more citations in recent years, given that the profession has opened up to women in the last two decades. This seems to indicate that the gap between men and women is slowly closing and it is likely that women's publications will receive more citations in future.

Table 5-1 comparison of the approach to multi-authorship in previous studies

Authors	Date	Approach to multi-authorship	Discipline
Reskin	1978	Unknown	Chemistry
Cole	1979	Unknown	Biology, Chemistry, Psychology and Sociology
Over	1982	Complete count	Psychology
Cole and Zuckerman	1984	Straight count	Astronomy, Biochemistry, Chemistry, Earth Science, Mathematics, Physics
Long	1978	Unknown	Biochemisty
Long	1992	Fractional count	Biochemistry
Lewison	2001	Fractional count	All Icelandic researchers
Bordons, Morillo et al.	2003	Unknown	Natural Resources and Chemistry
Leta and Lewison	2003	Unknown	Astronomy, Immunology, and Oceanography
Mauleon and Bordons	2006	Unknown	Material Science
Peñas and Willet	2006	Unknown	Library and Information Science
Reese-Evans	2010	Straight count	Library and Information Science
Cline	1982	Straight count	Library and Information Science
Metz	1989	Straight count	Library and Information Science
Davenport and Snyder	1995	Straight count	Library and Information Science
Terry	1996	Straight count	Library and Information Science
Mukherjee	2009	Complete count	Library and Information Science
Olsgaard and Olsgaard	1980	Complete count	Library and Information Science
Adamson and Zamora	1981	Complete count	Library and Information Science

Another aspect of productivity that has been studied in this research was h-index. The result of the statistical test in this study confirmed that there are not statistically significant differences between men's and women's h-index score. This result was largely expected because according to the definition of h-index, h-index is affected by number of publications and number of citations. As previously argued, the findings in this study showed that gender did not have an impact on the overall number of publications or citations for both men and women. Therefore, as expected, no significant differences were observed in the h-index score for men and women, meaning that gender of academics does not have an impact on the h-index value they receive.

5.3 Productivity Puzzle

As discussed in the literature review, several studies had previously suggested that women academics publish at lower rates compared to their male counterparts. Attempts to explain this disparity had mainly been unsuccessful and therefore, in a classic definition of the problem, gender difference in productivity was named 'productivity puzzle' by Cole and Zuckerman (1984:218). It was also argued in the literature review that several studies responded to this problem by considering many control factors, such as age, family status, work status, academic collaboration, rank and cultural matters. Some of these studies have found that a number of these factors account for women's lower productivity. However, despite these explanations, the puzzle remained largely unsolved as the gender differences between men and women continued to exist in academic publications. Because the matter of "productivity puzzle" and the controversies which surround it, were among the reasons that motivated this study, it is logical to ask whether this study has solved the

'productivity puzzle'. The answer is yes in the sense that the results of this study suggest no statistically significant differences between the productivity of male and female academics in LIS departments in the UK. Therefore, productivity from the perspective of gender differences is not a puzzle among LIS academics in the UK. However, the differences in the number of male and female academics at the highest professional academic levels and middle categories suggest that for some reasons women academics in LIS have remained in middle rank categories and therefore are under-represented in the highest professional level. In terms of productivity, however, women are as productive at top rank categories. Further studies are needed to investigate possible social, cultural and personal related matters that are affecting LIS women in moving up the academic ladder despite being as productive as their male colleagues.

In previous studies of the LIS profession in the UK, it was suggested that a major barrier to women's promotion is related to their domestic responsibilities and the fact that women have to take break from their career to bring up their children (McDermott 1998; Jones and Goulding 1999; Jones and Oppenheim 2002). Jones and Oppenheim (2002) argued that women who return to work on a part-time basis do not have the same opportunities compared to their male full-time counterparts. In addition, Jones and Goulding (1999) suggested that women should have more options such as flexible working hours in order to succeed in their careers. Are these the reasons that women have not climbed the academic ladder rank as quickly and easily as men do? It is hard for this study to answer this, despite the fact that the data for half of the sample suggested that women hold more part-time posts than full-time. Perhaps further studies are needed to investigate why women with a high level of productivity have not been promoted to the highest rank. If the answer is

because of women's domestic responsibilities and lack of rules' for flexibility at work, as suggested in previous studies, it is time to review the departmental structures and organisational policies before we face an unexplainable career puzzle.

5.4 Institutional factors and productivity

In this research, male and female LIS academics in the UK were put side by side in each academic professional level and were compared in terms of the number of items they have published. The results of this study portrayed the positive impact of the academic rank on productivity, an issue that was also addressed in previous studies. This study also shows that women are more productive in middle professional rank categories while men outnumber women in the highest academic professional categories. The comparison of academics' affiliations were in line with the observed rank model, meaning that in those universities which have higher numbers of women, women are mostly working in middle rank categories, and in those universities with a male concentration, the top rank posts of professors are occupied by men. Academics were also compared in terms of their working status. However, as valid data were only available for half of the sample, it is therefore difficult to conclude how gender affects working status. Nevertheless, for half of the sample, the result of this study states that women are employed in more part-time posts than full-time. Another analysis related to institutional factors which was carried out in this study compared male and female academics in LIS in terms of the number of years they had worked in the profession. A clear male domination of academics in the early years of the field studied suggests that LIS academic males have worked for longer in the profession, and hence their publications have more

opportunity to accumulate citations. Therefore, unlike Peñas and Willett's (2006) study, in which length of career was not the reason for difference in publication patterns, in this study the male academics' length of career is clearly the reason for the imbalance between the number of citations male and female academics' publications have received. However, the comparison of the male and female lengths of career also suggested that the LIS discipline has opened up to women in recent years. Perhaps further studies can investigate whether the increase in the number of women in recent years will further affect the LIS profession in terms of the patterns that were observed in this study.

Another aspect of the impact of institutional factors on productivity was the investigation of co-authorship and collaboration patterns among LIS academics. This study found that the overall number of men for the total number of publications that were found was nearly twice that of the number of women. The reason for such disparity is explained by comparing the way male and female academics collaborate. The result of this comparison confirmed that the majority of the male academics mainly collaborate with other men while women collaborate more or less equally with both men and women. The reasons why such a tendency exists among LIS academics in the UK is beyond the scope of this research but can be investigated in further studies.

Finally, male and female academics' publications in LIS were compared in terms of the sub-disciplines and the subject areas in which they have been published. This study showed that women are equally productive in digital and electronic related topics such as digital libraries, e-books, and internet, which are generally the most popular areas in the discipline. The result of this study also confirmed the same

pattern for the next most popular subjects in LIS discipline, which are those related to information literacy, teaching and learning. However, a gender disparity in favour of males was observed in the area of information retrieval, copyright and legal issues and bibliometric studies. The overall comparison of the sub-disciplines analysis of LIS publications with previous studies such as Atkins (1988), Buttlar (1991) and Peñas and Willett (2006) not only suggests change and evolution in the subject trends in LIS but also indicates how some subjects have remained popular among both men and women.

5.5 Limitation of the study

As pointed out in chapter three, bibliometric studies can provide invaluable data for assessment and evaluation of a discipline or a group of authors by quantitative analysis of their publications. Therefore, to gain a comprehensive perspective on the publication pattern and productivity of LIS academics in the UK, this study applied bibliometric techniques to gather and analyse the data. Like any other method, bibliometrics has some limitations and the limitations faced by this study are mainly related to the limitations of bibliometrics. This section will briefly address these limitations.

Bibliometric studies are typically time-consuming in nature. This is because firstly, most bibliometric studies investigate a large volume of data, and secondly, researchers have to allocate a considerable amount of time to identify, store and edit the related data. Apart from this, researchers have to specify a time frame to confine the publications. In this research, to gain a comprehensive perspective of the academics' publications, it was decided to find as many publications as possible back in time. However, as the data collection process was taking place in 2010, any

publications after that are excluded from this research. In addition, it is likely that the LIS departmental structures has changed, with new staff appointments or old staff retirements since the data for this research was collected.

Although bibliometric studies can provide invaluable information about the existing patterns within a discipline, they cannot explain why such patterns exist. Some of the patterns that were observed in this research such as productivity and the impact of rank and gender have clearly provided a new insight into the matter of gender and productivity. However, to discover why these patterns exist further studies should be carried out.

To recap, it can be stated that some of the findings from this study will need to be revised in the light of institutional changes in LIS departments and the volume of publications that is being published every day. However, the methodology of this research will continue to be useful for further studies in this area and the research done can serve as a point of reference for further research in gender studies of productivity among LIS academics.

5.6 Further work

As discussed in the literature review, women's academic productivity was addressed in science and engineering disciplines more than 30 years ago. Despite numerous studies in this area, there was a need to investigate the issue in a discipline such as LIS, which is not only related to social sciences and humanities, but is also claimed to be female dominant. Therefore, although the earlier research is an important first step in the area of LIS productivity in the UK, there is still ground for further

development in future. This study found no statistically significant difference between male and female LIS academics' productivity; however, the disparity in the number of academics working at higher professional academic levels provides a new initial starting point for continued work in this area in future. Moreover, this study also showed that although women are not highly presented in high rank positions, they are over-represented in the middle rank categories and as productive as their male colleagues. Therefore, there is a need for further investigation in the future to study the possible changes this can cause to the observed professional rank model in this study. There is also room for further qualitative research in this area to investigate the factors that are affecting women at present and possible answers as to why women move more slowly up the academic hierarchy.

Finally, as stated earlier in this chapter, the quantitative method in this research provides a broad perspective of productivity and publication patterns among LIS academics in the UK. Therefore, the results provided by this study can be used as a basis for further qualitative studies that examine the causes and explain reasons for some of the patterns presented in this study. Furthermore, both this study and previous studies about gender and LIS in the UK have addressed the impact of academic rank and working status on academics' promotion and productivity. Further analytical research could offer some insights specifically into this matter.

5.7 Contribution of this study

The matter of gender and research productivity has been previously addressed in different disciplines and countries. The present study contributes to the existing work from the two levels of theoretical and practical perspectives.

From a theoretical perspective, this study's findings offer fresh insight into the matter of women's presence and participation in academic publication. Unlike the existing theory in this area which suggests women are under-represented in publications, this study found that women are productive at the same level as men in the LIS discipline in the UK. Previous studies had mostly been conducted in scientific disciplines and had mainly applied 'publications to authors' method or had an unequal number of men and women as their study sample. This work argued that in order to have a fair assessment of the matter, an equal number of men and women should be assigned for measuring productivity among academics of a discipline. Furthermore, this research is the first of its kind that looked at LIS academics productivity in the UK.

The second level of this study's contribution is related to the methodology and the practical aspects of conducting research of this kind. Using two datasets (one for publications and one for academics) enabled this study to compare productivity patterns from two separate perspectives. This method also enabled this study to observe the differences caused by co-authorship. This method and the related findings might be a useful point of reference for further studies of gender and productivity.

Finally, it is expected that this study will contribute to the better understanding of productivity and the impact of gender and different variables in the LIS discipline in the UK.

5.8 Summary

This chapter summarised the main findings of the study and drew conclusions by referring to the study's objectives. The impact of gender on productivity was

discussed and it was concluded that gender alone does not directly influence productivity. Additionally, productivity of the LIS male and female academics was compared in the light of institutional factors such as academic rank, working status, collaboration and sub-disciplines. In addition, this chapter discussed the contribution of this study to the related areas while pointing to the limitations of the research. Lastly, new lines of inquiry for further research were suggested.

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Appendices

Appendix 1: The pilot study list of journals and related databases

Academics at the department of information studies at UCL were selected for a study to compare the coverage of Web of knowledge, Scopus and Library and Information Science Technology Abstract (LISTA). The academics were searched for their publications in these three databases. The results were first saved in EndNote software and then moved to an excel spreadsheet for comparison. The following table shows the unique titles and the titles that are shared between them.

Web of Knowledge	Scopus	LISTA: Library and Information Science Technology Abstract
5th ACM/IEEE Joint Conference on Digital Libraries		5th ACM/IEEE Joint Conference on Digital Libraries 2nd edition
5th International Conference on Science and Technology Indicators, Cambridge		1968 November. National Bureau Of Standares, Washington
6th International Conference on Computers in Education (ICCE 98)		
6th WSEAS International Conference on E-Activities,		
7th ACM/IEEE Joint Conference on Digital Libraries, Vancouver		
8th International Conference on Durability of Building Materials and Components, Vancouver		Against the Grain
17th International Online Information Meeting, London,		American Archivist
21st International Online Information Meeting		American Libraries
	Archival Science	**Archival Science**
	Archives Europeans de Sociologies	Archives
Annual Review of Information Science and Technology		Ariadne: A Web & Print Magazine of Internet Issues for Librarians & Information Specialists
Aslib Proceedings	**Aslib Proceedings**	**Aslib Proceedings**
Bulletin of the Medical Library Association		Booklist

Web of Knowledge	Scopus	LISTA: Library and Information Science Technology Abstract
	Cataloging and Classification Quarterly	Bookseller
Computers & Education	**Computers & Education**	British Library Research & Development Report 5334
	Electronic Library	Cataloging & Classification Quarterly
Health Information and Libraries Journal		Catalogue & Index
	Human IT	Design Of Information Systems In The Social Sciences.
		Digital Literacies: Concepts, Policies & Practices
		Education for Information
		Health Information & Libraries Journal
		Huntington Library Quarterly
		IFLA annual 1976
		American Federation Of Information Processing Societies
		Proceedings Of The Conference On Interlibrary Communications And Information Networks
		Changing Patterns In Information Retrieval. Tenth Annual National Information Retrieval Colloquium
		Information Policies: A Sourcebook
Information Processing & Management	**Information Processing & Management**	**Information Processing & Management**
Information Research	**Information Research**	**Information Research**
		Information Scotland
		. Information World Review
		Internet & Higher Education
		Internet Reference Services Quarterly
Interlending & Document Supply	**Interlending & Document Supply**	

Web of Knowledge	Scopus	LISTA: Library and Information Science Technology Abstract
	Internet Reference Services Quarterly	
International Conference on Politics and Information Systems		
International Journal of Information Management		
Journal of Academic Librarianship	**Journal of Academic Librarianship**	**Journal of Academic Librarianship**
	Journal of Archival Organization	
Journal of Documentation	**Journal of Documentation**	**Journal of Documentation**
Journal of Government Information	**Journal of Government Information**	**Journal of Government Information**
	Journal of Education for Teaching	Journal of Hospital Librarianship
Journal of Information Science	**Journal of Information Science**	**Journal of Information Science**
Journal of Information Technology		Journal of Internet Cataloguing
journal of Librarianship and Information Science	**journal of Librarianship and Information Science**	**journal of Librarianship and Information Science**
		Journal of Technology in Human Services
Journal of the American Society for Information Science and Technology	**Journal of the American Society for Information Science and Technology**	**Journal of the American Society for Information Science and Technology**
		Journal of the American Medical Informatics Association
		Journal of the American Society for Information Science & Technology
	Journal of the Society of Archivists	**Journal of the Society of Archivists**

Web of Knowledge	Scopus	LISTA: Library and Information Science Technology Abstract
Knowledge Organization	**Knowledge Organization**	**Knowledge Organization**
Law Library Journal		
Learned Publishing	**Learned Publishing**	**Learned Publishing**
		Libraries & Google
	Libraries and the Cultural Record	**Libraries and the Cultural Record**
Library & Information Science Research	**Library & Information Science Research**	**Library & Information Science Research**
Library Journal		Library & Information Update
Library Quarterly		Library Association Record.
	Library Management	
	Library Review	**Library Review**
Library Trends	**Library Trends**	**Library Trends**
Libri	**Libri**	**Libri**
	Literary and Linguistic Computing	**Literary and Linguistic Computing**
		LOGOS: The Journal of the World Book Community
		Louisiana Libraries
		Managing Information
		New Library World
		New Review of Hypermedia & Multimedia
		New Review of Information Behaviour Research
		New Review of Information Networking
		New York Review of Books
		New York Times Book Review
		Nieman Reports.
		OCLC Systems & Services
Online & Cdrom Review		**Online & CD-Rom Review**
Online Information Review	**Online Information Review**	**Online Information Review**
		Online Review

Web of Knowledge	Scopus	LISTA: Library and Information Science Technology Abstract
		Proceedings of the 17th International Online Information Meeting
		Proceedings of the 19th International Online Information Meeting
		Proceedings of the 20th International Online Information Meeting
		Proceedings of the International Online Information Meeting
		Program: Electronic Library & Information Systems
	Proceedings of the ACM International Conference on Digital Libraries	Publishing Research Quarterly
proceedings of the American Society for Information Science		
Program-Automated Library and Information Systems	**Program-Automated Library and Information Systems**	
	Records Management Journal	**Records Management Journal**
		Records Management Society Bulletin
Reference & User Services Quarterly		Reference & User Services Quarterly
		Reference Librarian
		Report Nbs-monogr
		Research Reports Series
Research Evaluation		**Research Evaluation**
Science & Society	**Science & Society**	
		School Library Journal
		Science & Technology Libraries
		Science in Parliament
		Scientometrics
		SCONUL Focus
		Serials Librarian

Web of Knowledge	Scopus	LISTA: Library and Information Science Technology Abstract
		Voice of Youth Advocates
		Volume 2, Processing, Storage, And Output Requirements In Information Processing Systems
		Yale University Library Gazette
In common with the other two databases /Total		
19 /40	**19/34**	**22/88**

Appendix 2: Gender and h-index ANOVA (comparison) Test

The following tables show the details of the results of gender and h-index ANOVA test using SPSS.

Estimates

Dependent Variable: H-index

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Female	2.350	.550	1.261	3.439
Male	3.289	.515	2.269	4.308

Pairwise Comparisons

Dependent Variable: H-index

(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Female	Male	-.938	.753	.215	-2.430	.553
Male	Female	.938	.753	.215	-.553	2.430

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: H-index

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Contrast	17.035	1	17.035	1.552	.215	.013
Error	1317.118	120	10.976			

The F tests the effect of Gender. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Appendix 3: Test of between subject affect for gender, h-index and academic rank

The following tables depicts the details of the test that examines the interaction between gender, h-index and academic rank

Levene's Test of Equality of Error Variances[a]

Dependent Variable: H-index

F	df1	df2	Sig.
12.104	11	120	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + GENDER + RANK + GENDER * RANK

Tests of Between-Subjects Effects

Dependent Variable: H-index

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	605.813[a]	11	55.074	5.018	.000	.315
Intercept	615.119	1	615.119	56.042	.000	.318
GENDER	17.035	1	17.035	1.552	.215	.013
RANK	381.591	5	76.318	6.953	.000010	.225
GENDER * RANK	44.451	5	8.890	.810	.545	.033
Error	1317.118	120	10.976			
Total	3093.000	132				
Corrected Total	1922.932	131				

a. R Squared = .315 (Adjusted R Squared = .252)

Appendix 4: Frequency and the percentage of publication under each subject category

This table depicts the number of publications (frequency of the publications) in each subject categories

	Frequency	Percent	Valid Percent	Cumulative Percent
Reports, editorial notes, book reviews, general articles	375	12.9	12.9	12.9
Digital libraries, e-books, e-publishing, digital issues, digital age, internet	543	18.7	18.7	31.6
Human and social aspects of information handling, organisational behaviour, user studies	485	16.7	16.7	48.2
Information retrieval	167	5.7	5.7	54
Books, collections, records and library management, literature, preservation, publishing , documentation, reference work	408	14	14	68
Automation, database systems, systems management, technical issues	345	11.9	11.9	79.9
Cataloguing, classification, indexing, knowledge organisation, taxonomies, thesaurus construction	145	5	5	84.8
Bibliometrics, citation studies, Informetrics, Webometrics, log analysis	149	5.1	5.1	90
Information literacy, teaching and learning, public libraries and services	181	6.2	6.2	96.2
Copyright, legal issues, e-copyright, ethical issues	111	3.8	3.8	100
Total	2909	100	100	

Appendix 5: Publication by male and female academics in LIS sub disciplines based on the gender of collaborative authors

		gender mixed			Total
		male	female and male	female	
1	Reports, editorial notes, book reviews, general articles	248	32	94	374
		182.8	95.1	96.1	374.0
		66.3%	8.6%	25.1%	100.0%
2	Digital libraries, e-books, e-publishing, digital issues, digital age, internet	207	186	147	540
		263.9	137.3	138.8	540.0
		38.3%	34.4%	27.2%	100.0%
3	Human and social aspects of information handling, organisational behaviour, user studies	206	142	136	484
		236.6	123.0	124.4	484.0
		42.6%	29.3%	28.1%	100.0%
4	Information retrieval	108	44	13	165
		80.6	41.9	42.4	165.0
		65.5%	26.7%	7.9%	100.0%
5	Books, collections, records and library management, literature, preservation, publishing , documentation, reference work	213	74	120	407
		198.9	103.5	104.6	407.0
		52.3%	18.2%	29.5%	100.0%
6	Automation, database systems, systems management, technical issues	147	90	105	342
		167.2	86.9	87.9	342.0
		43.0%	26.3%	30.7%	100.0%
7	Cataloguing, classification, indexing, knowledge organisation, taxonomies, thesaurus construction	67	40	35	142
		69.4	36.1	36.5	142.0
		47.2%	28.2%	24.6%	100.0%
8	Bibliometrics, citation studies, informetrics, webometrics, log analysis	77	55	17	149
		72.8	37.9	38.3	149.0
		51.7%	36.9%	11.4%	100.0%
9	Information literacy, teaching and learning, public libraries and services	74	52	55	181
		88.5	46.0	46.5	181.0
		40.9%	28.7%	30.4%	100.0%
10	Copyright, legal issues, e-copyright, ethical issues	68	21	22	111
		54.3	28.2	28.5	111.0
		61.3%	18.9%	19.8%	100.0%
	Total	1415	736	744	2895
		1415.0	736.0	744.0	2895.0
		48.9%	25.4%	25.7%	100.0%