Invisible Intermediaries: A Systematic Review into The Role of Research Management in University and Institutional Research Processes

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Abstract: *The introduction of competitive rankings and research assessment frameworks have necessitated that research organisations continually monitor their research strengths and weaknesses. Such monitoring is essential to be able to strategically respond in a competitive environment. There is little research on the role of research management in research organisations, including universities, but the literature suggests that when implemented well, research management is an essential component of the research process. Despite this, an evidence-based understanding of the strategies available for successful research management is lacking. In order for organisations to structure their research management strategies more efficiently, as well as to inform practitioners of the best way to deliver their service, an understanding of the evidence for successful research management strategies is needed. The aim of this article is to provide a systematic review to investigate the evidence base for successful research management strategies.*

Keywords: *research support, research management, technology transfer, knowledge transfer, commercialisation, research collaboration*

Introduction

In many countries the introduction of competitive rankings and assessment frameworks have necessitated that universities continually monitor and strategically promote their strengths. This management objective also requires that universities be able to promote and encourage research behaviour that increases the probability of research success using research administrators and/or managers as facilitators. Research administrators are now regarded as key participants in research planning at the department, college, and university levels to attract and manage strategically desirable research and researcher behaviour. In order for organisations to structure their research management strategies more efficiently, as well as to inform practitioners as to the best way to deliver their services, an understanding of techniques and state of the research administration role is needed.

The research management/administration profession has sought to define itself in recent years. In the UK, in 2009 the Higher Education Funding Council for England and Medical Research Council funded a study entitled 'Professionalising Research Management'. The study's main objective was to identify whether there was a demand for the development of a professional framework for the training of Research Managers and, if so, how this demand could be addressed. However, as part of this study, the authors articulated a range of work activities and skill requirements associated with research work. It also identified the variety of research management structures within universities, the levels at which research managers operate, and their involvement at strategic levels within the university. Building on such understandings of 'research management', the UK's National Association of Research Administrators (ARMA) has recently implemented a 'Professional Development Framework' which outlines the 'activities, knowledge, skills and behaviours required across the full range of research management and administration roles' (https://www.arma.ac.uk/professional-development/PDF). This framework describes the key activities at the operational, management and leadership levels. As a result of this framework, the Association has developed professional certificates in research administration, management and leadership. It could be suggested, therefore, that there is now a detailed understanding of the constituent parts that broadly make up 'research management'. However, as noted by Green and Langley (2009), the huge variety in how it is delivered across the sector, and the constant restructuring of research services within universities, suggests a lack of understanding regarding how it can most effectively be delivered. Indeed, recognition that 'research management' lacks the consistency and standardization of professions such as Finance and Human Resources means that it is more difficult for those outside of the profession to understand and value its function, and more complicated to define and situate in terms of its role within a university.

Hockey & Allen-Collinson (2009) state that formal research on administrative/management staff in higher education is lacking (McInnis, 1998; Whitchurch, 2006b; Allen-Collinson, 2006). Research management provides a balance between promoting the needs of institutions to meet their organisational objectives and the ability of academics to determine the best means of performing research. Despite the importance of research management as part of the modern university, there is little consensus within the literature available regarding what are the successful strategies for this profession. In particular, which management models and strategies specifically for the research management profession are the most effective? In addition to that, those outside of the profession are often unsure with regards to what constitutes 'research management', what value it adds, and how best it can be operationalised (Green & Langley, 2009). What is required, therefore, is an evidence-informed understanding of best practice for research management.

The aim of this review is to draw from the literature an understanding of how the role of research management is considered, as well as to investigate the evidence base for successful strategies of research management. By addressing this, this review provides one of the first investigations of both the academic and professional literature of the role of research management. The objective is to review the state of research management/administration research, and to provide a description of the effectiveness of strategies and structures investigated in the literature.

Methodology

The systematic literature review originated as an approach within medical science and healthcare as a way to ensure rigorous secondary research that could be used to inform practice. It is distinct from more narrative approaches to literature review as it adopts 'a replicable, scientific and transparent process, in other words a detailed technology, that aims to minimize bias . . . and by providing an audit trail of the reviewers' decisions, procedures and conclusions' (Tranfield, Denyer & Smart 2003, p.209). This approach is now being used more widely by researchers as a means of assimilating '"best practice" to provide insights and guidance for intervention into the operational needs of practitioners and policy makers' (Tranfield, Denyer & Smart 2003, p.208). As this study seeks to identify evidence to inform research management practice, the methodology is appropriate.

This research involved the key components of a systematic review (Spencer et al., 2003; Buchanan & Bryman, 2009), including:

1. Formulating a research question;
2. Locating studies with the aim of locating, selecting and appraising as many studies as possible that were relevant to the review;
3. Setting exclusion and inclusion criteria to inform study selection;
4. Critically evaluating and appraising the literature selected;
5. Drawing inferences from the literature's recommendations;
6. Making recommendations for future research.

The review model adopted prioritised a divergent/convergent approach which allowed the authors to remain open to the variety of research management literature sources available (initial diverging), but to also employ an empirically structured approach designed to identify the structures and strategies deemed successful by the academic evidence base (subsequent converging).

The diverse nature of the research management field, as well as a hypothesised separation between the academically- and professionally-based literatures, necessitated the adoption of such a semi-structured approach to the consideration of the literature.

Table 1. A Divergent/Convergent Review Process

	***Divergent* Scoping**	***Convergent* Systematic Review**
Aim	Broad	Tightly specified review question.
Scope	Wide	Narrow
Review Plan	Unplanned exploration.	Transparent process with audit trail.
Study identification	Probing selection informed by previous studies read.	Rigorous and comprehensive search using databases and cross referencing.
Study Selection	Studies chosen by reviewer.	Inclusion and exclusion criteria determine selection.
Quality Assessment	Limited critical appraisal.	Formulated assessment of methodological quality.

Adapted from a presentation by Professor Richard Wilding (2010).

Search Strategy

Between the authors, a definition was developed in order to guide the identification of suitable papers and to aid the development of relevant inclusion and exclusion criteria (described below). In addition, the development of a definition for this review was an attempt to maintain some of the characteristics of a systematic review, while adhering to the convergent-divergent model necessary for analysing the social science literature. The following question guided the selection of relevant literature for this review;

> *"What are the successes of different models and structures of research management within research organisations?"*

A list of journals was constructed by the authors that were considered as potential targets for research involving research management. These journals were drawn from the management, innovation, professional, and sociology literature in order to capture as many relevant articles as possible. Following the identification of potentially relevant journals, a series of key words were identified in order to develop suitable search strings. Articles included in the final sample id were:

1. Based on cases, policies or data generated in the US, UK, and Europe;
2. Published in English; and,
3. Published within 2003-2013.

Three unique search strings were employed independently to a representable sample of articles for the review. Each search string was run separately, with the results of each search string then combined and any repeated articles deleted. The number of articles resulting from each search string, with the total number of articles (minus repeats) identified, is shown below in Table 2.

Table 2. Number of articles from each search string run in Web of Science (WoS)

Search String	**Results from WoS**
(Research* OR universit*) AND (Management OR Administration or support)	5693
(Universit* OR research*) AND (knowledge OR technology) AND transfer) OR commercialisation)	927
(Universit* OR research*) AND ("business development" OR collaboration)	1521
Total (excluding repeated articles)	**4211**

The search string described above returned a total of 4211 articles. Articles were then manually checked by GD and AN to eliminate any irrelevant articles including those (i) not relevant to research management or administration, (ii) not focused on academic research either in universities or research organisations, and (iii) did not include a consideration of the structures and strategies of research management. This process successfully eliminated 3842 irrelevant articles.

At the same time, manual checks of the journals initially identified as potential targets, but not indexed by Web of Science, were conducted by GD. This process added a further 55 relevant

articles to the sample. A final, more in-depth consideration of the articles was conducted where each article's relevance to the central research question, according to a detailed analysis of its abstract and full papers, was determined. At the conclusion of this process, articles were automatically discarded if a conflict in classifications between AN and GD still existed. This resulted in 98 articles being included in the final review. A diagram of the above process and the number of articles included at each stage of consideration are included in Figure 1.

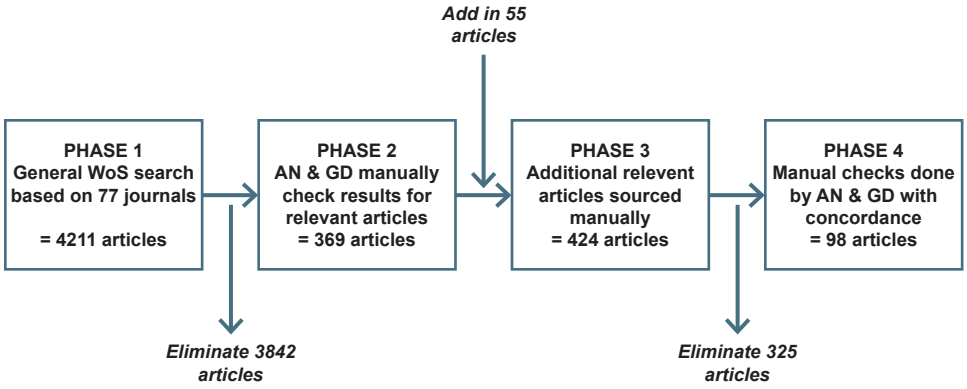

Figure 1. Summary of sources contributing to the systematic review

Analysing Article Characteristics

An analysis of the journals of the articles was performed. The purpose of this analysis stage was to guide the overall review of the literature, especially for the development of themes described in the critical analysis of the literature. A secondary purpose analysing the publication characteristics of the sample articles was to generate quantitative evidence related to the focus of the sample of articles identified.

Critical Appraisal of the Literature

Due to the broad nature of the articles under investigation, a similarly broad appraisal of each article's methodological strengths and weaknesses was adopted. This was especially important considering the sample included qualitative, quantitative, mixed-methods, commentary, and literature review articles. As such, adopting a broad approach to the appraisal of the literature was essential to assess the evidence presented in each article and therefore addressing the objectives of this review. For the empirically-orientated articles, however, the appraisal framework adopted was based on the guidelines presented by Spencer et al (2003) for systematic reviews in the social sciences. These guidelines were then adapted and applied as per the needs of this review relative to the research question and systematic review definition. This included an appraisal of how each article fulfilled its objectives, the representativeness of the sample used, the appropriateness of the methodology employed, and therefore the value of the conclusions. The results of this appraisal relative to the guidelines adopted from Spencer et al (2003), as well as an assessment of

the relevance of the article for addressing the objectives of this review, for each of the 98 articles under investigation are presented in Table 3.

Theme Development

Each paper was also reviewed to identify and understand a variety of themes that emerged in the literature. This approach was useful to address the review objective regarding the current extent of research management/administration literature.

Results

Methodological approaches

There was a relatively equal distribution between articles with a qualitative (44/98) and a quantitative (38/98) focus. These encompassed a variety of different approaches including the use of surveys, interviews, bibliometrics and the use of pre-existing databases for econometric analysis. About 11/98 of the articles in the sample used a combination of qualitative and quantitative (mixed-methods) approaches. The remaining articles did not include a classifiable qualitative or quantitative approach.

An analysis of the journals in which our selected group of 98 articles were published revealed that the majority of articles were published in two distinct journals, Research Policy, and the Journal of Research Administration. This was interesting as Research Policy is a high ranking, academically-focused journal in the innovation and science policy field. In contrast, the other popular journal, the Journal of Research Administration, is a journal that primarily targets research management professionals and is published by the Society of Research Administrators International.

The other journals identified in this analysis as publishing a high proportion of articles included in our sample include Higher Education Quarterly (n=9), and Higher Education Management and Policy (n=6), as well as some traditionally technical journals such as Technovation (n=5), and Technology Analysis & Strategic Management (n=6).

Theme Analysis

The many guises of the research manager in the literature

Many of the studies refer to *"research management"* as a new management profession that now includes its own professional organisations, means of communication and guidelines. In addition, the existence of *The Journal of Research Administration*, produced by the US-based Society of Research Administrators International, and *Research Global*, a magazine produced by the Association of Commonwealth Universities, demonstrate not only the increasing professionalisation of the industry, but the increasing interest in improving management practices and guidelines based on an increasing, empirical evidence base. However, one of the prevailing issues with providing a meaningful evidence base for improving policies and procedures is that

Table 3. Summary of the methodology of articles contributing to the convergent-divergent systematic review

Year	Author	Title	Journal	Qualitative or Quantitative	Approach	Objectives	Direct / Indirect	Country
2003	Drummond.	Strategic Planning for Research Administration	Journal of Research Administration	Qualitative	Literature based discussion	To describe a 7 step plan to implementing research administration professionals within research organisations	Direct	Global
2003	Jacob.	Organising the Academy: New Organisational Forms and the Future of the University	Higher Education Quarterly	Qualitative	Literature review based commentary	Discuss 3 new organisation methods that can be applied to European universities	Indirect	Europe (including UK)
2003	Krauser	The Research Administrator as Servant-Leader	Journal of Research Administration	Qualitative	Literature based analysis	Discussion of the purpose of research administration	Direct	
2003	Sanz-Menendez & Cruz-Castro.	Coping with environmental pressures: public research organisations responses to funding crises	Research Policy	Quantitative	Case study	To analyse how Spanish PROs have adapted to a reduction in the direct transfer of state funds	Indirect	Spain
2003	Siegel, et al.	Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study	Research Policy	Mixed methods	Survey and Interviews	To analyse the relative productivity, and reasons for this productivity, of university based TTOs	Indirect	US
2004	Morphew & Baker.	The cost of prestige: Do new research I universities incur higher administrative costs?	Review of Higher Education	Quantitative	Financial analysis of universities	To investigate the consequences of rising university administration costs	Direct	US
2004	Whitchurch, C.	Administrative Managers – A Critical Link	Higher Education Quarterly	Qualitative	Literature review	To consider the changing roles of university research managers	Direct	Global
2005	Audretsch & Lehmann.	Do University policies make a difference?	Research Policy	Quantitative	Economic analysis of IPOs	Investigate if the university type affects the performance of knowledge based start-ups	Indirect	Europe
2005	Chapple et al.	Assessing the relative performance of UK university technology transfer offices: parametric and non-parametric evidence	Research Policy	Quantitative	Survey	Investigate the efficiency of university technology transfer	Indirect	UK
2005	Ehrenberg.	Why universities need institutional researchers and institutional researchers need faculty members more than both realize	Research in Higher Education	Quantitative	Survey and literature review	To illustrate the importance of data provided by various institutional research administration offices	Indirect	US
2005	Goddard.	Institutional Management and engagement with the knowledge society	Higher Education Management and Policy	Qualitative	Literature case study	To argue that external engagement with business and community poses challenges for the management of Higher Education Institutions (HEIs)	Indirect	UK and Finland

Year	Author	Title	Journal	Qualitative or Quantitative	Approach	Objectives	Direct / Indirect	Country
2005	McAdam et al.	Defining and improving technology transfer business and management processes in university innovation centres	Technovation	Qualitative	Comparative case studies	To investigate how management inputs can be used to suggest improvements for 2 technology transfer processes	Indirect	UK
2005	Olsen.	Constructing a Grants Office Review: A Case Study	Journal of Research Administration	Qualitative	Literature based commentary	Describes a potential model to evaluate a university grants office	Direct	US (NJ)
2005	Porter.	Helpful Gatekeepers: Positive Management of the Limited Submission Process	Journal of Research Administration	Qualitative	Case study	Investigates one case for managing limited grant submission processes	Direct	US
2005	Sapienza.	From the inside: scientists' own experience of good (and bad) management	R & D Management	Mixed methods	Interviews, document analysis, participant observation and surveys	Investigate scientists opinions about effective management	Direct	Europe, Asia and US
2006	Casu & Thanassoulis.	Evaluating cost efficiency in central administrative services in UK universities	OMEGA-International Journal of Management Science	Qualitative	Literature based case study	To re-evaluate expenditure on central administration to identify efficient and inefficient universities	Indirect	UK
2006	Deem.	Changing Research Perspectives on the Management of Higher Education: Can Research Permeate the Activities of Manager-Academics?	Higher Education Quarterly	Qualitative	Comparative case studies	To analyse the extent to which manager-academics in universities use externally generated research in their roles, values and management policies	Indirect	UK
2006	Gjerding et al.	Twenty practices of an entrepreneurial university	Higher Education Management and Policy	Qualitative	Interviews	To analyse the characteristics of entrepreneurial universities in line with Clark (2004)	Indirect	Europe
2006	Mason & Learned.	The Role of "Development" in a Research Administration Office	Journal of Research Administration	Qualitative	Literature based commentary	To discuss how current challenges faced by universities are "development" activities that devises strategies to procure external funding for research administration activities	Direct	US
2006	Roberts.	Everyone's Mentor: Perceptions of Research Administrators on the Value of Certification	Journal of Research Administration	Quantitative	Survey	To investigate the value of certification in research administration	Direct	
2006	Sivrais & Disney.	Changing the Culture of Research Administrators at a Public University	Journal of Research Administration	Qualitative	Case study	Describe a case of how the University of Michigan changed and sustains a research administration culture	Direct	US

2007	Atkinson et al.	The Dimensions of Influence on Research Administrator Behavior: Toward a Theoretical Model of Research Administration as a Public Service Profession	Journal of Research Administration	Qualitative	Literature review analysis	Creates a theoretical model of the research administrator profession based on the literature of the sociology of "professions"	Direct	US
2007	Bartunek.	Academic-practitioner collaboration need not require joint or relevant research: Toward a relational scholarship of integration	Academy of Management Journal	Qualitative	Literature review analysis	How management research published in the AMJ influences practice	None	Global
2007	Cole.	Research Administration as a Living System	Journal of Research Administration	Quantitative	Delphi-survey study	Analyse the opinions about how changes in research administration stimulates growth and collaboration with researchers	Direct	US
2007	Decter et al.	University to business technology transfer - UK and USA comparisons	Technovation	Quantitative	Survey	To compare the function and successes of UK and US Technology Transfer Offices	Indirect	US and UK
2007	D'Este & Fontana.	What drives the emergence of entrepreneurial academics? A study on collaborative research partnerships in the UK	Research Evaluation	Quantitative	Existing data from the EPSRC collaboration grants 1991-2003	To study the patterns of engagement in collaborative , university-industry research among university researchers	Indirect	UK
2007	D'Este & Patel.	University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?	Research Policy	Quantitative	Existing data from the EPSRC collaboration grants 1991-2004	To examine the nature of channels used by researchers to interact with industry and the factors influencing researcher engagement with these interactions	Indirect	UK
2007	O'Shea et al.	Delineating the anatomy of an entrepreneurial university: the Massachusetts Institute of Technology experience	R & D Management	Quantitative	Case study	To describe the factors associated with successful academic entrepreneurship at MIT	Indirect	US
2007	Rutherford & Langley.	Implementation of Systems to Support the Management of Research: Commentary from a UK University Perspective	Journal of Research Administration	Qualitative	Case study	To comment on the implementation of a research management system in the UK university sector	Direct	UK
2007	Sousa & Hendriks.	That obscure object of desire: The management of academic knowledge	Minerva	Qualitative	Interviews	Explore how research management perceive research quality and how it is managed.	Direct	The Nether-lands
2007	Vargas & Hanlon.	Celebrating a Profession: The Servant Leadership Perspective	Journal of Research Administration	Qualitative	Commentary	To discuss the model of research managers as "servant leaders"	Direct	US
2007	Ward.	Academic values, institutional management and public policies	Higher Education Management and Policy	Qualitative	Literature based analysis	How new university revenue streams have influenced university management	Indirect	US
2008	Boardman & Corley.	University research centers and the composition of research collaborations	Research Policy	Quantitative	Survey analysis	Identifies how centre-level attributes affects research collaboration	Indirect	US

Year	Author	Title	Journal	Qualitative or Quantitative	Approach	Objectives	Direct / Indirect	Country
2008	Burnside & Witkin.	Forging successful university-industry collaborations	Research-Technology Management	Qualitative	Case study	To describe the establishment of a collaborative agreement between Hewlett-Packard, University of California Berkeley and the Bay Area Science and Innovation Consortium	Indirect	US
2008	Jong.	Academic organizations and new industrial fields: Berkeley and Stanford after the rise of biotechnology	Research Policy	Quantitative	Comparative case studies	Outlines how industry ties opens opportunities for scientific institutions builders to strengthen the legitimacy of their fields of scientific enquiry	Indirect	US
2008	Kirkland, J.	University research management: an emerging profession in the developing world	Technology Analysis & Strategic Management	Qualitative	Literature review	Investigate the importance of research management in developing countries	Direct	
2008	Lintz, E.	A Conceptual Framework for the Future of Successful Research Administration	Journal of Research Administration	Qualitative	Conceptual model	Presents a conceptual model for research administration	Direct	US based
2008	Mullen et al.	Listening to Those We Serve: Assessing the Research Needs of University Faculty	Journal of Research Administration	Quantitative	Survey	To identify the impediments, as perceived by university staff, that influence research	Direct	US
2008	Sá.	University-Based Research Centers: Characteristics, Organization, and Administrative Implications	Journal of Research Administration	Qualitative	Interviews and document analysis	Examine the characteristics and organisational values associated with university-based research centres	Indirect	US
2008	van der Heide et al.	The institutional organisation of knowledge transfer and its implications	Higher Education Management and Policy	Qualitative	Comparative case studies	Investigates how universities have embedded knowledge transfer activities	Direct	Europe
2008	van der Weijden et al.	Implications of managerial control on performance of Dutch academic (bio)medical and health research groups	Research Policy	Quantitative	Survey	To examine the relationship between managerial control and research performance of academic groups	Indirect	The Nether-lands
2008	Whitchurch.	Shifting Identities and Blurring Boundaries: the Emergence of Third Space Professionals in UK Higher Education	Higher Education Quarterly	Qualitative	Interviews	To understand university professional administration	Indirect	UK, US and Australia
2008	Woodfield & Kennie.	'Teamwork' or 'Working as a Team'? The Theory and Practice of Top Team Working in UK Higher Education	Higher Education Quarterly	Qualitative	Comparative case studies	To explore the different ways that universities organise their senior management teams	Indirect	UK
2008	Wright et al.	Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries	Research Policy	Qualitative	Interviews	To examine the processes involved in universities' interaction with industry in mid-range European universities.	Indirect	Europe

2008	Young et al.	Intellectual Property management in publicly funded R&D centres - A comparison of university-based and company-based research centres	Technovation	Mixed methods	Survey and interviews	To explore the difference in IP management practices at PRCs in universities compared to firms, and how these influence knowledge spillover	Indirect	Northern Ireland
2009	Arena et al.	Developing a Performance Measurement System for University Central Administrative Services	Higher Education Quarterly	Mixed methods	Comparative case studies	Evaluate the success of a Performance Management System	Indirect	Italy
2009	Barboll & Corredera.	Critical factors for success in university-industry research projects	Technology Analysis & Strategic Management	Quantitative	Case study	Identify factors of successful and unsuccessful technology transfer	Indirect	Spain
2009	Blackman & Kennedy.	Knowledge management and effective university governance	Journal of Knowledge Management	Qualitative	Case study	To identify the relationship between knowledge processes and governance structures	Indirect	Australia
2009	Boardman.	Government centrality to university-industry interactions: University research centers and the industry involvement of academic researchers	Research Policy	Quantitative	Survey	Identify personal and professional characteristics that affect how scientists interact with private companies	Indirect	US
2009	Boardman & Ponomariov.	University researchers working with private companies	Technovation	Quantitative	Survey	How different types of university research centres affect individual level university-industry interactions	Indirect	US
2009	Geuna & Muscio.	The Governance of University Knowledge Transfer: A Critical Review of the Literature	Minerva	Qualitative	Literature based analysis	To critically discuss models of university knowledge transfer	Indirect	Global
2009	Heinze et al.	Organizational and institutional influences on creativity in scientific research	Research Policy	Mixed methods	Survey, interviews, archive and bibliometric analysis	To analyse the organisational factors that influence scientific creativity	Indirect	Europe (incl UK) and US
2009	Hockey & Allen-Collinson.	Occupational Knowledge and Practice amongst UK University Research Administrators	Higher Education Quarterly	Mixed methods	Surveys and interviews	Investigate what knowledge is required for research administration in UK universities	Direct	UK
2009	Nosella & Grimaldi.	University-level mechanisms supporting the creation of new companies: an analysis of Italian academic spin-offs	Technology Analysis & Strategic Management	Quantitative	Survey	To investigate the role of policies and strategies in Italian university TTOs in creating spin-off companies	Indirect	Italy
2010	Albors-Garrigos.	New R&D management paradigms: rethinking research and technology organizations strategies in regions	R&D Management	Quantitative	Survey	No firm conclusions drawn and no new R&D management paradigm constructed. A relationship between different variables conducted.	Indirect	Spain
2010	Auranen & Nieminen.	University research funding and publication performance-An international comparison	Research Policy	Quantitative	Bibliometric analysis	How funding systems vary between countries and whether more competitive systems produce more publications	None	Mixed

Year	Author	Title	Journal	Qualitative or Quantitative	Approach	Objectives	Direct / Indirect	Country
2010	Brostrom.	Working with distant researchers- Distance and content in university-industry interaction	Research Policy	Quantitative	Survey	Studies the role of geographical proximity for interaction on R&D for engineering	Indirect	Sweden
2010	Bruneel et al.	Investigating the factors that diminish the barriers to university-industry collaboration	Research Policy	Quantitative	Survey	Explore the effect of collaboration experience, breadth of interaction, and inter-organisational trust on barriers to industry collaboration	Indirect	UK
2010	Caldera & Debande.	Performance of Spanish universities in technology transfer: An empirical analysis	Research Policy	Quantitative	Survey	Investigate the role of university policies and science parks on technology performance	Indirect	Spain
2010	Chun.	Building a Research Administration Infrastructure at the Department Level	Journal of Research Administration	Qualitative	Case study	To investigate a university's reduction in its research administration burdens	Direct	US
2010	Cole.	Reframing Research Administration	Journal of Research Administration	Quantitative	Delphi-survey study	Compares the views received from research faculty and research administration about restructuring research administration	Direct	US
2010	Gururajan & Fink.	Attitudes towards knowledge transfer in an environment to perform	Journal of Knowledge Management	Mixed methods	Focus groups and survey	To determine the attitudes that impact knowledge transfer between academics in universities	Indirect	Australia
2010	Halilem.	Inside the Triple Helix: An Integrative Conceptual Framework of the Academic Researcher's Activities, a Systematic Review	Journal of Research Administration	Qualitative	Systematic review	To determine what are researcher activities, the institutional determinants of these activities, and the determinants of researcher roles	Indirect	Global
2010	Philbin.	Developing and Managing University-Industry Research Collaborations through a Process Methodology/Industrial Sector Approach	Journal of Research Administration	Qualitative	Case study	To describe a framework successfully employed at University College London to improve the research development and the management of industrially funded research collaborations	Indirect	UK
2010	Shelley.	Research Managers Uncovered: Changing Roles and 'Shifting Arenas' in the Academy	Higher Education Quarterly	Mixed methods	Survey and document analysis	To examine the changes in the role, status and professional identity of research managers in universities	Direct	UK
2010	Tello et al.	Individual choice or institutional practice Which guides the technology transfer decision-making process?	Management Decision	Qualitative	Interviews	To examine how technology transfer officer's heuristics and biases influence technology commercialisation.	Indirect	US

2010	Vogelgesang et al.	What Determines Faculty-Engaged Scholarship?	Review of Higher Education	Quantitative	Survey	To explore faculty members' perceptions of institutional support and the increased likelihood of engaging in scholarship in local communities.	Indirect	US
2010	Zalewska-Kurek et al.	The impact of the autonomy and interdependence of individual researchers on their production of knowledge and its impact: an empirical study of a nanotechnology institute	Research Evaluation	Quantitative	Survey and bibliometric analysis	To discuss how to manage and organise research to maximise performance	Indirect	UK
2011	Conti & Gaule.	Is the US outperforming Europe in university technology licensing? A new perspective on the European Paradox	Research Policy	Quantitative	Survey	To investigate the "European Paradox" through analysis TTO activity in Europe and the US	Indirect	US and Europe
2011	Hall.	University Research Centers: Heuristic Categories, Issues, and Administrative Strategies	Journal of Research Administration	Qualitative	Interviews and survey	To illuminate centre types, issues and strategies used to address issues under each centre type	Indirect	US
2011	Johnson.	Managing university technology development using organizational control theory	Research Policy	Qualitative	Literature based theory	Discuss university-industry technology transfer processes	Indirect	Global
2011	Lam.	What motivates academic scientists to engage in research commercialization: 'Gold', 'ribbon' or 'puzzle'?	Research Policy	Mixed methods	Interviews, survey	To examine scientists' motivations to engage in commercialisation	Indirect	UK
2011	Leisyte & Horta.	Introduction to a special issue: Academic knowledge production, diffusion and commercialization: policies, practices and perspectives	Science and Public Policy	Introduction to a special issue	N/A	To review the papers related to, changing national science policies and their influence on knowledge management in universities, and the impact of policies on academic knowledge production, diffusion and commercialisation	Indirect	Europe
2011	Philbin.	An Investigation of the Development and Management of University Research Institutes	Journal of Research Administration	Qualitative	Case study	To discuss the management activity within the first two years of a research institute and any difficulties	Indirect	UK
2011	Waite.	Research Administrators as Servant Leaders	Journal of Research Administration	Qualitative	Literature review	Investigate how research managers can effectively facilitate successful grant applications	Direct	Global
2012	Berbegal-Mirabent et al.	Brokering knowledge from universities to the marketplace The role of knowledge transfer offices	Management Decision	Quantitative	Analysis of patents, revenues, number of spin offs	Investigate the role and factors related to successful knowledge transfer offices	Indirect	Spain
2012	Clausen et al.	Mobilizing for change: A study of research units in emerging scientific fields	Research Policy	Quantitative	Survey	Investigate the factors that influence the success of local research units	Indirect	Global

Year	Author	Title	Journal	Qualitative or Quantitative	Approach	Objectives	Direct / Indirect	Country
2012	Hewitt-Dundas.	Research intensity and knowledge transfer activity in UK universities	Research Policy	Quantitative	Use of Higher Education Business and Community Interaction Survey	To investigate the relationship between university research performance and their knowledge transfer activity	Indirect	UK
2012	Kenna & Berche.	Critical masses for academic research groups and consequences for higher education research policy and management	Higher Education Management and Policy	Quantitative	Bibliometric analysis	To explore the nature of critical mass in smaller, research-intensive universities in terms of research management and policy	Indirect	UK
2012	Martins & Meyer.	Organizational and behavioural factors that influence knowledge retention	Journal of Knowledge Management	Quantitative	Survey	To identify and explore organisational and behavioural factors that influence knowledge sharing.	Indirect	South Africa
2012	Mom et al.	The skills base of technology transfer professionals	Technology Analysis & Strategic Management	Mixed methods	Survey and interviews	To identify and assess the skills necessary for technology transfer professionals	Direct	European
2012	Sa & Tamtik	Strategic planning for academic research	Higher Education Management and Policy	Qualitative	Content analysis and interviews	To analyse how strategic planning has been applied to research	Indirect	Canada
2012	Teelken.	Compliance or pragmatism: how do academics deal with managerialism in higher education? A comparative study in three countries	Studies in Higher Education	Qualitative	Interviews	To explore the effect of managerial measures on European universities	Indirect	Europe
2012	Volberda et al.	Technology transfer: the practice and the profession	Technology Analysis & Strategic Management	N/A	Commentary (introduction to a special issue)	To introduce a special issue on Technology Transfer.	Direct	Global
2012	Wilbon.	Interactive planning for strategy development in academic-based cooperative research enterprises	Technology Analysis & Strategic Management	Qualitative	Case study	To evaluate the approaches taken by university-based research collaboratives to support strategic management	Indirect	US
2013	Amayah.	Determinants of knowledge sharing in a public sector organization	Journal of Knowledge Management	Quantitative	Survey analysis	Investigate factors that affect knowledge sharing	Indirect	US
2013	Ankrah et al.	Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit	Technovation	Qualitative	Comparative case studies	Examine the motives of academic and industry to engage in knowledge transfer	Indirect	UK

2013	Bosua & Venkitachalam.	Aligning strategies and processes in knowledge management: a framework	Journal of Knowledge Management	Qualitative	Comparative case studies	To illustrate the importance of aligning knowledge management strategies with processes.	Indirect	Australia and New Zealand
2013	Bozeman & Boardman.	Academic Faculty in University Research Centers: Neither Capitalism's Slaves nor Teaching Fugitives	Journal of Higher Education	Quantitative	Survey analysis	Investigate the effect of university and industry interactions on organisational outcomes	Indirect	US
2013	Chen et al.	A sustainable collaborative research dialogue between practitioners and academics	Management Decision	Quantitative	Survey and content analysis	To investigate the co-production of knowledge via the collaboration between management academics and practitioners	Indirect	Global
2013	Chirikov.	Research universities as knowledge networks: the role of institutional research	Studies in Higher Education	Qualitative	Comparative case studies	Investigate the best method for structure, staffing and responsibilities of the institutional research office	Indirect	Russia
2013	Derrick & Bryant.	The role of research incentives in medical research organisations	R & D Management	Mixed methods	Interviews and bibliometric analysis	Investigate institutionalised financial incentive programs to encourage high impact publishing and commercialisation engagement	Indirect	Australia
2013	Edgar & Geare.	Factors influencing university research performance	Studies in Higher Education	Quantitative	Survey	To identify the management practices associated with superior research performance	Indirect	New Zealand
2013	Freitas et al.	Finding the right partners: Institutional and personal modes of governance of university-industry interactions	Research Policy	Quantitative	Pre-existing survey data	To compare two forms of university-industry interaction (institutional and personal forms of governance)	Indirect	Italy
2013	Konig et al.	A framework for structuring interdisciplinary research management	Research Policy	Qualitative	Case study	To develop a framework for addressing the needs of interdisciplinary research management	Indirect	Europe
2013	Whitchurch & Gordon.	Reconciling Flexible Staffing Models with Inclusive Governance and Management	Higher Education Quarterly	Qualitative	Interviews	To investigate how institutional management and governance practices facilitate innovative developments	Indirect	UK

research management and/or administration is still regarded by the literature as an abstract concept. Indeed, even defining *"administrators"* as a distinct occupational group is problematic, as Dobson and Conway highlight:

> *"There is little recognition beyond administrators themselves that a definable occupational grouping exists. The existence of administrators with qualifications equal to those of a university's professors is a new phenomenon, and not all these 'super administrators' are simply academics who have transferred from academe."* (2003, p. 125; quoted in Whitchurch, 2006b, p. 11)

The above statement from an article within the literature sample demonstrates how a new professional base for "research administrators" has developed that includes professionals who do not necessarily possess an academic background or direct experience in academic research.

Within the literature analysed there was a lack of a single, definitive definition of what research management is and what it does. Kirkland (2008) provided a brief description of research management and how it relates to the research process within universities. According to Kirkland (2008), research management is an "activity institute" at the level of the institution which seeks to add value to the research activity of academic staff, without being part of the research process itself. This definition does indeed provide a description but it regards research managers as a passive group of professionals separated from the activity of researchers and yet members of the same institution. Further to Kirkland′s description, research management has been described in other abstract forms such as servant leaders (Krauser, 2003), gate keepers, intermediaries, facilitators, enablers, and in some cases, a broker. Siegel et al (2003) defined the role of research management as facilitators of technological diffusion. Carlsson & Fridh (2002) defined knowledge brokers as a subset of research management, as a role that assists researchers in the dissemination of research results for the public good. All of these descriptions suggest that, in contrast to Kirkland′s definition, research management is an active and important part of the research process, rather than a passive and separated group of non-researchers. This is not to say that Kirkland′s (2008) definition is not without merit, but to illustrate that within the literature the concept of the research manager is undefined and it is still unclear. Furthermore, it is clear from the variety of concepts used to define research management, that research management is involved in influencing many aspects of the research process. The literature suggests that research management plays an important role in the research processes that result in technology transfer, knowledge brokering and sharing, scientific collaboration, grant success, industry involvement, productivity through publications, and even university student outcomes. However, within these studies, although research management is regarded as a role that exists and is important, its specific nature and the characteristics of those who perform this role are overlooked. Issues associated with overlooking the direct consideration of research management as a dependent variable in the literature is discussed in detail below.

Atkinson et al (2007) attempted to define research management as a profession by creating a theoretical model based on the sociology of "professions". He argued that research administration represented a legitimate profession that supports a defined field of knowledge, protects individuals who are dependent on the profession (researchers), hosts a level of specialisation, and is guided

by a set of ethics. Although not empirically-based, Atkinson´s et al (2007) model provided a representation of a "research administrator" or "research manager". In addition, the resulting model proposed how many factors within the research environment, including the institution and professional organisations, dictate how the profession responds to issues. Hockey & Allen-Collinson (2009) provide a definition of research administration that regards the role as a partner in the research process. According to their 2009 article, research administrators play an important part in formulating, developing, supporting, monitoring, evaluating and promoting the research and research-degree activity of their universities. This recognition of research management as a partner in the research process was first brought to light as a result of universities' need to secure additional competitive research funding from a variety of sources (Hockey & Allen-Collinson, 2009) not traditionally considered by universities (Miller, 1995). This description reflects one of the five factors driving the institution-led research management that was proposed by Kirkland (2008). Whitchurch (2006a) has argued for the concept of a 'hybrid' or 'multi-professional' identity for those staff members who demonstrate the ability to cross functional boundaries. These professionals often perform translational and interpretive functions between different constituencies, and many research administrators appear to hold such a hybrid identity (Allen-Collinson, 2006). Whilst in the past a clear boundary was perceived between the 'academic administration' and 'academic staff', with the former being seen as 'serving' the latter, nowadays the term tends increasingly to refer to registry and secretariat functions (Whitchurch, 2006b) where administrators act as 'guardians of the regulations' (Barnett, 2000: 133).

A polarising definition of research management was presented in Krauser (2003) and Vargas & Hanlon (2007). These articles referred to research managers as "servant leaders". Under this definition, the primary responsibility of the research manager was to *"to serve our researchers so they may concentrate on the research"*. Parolini (2004) suggested that, *"Servant leaders are defined by their ability to bring integrity, humility, and servanthood into caring for, empowering, and developing of others in carrying out the tasks and processes of visioning, goal setting, leading, modeling, team building, and shared decision-making"* (p. 9). This description of research management contrasts with those descriptions above that emphasise the importance of a partnership between researchers and research managers. In addition, Krauser's (2003) definition suggests a more manipulative role for research managers, where research managers must be kind, loving, attentive, intelligent, and reasonable towards researchers only so *"we can better accomplish that by serving first, teaching well and leading in such a manner that people aren't even aware that they are being led."* This definition also assumes that research managers, in other words, *"should serve so that they may lead."* Vargas and Hanlon (2007) described the primary goals of research administrators, *"to both serve and lead our researchers (faculty), while still keeping in mind our responsibilities to our institutions, sponsors, and community"* (p. 45). This hypothesised definition and goals, although not empirically tested by either Krauser (2003), or the later study by Vargas & Hanlon (2007), assumes that researchers view research administrators as troublesome, forcing the research administrators to win trust by *"serving as a resource to our researchers"* (Vargas & Hanlon, 2007). Although, Krauser (2003) did state that once trust was established, that researchers stopped viewing researcher administrators as *"troublesome"*.

The Technology Transfer Office and Research Management

A considerable amount (20/98) of the literature examined the role of the Technology Transfer Office (TTO) in a research organisations' and researchers' output production performance. Within this group of articles, a smaller group identified the personnel of these TTOs as an important variable to consider when investigating the production of research outputs. However, a number of other variables associated with the TTO were considered when investigating how characteristics of the TTO were associated with productivity, efficiency and research outcomes. These included the TTO size, TTO age, the volume of TTO activity and the degree of TTO specialisation.

From the literature analysed, an important mechanism by which it considers the role of research management is through their investigation of Technology Transfer Offices (TTO). Siegel & Wright (2007) explained how research organisations that established TTOs are keen to exploit the commercial products already embedded within their research that would perhaps not be exploited without the help of trained professionals and policies. As such, the specialisation and the professionalism of TTOs have become imperative for the success of organisational technology transfer. This is because organisations need to consider either developing or acquiring a broad range of capabilities that will allow them to commercialise a technological invention. As a response, a market for technology transfer training has emerged in which professional associations and private training providers have attempted to support the specialisation and professionalism of TTOs. The emergence of this market is reflected in how the academic literature perceives the activities of the TTO as related to the consideration of research management.

Many articles focused on technology transfer as reflective of research management. Despite the rather narrow consideration of research management as solely through technology transfer, there are important inferences that can be drawn regarding the strategies and structures considered successful by our article sample. Indeed, as suggested by Volberda et al (2012), understanding technology transfer raises questions with regard to the pool of capabilities organisations need to develop to ensure the successful commercialisation of a technological invention. This consideration is central to our research objective related to identifying strategies and structures of successful research management/administration.

Disguising the Role of Research Management

Within the literature, two levels of analysis of the role of "research management" were considered: the Direct (28%); and the Indirect (72%). For the purposes of this review, "indirect" research management is defined when the role of research management and/or the research manager, was considered as part of a larger, overarching variable such as, for example only: organisational culture, institutional support, the TTO, support services, and knowledge management. In contrast, "direct" research management was when the characteristics of research management were assessed directly and as the primary dependent variable, for example with Drummond (2003), Sousa & Hendrick (2007), and Shelley (2010).

It is interesting to note that over 60% of the articles that considered research management as a direct variable were from the Journal of Research Administration. This is not surprising as

the profession has better understanding of its own role than external actors and, possibly, more interest in exploring how best to operate. However, these studies tended to be more localised to particular experiences and not empirically tested. A majority of the research identified in this review visualised the interaction between research and non-research actors, such as industry, etc., as essentially a linear process. Hewitt-Dundas (2012) argues that the traditional conception of a linear innovation process has been adopted by the majority of the literature. This process assumes that two actors are involved in the research-industry relationship where the ability for research to be communicated to non-research actors is influenced primarily by the motivations, characteristics and values of the actors involved. The preoccupation with the linear model overshadows a more complex, multidirectional and iterative process that involves multiple actors. Although the field of research management is developing towards a perception that the process involves more than just the relationship between research and industry and research and society, unfortunately, it still overlooks the importance of research management as an independent system that determines knowledge transfer success, thereby considering the research management variable directly rather than indirectly. This continued overshadowing also overlooks the possibility that changes in research management structures and strategies can be an important avenue for research organisations wishing to push knowledge transfer outcomes in desired directions. As shown in the literature sample, very few research studies attempted to view this intermediary role directly as a physical actor or consider the characteristic motivations and values of these actors (direct). Instead, these variables are dissolved under macro-level variables (indirect) such as organisational culture, research climate, or the support structures of the university or knowledge transfer office. Therefore, this overlooks the value that research management adds to facilitate research outcomes within organisations. This conception by the innovation and research policy literature contributes to intermediary actors, such as research management personnel, remaining invisible.

Caldera & Debande (2010) consider the role of "intermediaries" to facilitate partnerships and knowledge and technology transfer. However, they fail to capture or consider the individual characteristics of these intermediaries beneath a surface-level definition of "research management". In addition, many of the studies assessing the effects of organisational and institutional attributes on research activity have focused on university-level characteristics (e.g., total research expenditures, quantity of faculty, institutional prestige) and aggregated, university-level production (e.g., of patents, Payne and Siow, 2003; Carlsson and Fridh, 2002; Coupe, 2003; Foltz et al., 2003; and of licensing agreements, Turk-Bicakci and Brint, 2005). Often these studies do not explain the effect of organisational policies or other indirect research management variables on less salient research outcomes such as grant success, publication numbers, university rankings etc. They also do not explain the impact of these policies on individual researchers and/or teams. In addition, as is discussed below, the indirect consideration of research management affects the types, and practical application, of many of the recommendations made by these articles about strategies associated with effective research management and managers.

Perhaps a reason that the explicit representation of research management has been neglected within the primarily academic literature lies in an explanation provided by Hockey & Allen-Collison (2009) where the possession of academic capital has elevated the status of the role of researchers

relative to other occupational groups within the social system. This, they argue, has allowed researchers to exclusively label themselves as central to the university mission to the detriment of other groups which are then labelled as peripheral (Kimber, 2003) and classified as "support staff". With the social system and the researchers perceiving support staff as secondarily influential to the organisational mission, there is no ability to consider their role as a direct influence. Furthermore, as research management does not always cohere into an independently distinct grouping (such as finance or human resources), it can be more complicated to separate out the activity within an organisation. Research managers' influence, therefore, is classified into descriptive, overarching and indirect variables such as "organisational climate."

Nonetheless, the analysis of the strategies and structures identified in the sample of literature described below will discuss those studies considering direct and indirect research management indirectly and directly together.

Success of Strategies and Structures Identified in the Literature

This section provides an overview of the strategies and structures presented in the literature, as well as a brief discussion regarding the relative success of these strategies, and an identification of the most frequently reoccurring strategies suggested within the literature.

Although only a few studies concentrated on the direct involvement of research administration/management professionals, a few common characteristics of successful practice did emerge. It must be noted, however, that within our sample the vast majority of these characteristics were presented as suggestions only and were not tested empirically regarding their level of success or any benefits to the organisation, researcher or professional. Indeed, the structures and strategies presented in the sample of research articles were frequently suggested by authors as potential avenues for research administration but not rigorously tested for their effectiveness. This was primarily the case for articles that were published in the practice-based journals, such as the Journal of Research Administration. On the other hand, in many cases where suggestions were based on the results of variables tested that were only indirectly related to research management, these occurred in the academic-based journals such as Research Policy, or Technovation.

One of the more popular strategies for research management explored in our sample of articles was the use of "incentives" or "rewards". The existence of incentive structures as a method to influence researchers towards desirable behaviour was described as a characteristic of entrepreneurial universities (Gjerding et al, 2006). So-described "desirable researcher behaviour" referred to management of incentive programs that rewarded engagement in knowledge transfer (Young et al, 2008), commercialisation (O'Shea et al, 2007; Derrick & Bryant, 2013), publication success (Derrick & Bryant, 2013), and knowledge sharing (Martins & Meyer, 2012). In addition, one case study included an incentive program for the activity of submitting grant applications, regardless of its success (Masen et al, 2006). The lack of properly-targeted incentive structures was identified as a major barrier to engagement (Siegel et al, 2003; Decter et al, 2007; and Guruajan & Fink, 2010). In particular, Siegel et al (2003) investigated the organisational factors associated with increased TTO productivity and found that interviewees identified the lack of rewards for TTO engagement as one of the major limiting factors to further engagement. Likewise, Decter

et al (2007) analysed the reasons for the success of TTOs in the US and the UK. As with Siegel et al (2003), the study suggested that a lack of an incentive structure in UK TTOs was a reason for their relative lack of success compared to their US counterparts. In total, 14 of our 98 studies included either a description or an analysis of an incentive structure. However, the incentive itself was not always financial, but also non-financial incentives such as special commendations (van der Weijen et al, 2008) and rewarding "individual merit" (Sa et al, 2008). Despite this, financial incentives were the more popular strategies investigated. However, the perceived benefit of financial incentives as motivators for desirable research behaviour is questioned by Martins & Meyer (2012). In this article, the variable "financial reward" was negatively associated with knowledge sharing. This questions the assumption that financial incentive policies work in all organisations as a motivational tool. Indeed, the study by Derrick & Bryant (2013) analysed a number of different incentive programs in research organisations that aimed to increase the number of publications in high impact journals, and success of commercialisation ventures. Using a mixed-methods framework, this study found that incentive programs were only successful when they aimed to reward already existing objectives of the researchers, such as high impact publishing. Conversely, success modifying behaviour and the update of incentivised programs were limited when researchers did not already consider those activities to be included in their roles (Derrick & Bryant, 2013).

Another major research administration strategy investigated was the flexibility of organisational policies governing the autonomy of researchers, and the perceived ease in which researchers can engage in desirable activities. Seyd (2000, p. 35) has portrayed how academics are typified by administrators as: *'unworldly, unreliable, incompetent at managerial and administrative tasks and never in the office when needed to deal with urgent student issues';* whilst from an academic's perspective, administrators may be viewed as *'rule-bound, bureaucratic, more concerned with process and systems than with the substance of issues and lacking in imagination'* (Seyd, 2000). Previous research has suggested that, where possible, a good research management strategy should not produce central control, or even supervision, but will combine a framework within which academics make their own decisions and a system to identify any emerging problems at an early stage. Hollingsworth (2000, 2002) and Hage (2006) have published on organisational structures that foster breakthrough research, however, the role of organisational structures on academic outputs is neglected by the literature.

Within the sample of articles, the concern of overly-restrictive bureaucracy was highlighted as a barrier. Siegel et al (2003) used a mixed-method approach which includes interviews with industry entrepreneurs, scientists and research administrators at five US research universities. One of the major barriers identified by all three groups of interviewees was restrictive university bureaucracy and the inflexibility of research administrators. This concern of overly bureaucratic university policies was echoed in McAdam et al (2005), Cole (2007), Mullen et al (2008), Bruneel et al (2010), Philbin (2010), and Edgar & Geare (2013). Indeed, Gjerding et al (2006) singled out "administrative flexibility" as a component that characterised a university as entrepreneurial. Other research articles referred to the importance of good organisational structure (Boardman, 2009) and recommended that research administration central offices, including TTOs, continue to maintain a large level of autonomy (Decter et al, 2007). In one study, the level of autonomy

was discovered to be a major determinant of research performance, as greater autonomy of research departments was found to be associated with greater research performance (Zalewska-Kurek et al, 2010). For the research projects that focused on surveying or describing the concerns of university researchers, overly cumbersome research policies or a large level of bureaucracy governed by research administration and management, were perceived as the main barriers for researchers to engage. Indeed, Teelken (2012) found that the presence of research management, and the university's increased focus on its importance, were perceived negatively by researchers. Regarding specific policies, Cole (2010) stated that "researchers need more financial support and less paperwork", while more empirical studies identified that researchers needed specific policies that provided a separate university grants approval process that was independent of the TTO (McAdam et al, 2005), linking this with Dector et al′s (2007) issue of autonomy. In addition, external firms that wish to collaborate with universities also highlighted overly cumbersome university research administration policies and procedures as a major barrier to engagement. All studies identified the issue of university bureaucracy as a limiting factor from a number of angles (researcher opinions, external firms, and research administrators themselves). Therefore, maintaining streamlined, easy to interpret university policies regarding the research process is a major recommendation of this review.

The above suggestions regarding the existence of research incentives and the streamlining of university policies, however, originated from studies that referred to the research administration and management variable indirectly. For those research articles directly referring to research administration and management, a set of more practical, micro-level strategies emerged. These included both a description of the personal qualities research administrators must possess, as well as the skills necessary for individuals to have or obtain to ensure effective research administration and management.

According to a range of the studies, there are a number of personal and professional qualities that research administrators possess. These qualities are particularly important when interacting with university researchers. Sapienza (2005) investigated the opinions of researchers about what constitutes good management. Using a combination of document analysis and interviews, it was found that researchers valued managers that were technically accomplished, but that also maintained a balance between being caring, to foster greater engagement, and being forceful, to ensure that targets were met. These personal qualities were reflected in Hockey's & Allen-Collinson's (2009) interviews of research administrators themselves, and what qualities they considered essential to be able to fulfil their responsibilities. Hockey & Allen-Collinson (2009) recommended that research administrators be "available" to researchers and "informal" in how they interacted. However Hockey & Allen-Collinson (2009) also recommended that to foster a higher level of engagement with researchers, research administrators should obtain a formalised higher degree. This element, they argued, allowed research administrators to promote a "professional image" of themselves and their role, fostering an equal partnership between themselves and university researchers. This recommendation echoes Sapienza's (2005) recommendation that researchers value managers that are "technically accomplished" and also that of Chun (2010) that recommends continued professional development for research administrators. In addition, Roberts (2006) found that the concept of certification of research

administrators a worthy recommendation to increase the professionalisation of the field. A number of the personal qualities necessary for a research administrator were also suggested. These include being "attentive and loving" which stem from the studies that describe research administrators as acting as "servant leaders" (Krauser, 2003; Vargas & Halon, 2007). In addition, Whitchurch (2004) described this as a move from a regulatory model to a more civil-service model of research administration, and Cole (2007) described it as offering research administration. However, the value of the evidence for these skills and qualities and the papers presented in the practice-based literature were relatively low.

More salient recommendations were made by studies where research managers promote shared values between researchers (Drummond, 2003), foster greater communication (Porter, 2005; Cole, 2010; Mom et al, 2012), and build a sense of community (Sirvais & Disney). Other studies focused on the success of more specialised strategies such as building contingency plans and having flexible deadlines when dealing with university researchers (Porter, 2005; Cole, 2007; Rutherford & Langley, 2007; Hockey & Allen-Collinson, 2009; Mom et al, 2012). These recommendations, however, can be interpreted as components of a wider consideration of maintaining a good working relationship with researchers. Although neither one of these more specific working-style recommendations were tested empirically there is no doubt in their validity. In particular, there is validity in the recommendations that emerge from studies of viewpoints of researchers, external companies, and even research administrators themselves. Most notably are the recommendations stemming from Cole's (2010) Delphi survey of opinions from both researchers and research administrators about the restructuring of research administration at a US university. Cole (2010) found that both researchers and research administrators believed that improved communication and collaboration between researchers and research administrators was important. In addition, both parties felt that is was important for research administrators to understand the motivations, strengths and weaknesses of research faculty in order to work more effectively towards achieving common organisational goals. Likewise, Mom et al (2012) used surveys and interviews to identify a number of essential "soft" skills for TTO-based research administrators (networking, communications, etc.), as well as to re-state the importance of "hard" skills which are primarily associated with a manager's technical competence (domain knowledge, commercial awareness). Both studies demonstrate that in different organisational settings (universities and TTOs) skills associated with promoting a workable organisational climate are an essential strategy for research management and managers.

Finally, both researchers and researcher administrators indicated guidance from research management was most useful in the financial preparation (pre-award) and management (post-award) areas of grant applications and successful grants (Mason & Learned, 2006; Cole, 2007; Kirkland, 2008; and Mullen et al, 2008). No distinction was given between the time when research managers had the most influence (pre- or post-award).

Conclusions and Recommendations for Future Research

Although the original aim of this report was to investigate the existing knowledge base regarding the strategies and structures of research management, the major finding of this study was the lack of evidence regarding successful research management. Currently, there is a strong divide between

the practice- and academic-based literature cultures. In these parallel worlds, there exists a research culture that has a strong methodological basis, but with little relevance to practice; alongside a practice culture with practical experience, but limited culture of methodologically-sound research. These findings call for future research that combines a strong empirical basis with existing practical questions. Indeed, future research should aim to empirically analyse the characteristics of successful research management, identify those strategies and structures that are deemed successful, and how this might vary between different types of research organisations. This is essential for establishing a reliable evidence-base for evidence-informed research management practices.

There is no denying that research management plays an important role in the research process. This role is becoming more pronounced and important as universities and researchers increasingly compete for limited funding, and where an organisation's prestige (even more so for universities) is linked to their performance on international league tables and in national research evaluation exercises. Performing well in these competitive environments is increasingly becoming related to the organisation's ability to successfully design, implement and alter strategies, incentive programs, etc. rather than the reputation of the research alone and its ability to achieve in traditionally academic channels. These strategies require administration by a group of fulltime, professional practitioners in research management/administration. However, the literature is unsure of how to perceive this role. In particular, it is unsure of whether the role of this professional lies as a partner, a servant or as a leader. Indeed, the majority of the literature discussed in this review prefers to comprehend the role of the research manager as a small, indirect part of a larger, overarching variable.

Despite widespread agreement about the importance of research management in the research process, there is a lack of evidence within the literature about effective research management strategies. There is some weak evidence for strategies such as incentives (both financial and non-financial) as well as evidence for the benefits associated with more streamlined, less bureaucratic university policies and practices to encourage both researchers and external bodies to engage in knowledge production activities. This lack of an empirical evidence base for effective research management strategies, combined with a lack of a firm definition for the role of the research manager, highlight the need for more targeted research in this area. In particular, there is a need for future research that encompasses the following themes.

First, there is a need for a stocktake of the characteristics of current research management teams and how they differ, if at all, between universities and other research organisations. Such research should aim to investigate the capacity of such teams, as well as the skills and knowledge base of the individual members of these teams relative to their role. This research would not only, for the first time, describe the characteristics of a research management role and that of research management teams, but also work towards understanding what components of research management teams, relative to the type of organisation, are more efficient. This research could also work towards understanding how research management differs from other, more general management roles, in line with Atkinson's et al (2007) description of research management as a stand-alone profession.

Second, in line with the finding of this review that there is weak evidence for the success of incentives as a research management strategy, further research should concentrate on expanding this evidence base. In particular, there is a need for an empirical understanding of the nature

of incentives (financial and various non-financial incentives) that are successful in rewarding or encouraging certain research behaviours. This research should start with a broad scale description of the various incentives currently offered by a random sample of universities and/or research organisations, and characterise them according to what behaviour they aim to reward or encourage (i.e. publishing, grant success and industry engagement). Further, once this has been characterised, their success can be measured by indexing the incentive against the type of activity it aims to encourage. For example, such as was attempted by Derrick & Bryant (2013), the success of incentives for publishing can be measured against an organisation's members' publishing activity in order to measure its effectiveness. Indeed, this type of empirical investigation should also aim to investigate what types of incentives are most successful and, for financial incentives, at what level the incentive is most effective and at what level do incentives fail to incentivise the desired behaviour. In addition, the literature appears to suggest that 'incentives' (particularly financial) as a management strategy have tended to be applied to technology transfer type activity, as opposed to purely research activity. It could be questioned whether taking this strategy from commercialisation to research activity will motivate the desired research behaviour. A recent study (Nickson, 2014) highlights the particular nature of research 'work', and that it does not fit the assumptions upon which strategies, such as financial incentives, are based. Such incentive structures should be based on an evidenced understanding of the nature of the work, and the individuals who undertake it.

Finally, as one of the major barriers identified in this review was overly bureaucratic university and research organisation policies and practices, a similar understanding of the nature of existing policies and practices is required to identify those that are the most effective. Such research would, of course, take into account confounding variables such as the strategic implementation gap, and focus not only on a description of the policy, but also investigate how, and if, this policy is implemented on the ground level. For example, the recent study by Nickson (2014) found that academic autonomy and control was vital to individuals' motivation and work achievement. However, where university policies were found to be supportive of academic autonomy and control, a strategic implementation gap meant that such policies did not translate into successful management practices 'on the ground'. Therefore, the issue is not only about having appropriate policies and strategies in place, but ensuring that they are effectively implemented. Future research should, therefore, investigate how university policies and practices manifest themselves within the research management team, and how their operationalisation impacts researchers. This research should combine an understanding of the nature of the research management team, described above, with a firm understanding of how top-level management policies are implemented within and by individuals on these research management teams.

The above suggestions are made in line with the findings of this review. It is hoped that by addressing the concerns highlighted in this review that the field of research management will work towards establishing a firm, research-informed evidence base for successful and efficient research management strategies.

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