

The changing scholarly information landscape: Reinventing information services to increase research impact

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Abstract

In an increasingly competitive global knowledge economy the role of the university in a nation's innovation agenda has taken on greater prominence. Innovation through knowledge creation and application is seen to be the driver of long term national economic and social prosperity. With this recognition comes a growing interest by government in quality assuring and measuring the value of their universities. University league tables have become an accepted part of this landscape, as nations seek to position themselves in a globally competitive environment. A university's research impact - the extent to which its research informs further research and practice - is a significant component of the innovation system, and of the league table measures. Citation impact is often used as a proxy for research impact, though it only tells part of the story. Against this backdrop the research lifecycle is being transformed by information and communication technologies, fundamentally changing the scholarly information and communication landscape. What once appeared to be a linear process, from research through to publication, has become more complex, more collaborative, challenging the boundaries between disciplines, organisations, nations [1]. Emerging opportunities to leverage research data to increase research impact have yet to be realised. Universities, as long lived institutions, must balance short term utilitarian demands driven by national innovation agendas and league table positioning, with their fundamental mission of knowledge creation, synthesis, transmission and preservation. This is a mission that aligns strongly with the traditional place of the library in providing access to scholarship for current and future generation for all who wish to learn, a role that has been challenged by apparently ubiquitous access to digital content. The complexity of the current environment offers new opportunities for a university's information service providers to further the

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university, and the nation's aspirations – both short and long term. Information service providers are ideally positioned to navigate the complexity of the scholarly information landscape to achieve university imperatives within a national context, through collaboration within and across organisational boundaries; to achieve short term imperatives whilst staying true to the long term mission of universities in knowledge creation, dissemination and preservation for future generations of scholars and practitioners. Griffith University, a research intensive, innovative university situated within the south east corner of Queensland, Australia enjoys the benefit of an integrated information services division. Information Services brings together library, information and IT professionals to provide the information leadership, services, systems and infrastructure which underpin the University's research, learning, teaching and administrative activity. Over the last twelve months the division has built on its strengths to re-shape its services to tightly align them with University's aspirations. A significant part of this re-shaping has been the implementation of new service models, new services and systems, and strengthened partnerships, to increase the University's research impact. This initiative has been welcomed by the academy. More complex measures will be required to indicate the success of this initiative over time.

Keywords: research impact; university information services;

1. Introduction

In an increasingly competitive global knowledge economy nations are looking to their universities to drive the economy and prosperity. University leagues tables seem to now be a permanent part of the higher education landscape. A university's research impact - its impact on future research and practice - is a key driver of national innovation and a core component of the leagues tables. We are seeing profound change in the scholarly information and communication lifecycle as technology facilitates new ways of researching, communicating, collaborating, and sharing scholarly outcomes. It is still unclear how this will evolve as conventional policies and practices are challenged by the opportunities offered through technological innovation. Taken collectively these trends have a profound impact on the way in which a university can, or should, seek to increase its research impact.

This paper explores these issues, concluding by showing how one Australian university is seeking to increase research impact through the role played by its information services. It begins by outlining Australia's national

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innovation agenda as it relates to universities, the research quality agenda and then explores how the scholarly information and communication landscape is changing. These observations are framed within the context of broader international trends. The concept of research impact is explored, a concept which is used differently by different stakeholders. It concludes with an exploration of how a university's information services can serve to increase research impact, using Griffith University as a case study.

2. Universities and the innovation agenda

"Over the last decade or so there has been firmly established among governments around the world the view that high quality, internationally competitive research and higher education, mostly contained within universities, are prerequisites for long-term success in globalised knowledge economies." [2]

The generic social and economic benefits of universities – through educating the population and generating knowledge - have long been recognised as an important source of industrial innovation [3]. More recently, in a world where knowledge and its application is seen as the key to global competitiveness, the world's developed and developing nations have renewed their focus on knowledge innovation as a driver of national prosperity, advocating a central role for universities [4]. Australia is no exception, following in the path that the UK and others have already travelled, though from a perspective relevant to the national context [5].

A logical consequence of governments' viewing universities as sources of highly specific benefits, as drivers of innovation and national prosperity, is a tendency to then regulate and stimulate to drive specific behaviours, and a consequent desire to measure the success of these policy drivers. The significant government investment in research infrastructure over the past decade, in e-science and cyber-infrastructure across North America, Europe and Australia; has been to stimulate national performance and competitiveness [6] - whilst the obsession with university research quality assessment and rankings is a consequence of the desire to measure performance (and often to provide a regulatory measure through performance driven funding).

The Australian Minister for Innovation, Industry, Science and Research commissioned a review of the national innovation system in 2008 [7] leading to publication of a Government innovation strategy in 2009 [8]. The review examined the way in which Australia's national innovation system was

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positioned in a globally competitive Internet-enabled world. Whilst Australia is small and geographically remote, with less than 1% of the global economy, we manage to produce 2% of the world's scientific literature [9]. Australia has more Nobel prize winners per capita than any other nation [10]. Yet a range of indicators showed that we had slowed in terms of productivity growth, despite an enviable record. The review raised concern that investment levels in research in Australian universities was low as compared to the OECD. The scope of the review was broad ranging – looking at the three highly interdependent aspects of a national innovation system: the development of new knowledge and ideas, the deployment of those ideas in a real world context and the diffusion and adoption of applied knowledge. The important contributions made by the social sciences and humanities to the health and prosperity of the nation were acknowledged- the review wasn't purely science and technology focused.

The breadth of the review meant that universities featured prominently – being seen as the repositories of existing knowledge and the hub for generation and exchange of new knowledge [11]. There was recognition that our understanding of innovation had changed – what is being referred to as the concept of 'open innovation' [12]. Innovation increasingly relies on distributed inter-organisational networks rather than innovation within an organisation. Universities form part of multi-faceted social or information channels or mechanisms through which information, knowledge and other resources are shared or co-produced- a much richer picture of university engagement than that of the traditional university concept of knowledge transfer [13]. The critical value of the nation's information infrastructure to the national innovation system was therefore central: from high speed networks and collaboration tools, through to the value of unlocking public information and content, the importance of the national collections held by libraries, museums and other agencies. Specifically the review acknowledged the need for a high level of interaction between knowledge providers and knowledge users – particularly given that productivity growth in Australia will require the capability to adopt and adapt the 98 percent of new knowledge which is generated by the rest of the world [14].

The subsequent national strategy: Powering Ideas adopts many of the review's recommendations. More than A\$3.1 billion in funding is to be made available through the strategy. Of particular relevance to this paper are that over the next four years, there will be more than doubling of funding for the indirect costs of research, a A\$1.1 billion investment in science infrastructure with A\$312 targeted at e-research infrastructure funding. This includes A\$97 million for data storage and collaboration tools through the Australian Research Collaboration Service (ARCS), A\$48 million to establish a national

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research data commons through the Australian National Data Service (ANDS) A\$48 million, A\$37 million to enhance the Australian Research Network, A\$130 for national high performance computing initiatives and A\$37 million for enhancement to the Australian research and education network [15].

Geoffrey Boulton and George Lucas critically examine the role of universities, questioning the current obsession of governments with universities as drivers of innovation [16]. They clearly articulate why, in a world of globalisation, universities are crucial national assets: “they research into the most theoretical and intractable uncertainties of knowledge yet also seek the practical application of discovery; they test, reinvigorate and carry forward the inherited knowledge of earlier generations; they seek to establish sound principles of reasoning and action which they teach to generations of students” [17]. They regard a national innovation system as ecology, a set of systems, premising that the way in which universities contribute to innovation varies according to the regional economy, the business sector involved and the nature of the university. The definition of the utility of universities is often too narrowly drawn from their perspective - the useful knowledge and skills generated by universities are a derivative of a much deeper capability than that of driving innovation. “It is a capability deeply embedded in the fundamental role that universities have in creating new knowledge and transmitting it to successive generations together with the knowledge which has been accumulated by predecessors and which in each generation is subjected to renewed tests of verification.” [18]. Their paper is a plea for the autonomy and freedom of universities to “do what they do best”, without oppressive mechanisms which seek to drive short term utility. It is the flexibility and adaptability of universities which enables them to stay true to their core mission in pursuing and explaining knowledge whilst being sensitive to the needs of the contemporary world. Courant, when considering the impact of disruptive technologies on universities, would concur, proposing that universities be both conservative and revolutionary: conservative in terms of mission and revolutionary in the way in which they attain their mission [19].

3. Defining research impact

Together with the stimulation strategy there is the consequent regulation strategy. Governments seek to measure the quality of their universities and the contribution they make to the nation’s prosperity. The impact of a university’s research is a significant element of a university’s contribution.

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They wish to maximise the economic and social returns from any public investment in research. Within Australia the federal government is in the midst of rolling out a national research evaluation framework, the Excellence in Research for Australia, to measure research quality against international benchmarks [20]. This is in keeping with overseas initiatives such as those in the UK [21]. The measures will be used to inform funding decisions based upon performance, though the detail of how this will be done is not yet known [22].

The obsessive interest in university league tables is similarly a symbol of the international interest in measuring university quality and impact. International league tables, such as the Shanghai Jiao Tong and Times, are now a permanent and significant feature of the higher education landscape. In a much more competitive global knowledge economy, with a more mobile, and valuable, international student market, universities are competing to attract the best students, the best teachers and researchers and the best grants. Global rankings of universities are a familiar and increasingly visible part of the higher education landscape, as universities compete to promote their value, status and attractiveness.

Within Australia the Research Quality Framework (RQF) was introduced in 2005 to follow in the footsteps of other nation's research quality frameworks [23]. The RQF differed from existing international research assessment exercises in that it sought to measure 'research impact'. 'Research impact' was defined as "the beneficial application of research to achieve social, economic, environmental and/or cultural outcomes." [24]. Measures of impact included analyses of patents, cost-benefit assessments, social returns and citations [25]. In its infancy the RQF was replaced by the Excellence in Research for Australia (ERA) initiative, which no longer seeks to measure research impact in the same way, instead examining more quantifiable measures of citation impact and esteem.

Whilst the broader definition of research impact measurement has been dropped in the ERA process, the concept is still part of the national landscape in Australia. One aspect of the Australian national innovation system and research landscape are the Cooperative Research Centres (CRCs) [26]. They are funded by the Australian government to build critical mass in specific research ventures which link universities and industry. The government commissioned Deloitte to develop a framework to evaluate the performance of CRCs [27]. The framework was to help CRCs assess their outcomes through examining the impact chain from inputs, through to activity, outputs, usage and impact. They note that quantifying the final impact of research is necessarily the most uncertain of the stages [28]. Impact types may include

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productivity gains, industry development, environmental, health and social benefits which are not easy to quantify and which are highly contingent in nature. This broad definition of research impact plays to the role of universities in achieving the national innovation agenda in its most complete sense.

In a knowledge economy it is the generation and exploitation of knowledge that plays the predominant part in the creation of wealth. Scholarly publishing plays a key role in the effective dissemination and diffusion of knowledge and research findings [29] and conventional publishing is still the main form of research dissemination [30]. It is therefore not surprising that the more complex, difficult to measure, yet valuable, definition of research impact as outlined above is often abbreviated to a measure of publishing quality as measured through journal ranking and citation impact [31]. Butler reasons that research quality is best judged by peers. Peer reviewed prestige publication is still the route to academic success [32]. A stellar publication record and citation impact is integral to promotion and tenure. Hence the importance of a published research paper as judged by academic peers through journal quality and citation has become an agreed quantitative measure of research quality [33] and of research impact. Missing from these measures is the evidence that the research has had a positive economic or social impact.

4. The changing scholarly communication landscape

The mission of a university's library is intertwined with that of the university – making the world's knowledge accessible to current and future scholars [34]. Libraries have traditionally seen their role as providing free access to the world's scholarship. "This freedom gave us something real. It gave us freedom to research, regardless of our wealth; the freedom to read, widely and technically, beyond our means. It was a way to ensure that all of our culture was available and readable" [35]. This role is now challenged by a scholarly information and communication landscape which has changed profoundly and irrevocably.

The scholarly information lifecycle is transforming as advances in information and communication technologies enable new ways to create, contribute to, access and use scholarly outputs of all types. The creation of a university's scholarly output, whether published works, research data, working papers, teaching materials or multimedia of a variety of kinds, is increasingly digital. Scholarly books are published in digital form with some

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predicting that virtually all new scholarly titles will be digital within 10 years [36]. More than 30% of Amazon's titles are now sold in digital form [37]. Scholarly information is published by individuals, institutions and large corporations and delivered via a multitude of business models which continue to evolve and change in unpredictable ways.

"The environment in which research is being conducted and disseminated is undergoing profound change, with new technologies offering new opportunities, changing research practices demanding new capabilities, and increased focus on research performance." [38]. As Borgman notes [39], every stage in the research lifecycle can be facilitated, or complicated by technology. Research practice is radically changing as large-scale, distributed, collaboration in research projects is facilitated through the capacity of digital technologies, enabling the study of complex problems across organisational and national boundaries [40]. Collaboration in the social sciences and humanities is increasing as rich data sets and previously difficult to access texts and objects are made accessible through digitisation. Just as new content is being created digitally, large collections of printed text and other objects are being made accessible globally and freely. Scholarly output now includes not only the published works but the research data, tools and techniques associated with the research. Existing research data can be re-mined and re-used, research algorithms, tools and techniques can be easily shared, large data sets can be visualised to render complex findings in useable ways.

An unknown amount of this research data will have value for the future as an important part of scholarly output. A recent Intersect study of four New South Wales universities found that more than 87% of researchers' collect or create research data, more than 50% said their data was almost all digital and a further 23% said it was more than 60% digital [41]. Almost half the respondents allowed access to the data from outside their research team. Fewer than half the respondents believed they faced data management or preservation issues and 20% weren't sure. Yet with appropriate stewardship research data has the potential to significantly increase research impact.

Australia has been well served by the Australian Partnership for Sustainable Repositories (APSR) [42], the agency that has led national thinking on the research data issue. In 2006 APSR released a report on Australian e-research sustainability. The report explores the issues surrounding research data stewardship, the incentives and disincentives for appropriate stewardship of research data. There were clusters of issues, some of which are now being actively addressed at a national level. The report suggests that from a policy perspective the research funding bodies lack guidelines for clear administrative responsibility for data stewardship, yet there is interest in maximising research outcomes from the public dollar. It

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was not difficult, therefore, to convince funding agencies to encourage more open access to research data. The policy framework has now been changed with the responsibility for research data access clearly resting with the university as a long lived institution. This mirrors international trends. Though whilst agencies require data management plans and deposit, enforcement is often inconsistent [43]. Policy is necessary, but not sufficient, requiring the addition of “carrots and sticks” if behaviour is to change.

The APSR report also found that there are strong disincentives for researchers to engage with long-term data management. They are funded to do the research, research groups come and go, there is no funding for stewardship, no rewards or recognition. Good research data stewardship will not, at least in the immediate future, impact on their ranking in ERA, nor in league table positioning. The universities themselves are one of the enduring features of the research landscape and hence arguably a logical home for long term commitment to data stewardship. But the report notes that whilst universities want an environment that maximises research outcomes, this is currently established by publishing and citation metrics – it is not in the university’s interest to follow policy prescriptions if there are no rewards and/or penalties [44]. One of the policy problems with data curation and preservation is that the costs persist long after the project ends [45]. Researchers may generate very long-lived and substantial financial responsibilities for the institution.

Universities have invested significant sums of money in building and sustaining library collections for future generations of scholars. They have done so based on a belief that the library plays a key role in supporting their research and learning through preserving and making accessible scholarly output- though arguably this is currently under challenge. Borgman notes that whilst libraries are a logical steward for research data management, libraries are no better placed to take on an unfunded mandate [46]. Lynch also notes that ‘With data storage services, campus cyberinfrastructure design and deployment begins to interconnect with fundamental campus policies and culture about the stewardship responsibilities of scholars, about contracts and grants compliance issues, and about risk management’ [47].

APSR also found that there was no systemic sustainable infrastructure available to broadly support research data management. It is in this area that we have seen significant national investment since the report, as noted in the earlier section of this paper. Australia has made a significant financial commitment to development of a national research data fabric, data storage, high performance computing and networks.

5. New challenges and opportunities

Swan [48] questions whether we would invent our present system of scholarly communication in our current context and decides not. If scholarly communication is to aid the progress of science, then, arguably, some of our current mechanisms act as barriers. Swan persuasively argues the case for open access, showing that it increases citation impact, shortens the research lifecycle, advances science by enabling use of new technologies to mine and manage science and opens the way for greater collaboration across discipline and geographic boundaries. Similarly Houghton and Sheehan [49] have sought to examine the economic benefit offered through increased access to research findings, afforded by new models of scholarly communication. They explore different publication models, examining their potential for greater research impact (as measured by citation). They analyse the literature and quantify the potentially measurable impacts of enhanced access to research findings, for researchers, government and the wider community, including:

- more timely access to both accelerate and widen opportunities for more timely, collaborative research, and for adoption and commercialisation
- greater access leading to improved learning outcomes, a greater opportunity to inform professional practice, improve the capabilities of practitioners, future researchers and research users
- the potential to create more informed citizens and consumers with implications for better use of health care, social benefits and education, and potentially improved productivity.

Their modelling shows significant economic benefit from open access to publicly funded research, with, for example, a 5% increase in access and efficiency in Germany worth USD 3 billion. This work was extended through a further study commissioned by JISC [50] to examine the economic implications of alternative scholarly publishing models. This paper posits that if the aim is to have the most cost-effective scholarly publishing system, then both costs and benefits must be quantified. All costs and benefits associated with the scholarly communication lifecycle are modelled in an attempt to understand the increasingly complex scholarly publishing landscape. They demonstrate that research and research communication are major activities with substantial costs and conclude that a preliminary analysis of the potential benefits of more open access to research findings suggest that the returns to research can be substantial. Different models for scholarly publishing can make material differences to the returns realised and the costs

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faced. Whilst the paper refers to the UK context (which produces 10% of the world's scientific papers [51]), the importance of promoting greater use of open access on an international scale is even more relevant to Australia if it means that the 98% of the world's scholarly output produced elsewhere will be more accessible.

A range of recommendations are made to overcome the barriers and realise the benefits of more open access publishing. Among these are to ensure that research evaluation is not a barrier to moving toward more cost-effective scholarly publishing models and that incentive and reward systems are aligned. Arguably these barriers still exist.

In a highly competitive and complex environment a scholar's competitiveness is still judged by the quality of their publication and citation record. Whilst the scholarly communication and dissemination landscape is changing dramatically, it is within the context of relatively conservative value and reward system for scholars, a system which has the practice of peer review at their core [52]. A recent study by the Center for Studies in Higher Education [53] found that from a researcher's perspective one of the greatest challenges for disseminating research is choosing where to publish. Scholars are concerned with the stature and selectivity of the publication outlet but also its appropriateness for the target audience. The study suggest that the primary motivation of a scholar is to choose an outlet that will have the highest visibility with the specific audience they want to reach, even if that audience is small, preferring a prestigious commercial publisher over an open access publication without a prestigious imprimatur. Interestingly a recent article on marketing publishing in Australia questions whether, in fact, scholars are publishing for other scholars at the expense of improving professional practise [54]. The CSHE study found, perhaps unsurprisingly, that young scholars were particularly conservative in their research dissemination behaviour whereas established scholars could afford to be more innovative [55]. Scholars remain under pressure to publish in high impact journals, many of which are still subscription access only, finding older business models profitable in an environment where national research quality schemes can serve to reinforce their market position.

Within ERA the concept of research impact is judged through citation impact and esteem measures. In calculating these measures the Australian Research Council has worked with the academic community to rank journals, including Australian titles, based on their assessment of quality. These rankings will inform the way in which publication quality is judged. This has been a highly contentious, and arguably flawed, process [56]. Butler is concerned that impact, as measured through publication quality and citations,

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is becoming the proxy for research quality in total, rather than only one aspect. She also expresses concern that a system which impacts on prestige and/or funding (which ERA will do on both counts) will affect the behaviour of researchers and administrators. There is a risk of goal displacement, where increasing the measure becomes the imperative. Within the context of ERA, where the scholarly community has ranked journals for the purposes of measuring research impact, it is already clear that there is now an unspoken imperative to seek to publish almost exclusively in journals ranked A and A* in order to drive ERA quality outcomes.

Arguably we are at risk of reducing our ability to achieve the more aspirational notion of research impact, of contributing to national innovation, as universities, faculties and/or individual researchers seek to maximise ERA outcomes at the expense of getting their research into the best place to maximise its real social and economic impact.

6. Reinventing the role of information services

The changing scholarly communication landscape increases the potential to increase research impact, and also increases the complexity. The once apparently linear process of research, communication and application of the results has become more much complex. Advances in information and communication technologies are disrupting the traditional models of publishing [57].

At all stages of the research lifecycle there are opportunities for information services providers to enhance their university's research impact.

6.1 Information access

Studies have shown that increasingly researchers use Google for everything, that they are confident they can manage their information seeking, though many are less certain that they are managing their research data well [58]. Haglund [59], in a study of young university researchers at three universities in Sweden, found that Google was the first choice of information seeking, search methodologies were haphazard at best, yet researchers feel they are competent information searchers. Convenience was important – if an item wasn't "one click away" they didn't bother seeking it, and they were receptive to new technologies such as PDAs.

6.2 Becoming part of the research endeavour

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Personal networks were important to researchers and collaboration was widespread yet they appeared to have no working relationship with the library. They rarely went to the library and did not see how the Library could assist them with instruction or IT support. Haglund proposes that the paradigm shift, wrought through the Internet, digital publishing and reinvention of libraries as the “living room” for undergraduates, has served to make libraries and librarians more removed from the world of the researchers.

6.3 Research data services, generic and tailored

In assessing the future of the scholarly communication landscape the recent Center for Studies in Higher Education study [60] found that support structures and organisations available for the preservation and storage of a researcher’s own data are uneven at best, with most institutions approaching the issue in a piecemeal manner. They found five key areas that need immediate attention:

- More nuanced tenure and promotion practices that did not rely exclusively on publication and ‘easily gamed’ citation metrics
- A re-examination of peer review – meaning, timing, mechanisms, locus
- Competitive high quality affordable publishing platforms
- New models of publication with institutional assistance to manage copyright
- Support for managing and preserving new research methods and products- GIS, visualisation, complex distributed databases etc.

The study found that the scope of support needs by the different disciplines was starkly different, with scientists wanting bigger ‘pipes’, new ways to store, manage, process and visualise large data sets and mechanisms to support ‘grand challenge’ research. Social scientists and humanists needs were more modest though they included interest in integrated complex data mining, computational analysis and visualisation. Arguably the differences are of scope rather than of substance. All disciplines identified the problem of data storage and preservation (the authors noted that it appears that the EU had prioritised this ahead of the US) [61].

The need for specialist support, particularly IT support, was prevalent though the preference was for technology-savvy scholars who work in collaboration rather than a model of “academic computing services” who are unaware of the scholarly questions and methodologies that drive a discipline. In many cases the library was seen as the locus of support for archiving, curation and dissemination of scholarly output. They conclude by noting that

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“although robust infrastructure are needed locally and beyond, the sheer diversity of scholars’ needs across the disciplines and the rapid evolution of the technologies themselves means that one-size-fits-all solutions will almost always fall short. As faculty continue to innovate and pursue new avenues in their research, both the technical and human infrastructure will have to evolve with the ever-shifting needs of scholars. This infrastructure will, by necessity, be built within the context of disciplinary conventions, reward systems, and the practice of peer review, all of which undergird the growth and evolution of superlative academic endeavours.” [62]

6.4 Clear leadership in research information services, internally and externally, with strong collaborative links

Within the Australian context the Intersect study [63] found that the vast majority of researchers had not heard of any of the major national bodies involved in developing and providing research information infrastructure services. When asked what support they most needed, scholars identified data management, expertise in data analysis, collaboration platforms, data management and storage, access to research software and the need for more IT personal.

APSR found that “the immediate critical issue for the stewardship of research data in Australia is the lack of administrative responsibility for the task” [64]. The report noted that “There are boundaries between research groups, data providers, repositories and data centres. These boundaries lead to duplication or capability gaps. It is important to identify responsibilities and opportunities across these groups where possible. Data management requires greater cooperation between the players” [65]. No administrative group has responsibility for research data sustainability – to create and manage policies, understand cost benefit, accept funding and harvest the benefits.

6.5 Publishing and curation

The Center for Studies in Higher Education study found that from a researcher’s perspective one of the greatest challenges for disseminating research is choosing where to publish. One response to this challenge has been that of the University of New South Wales. It introduced RIMS, the research impact measurement service, in 2005 to realign its services to support the university’s goals [66]. Recognising the increasingly competitive nature of the research environment and a renewed emphasis by the University on research outcomes the Library provided a new bibliometric service providing comparative publication and citation data to schools and faculties. Knowledge

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gained through this process informed collection development, training opportunities for the academy on higher-impact publishing.

A 2010 study [67] showed that scholars across a broad range of disciplines had a growing interest in electronic publication and that scholars embraced the potential of linking final publications directly to data sets and/or primary sources material. Though most of those interviewed believed they didn't have access to easy-to-use tools or to the expertise required. Publishing is seen as an emerging role for libraries as it becomes easier to implement e-press services. Hahn [68] found that in most cases libraries were assisting scholars to move existing journals into the digital world or into open access publishing; in some cases they were publishing new titles. The overlap of expertise and demands of publishing with the knowledge and skills required by libraries made it a natural progression.

It is against this backdrop that scholarly information services providers within the university context: libraries, information and communication technology units, must position themselves as valued partners in the scholarly and research endeavours of their universities. Lynch [69] questions how the cyber-infrastructure challenge differs for universities as compared with the national challenge. He believes there is a strong obligation and mandate for base level of universal service across all campuses: all researchers need to be able to apply IT in their research, to access and build on cyber-infrastructure services including data management, data curation, to get help in learning how to use the services, particularly those without specialist IT support. He notes that the campus perspective is concerned with the 'average' rather than the 'extreme' scholar. "One of the key challenges - politically, financially, and technically - is defining the demarcation between free universal service and the more specialized package of support services offered to extreme users, a package that may be predicated on such users' ability to obtain funds or other resource allocations" [70.] His recommendation - that campuses create a support organisation that can reach out to scholars early in the data lifecycle to assist with data management and curation/preservation strategies, involving IT professionals, librarians and archivists and maintaining a close relationship with the research and grants office and that perhaps the Library take responsibility for the long term curation of the data at an appropriate point in the lifecycle.

Borgman [71] suggest that data may become the new 'special collections' for libraries. Noting that strategies for data curation will require involvement from academics, the campus research office, the library and instructional and information technology services.

7. A case study

Griffith University is a university of some 38,000 students from 124 countries studying at undergraduate through to doctoral level in one of four broad academic groups: arts, education and law; business; science, engineering, environment and technology; and health. Griffith is a large multi-campus institution spanning Australia's fastest growing corridor from Brisbane to the Gold Coast in Queensland. Griffith's strategic research investment strategy positions it to be a world leader in the fields of Asian politics, trade and development; climate change adaptation; criminology; drug discovery and infectious disease; health; sustainable tourism; water science; music and the creative arts.

Griffith is regarded as one of Australia's most innovative tertiary institutions and one of the most influential universities in the Asia-Pacific region. This innovation is carried through into the provision of information services, with e-learning, e-research, library, information and communication technology services, systems and infrastructure offered through a single integrated division, Information Services. This provides a distinct advantage to the University in an increasingly complex scholarly information and communication environment.

In response to the University's strategic intent to build its research impact, informed by the rapid changes to the scholarly information landscape and the increased competitive nature of research measurement, Information Services created a unique service portfolio, Scholarly Information and Research (SIR), to provide an integrated end-to-end service, offering support to researchers at all stages of the research cycle. Information services already had established relationships with the academic community, with academic librarians working closely with disciplines where the library is their "research laboratory" and research computing services well connected to specific researchers and research groups. Research computing services initially focused on the provision of high performance computing services and specialist software development. More recently much of their work had involved not only development of research portals and research analysis tools but assistance with research data management. This particular service has grown through fee for service work, often with work undertaken under service level agreement, enabling us to recruit discipline specific specialists. We also had a thriving digital repositories team which had built a strong working relationship with the office of research, working under service level agreement to collect the data for all university publications for input into the

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research quality assessment and funding process. Our academic librarians, whilst providing traditional library research support services, felt they could be doing more to support the University's research mission. Across the division there was also a sense that no single Director provided leadership in support the University's research endeavours within Information Services. The creation SIR in 2009 brought together our academic librarians, digital repositories, acquisitions, cataloguing and metadata services and research computing under a single leader, providing the catalyst for a renewed focus on research. Our aim was to focus on driving the University's core research mission through service innovation and collaboration.

7.1 Information access

We are currently seeking more creative ways to expand access to scholarly content by adopting different purchasing models, fine tuning our selection processes to acquire relevant content and by moving to an e-preferred format. A new library system will go live mid-year, increasing discoverability of our collections. Through our involvement in relevant state and national bodies we will continue to be strong advocates for improved access to content of relevance to our scholars.

7.2 Becoming part of the research endeavour

In 2005 I noted that "we must bring our know-how forward and actively engage in strengthening our partnerships with each other [library, information and IT professionals] and with the researchers within our own institutions if we are to continue to be a relevant and important part of the research endeavours of our institutions." [72]. At Griffith we have created contact librarian roles as part of the new portfolio. Their role is to build and maintain relationships with the academic community, referring them to specialist librarians and IT professionals as required. They are required to develop a clear understanding of the academics' requirements, ensuring we deliver services to meet academic needs and expectations and that we continue to evolve services over time to meet changing requirements.

All universities were awarded funding (scaled according to publication record) to contribute to the Australia Research Data Commons, an initiative sponsored by the Australia National Data Service. The funding is to be used to describe research data collections produced by, or relevant to, Australian researchers, with the view of making research data more widely accessible. We used this opportunity to strengthen and build new relationships with the academy through the contact librarians. They have been progressively visiting every active researcher with a current national research grant, seeking

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their assistance in identifying and describing any research data associated with Griffith research projects. Whilst ostensibly their visit is to elicit the data required to meet the criteria set by the Australia Research Data Commons project, they are using the opportunity to explore a broader range of questions to better position our services to meet the researcher's needs. Their questioning is free flowing, as the librarian seeks to understand the researcher's environment, their research practices, how they currently use our services and to suggest some services we could provide to gain their level of interest in these. This process will be complete in the coming months, at which time the remainder of the academy will be interviewed. The results will be invaluable in shaping our services to meet University requirements.

The contact librarians will remain an important part of our new strategy as we seek to build stronger relationships with the academy. Whilst academic librarians have traditionally been invited to academic boards, this role is now strengthened as they are able to represent the broad base of services we provide to support the University's research endeavour.

7.3 Research data services, generic and tailored

We already have a good working model for tailoring services to specific researchers or research group. The challenge now is to extend this service, building a baseline of service for all researchers whilst still meet specific research groups or researcher needs. We are seeking to learn from our understanding of particular needs to build baseline university-wide services and infrastructure. Planned increases in federal research infrastructure funding to universities over the coming years provide an opportunity to raise policy and funding questions at a University level. A paper on the development of a University research data management service will be an early candidate for discussion.

From the work of the contact librarians we will know the types of research data our academics produce, the kinds of storage practices used for maintaining research data, how the research data is managed, what access permissions are in place or are required any legal requirements in respect to the data. This information will be used to develop a repository of metadata about the University's research data as part of the national data commons.

We are also working in collaboration with a partner university on another federally funded project to build tools to harvest metadata from commonly used institutional repositories to populate the national data commons.

Planning is underway for the development of a university research data management service. We plan to provide a baseline of service for all academics - a service which leverages national data storage services whilst

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providing complimentary local services - from policy, management and technical advice through to provision of infrastructure.

7.4 Clear leadership in research information services, internally and externally, with strong collaboration

Under the leadership of their Director, Scholarly Information and Research, information services staff: librarians, business analysts, information architects, programmers, advanced computing specialists; are developing into contemporary information workers, strengthening their capabilities in the areas of content, technology and the disciplines to build support services to allow the researchers to thrive in this demanding, competitive and rapidly changing environment. The gaps and overlaps that might occur with distributed units can be managed internally- a full information service offering can be provided akin to that proposed by Lynch [73]. The University has welcomed the clarity of leadership around research from an Information Services perspective. Building on the existing strong relationship with the Office for Research, and building strong relationships with other University research leaders, is much simpler. Library and IT domains can be represented by a single role – it leverages relationships which each professional group already had, drawing on different strengths and different expertise. The division now has a seat on the University's main research committee – something that can be more difficult for a library or IT unit alone. Many of the potential gaps and overlaps in supporting research are internalised within a single organisational unit, allowing them to be managed, whilst also making it easier to collaborate at a university level as fewer units must work together.

Another significant benefit is the ability to better manage the complexity, and leverage potential benefits, of the national and regional research information environment to get the best outcome for the University. Having a single division as the relationship manager on the University's behalf makes it easier to build to develop stronger and mutually beneficial relationships with the state and federal bodies. It removes some of the complexity for the external agency when dealing with the University and the complexity for our academics who no longer need to navigate through a complex environment.

7.5 Publishing and curation

The academic community is increasingly time poor, with heavy teaching loads, reduced administrative support and increasing pressure to generate high quality research. Research success is increasingly ranked by complex measures created from within this rapidly changing scholarly information landscape, evolving into a new discipline of research management and

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measurement. The new environment rewards researchers who profile themselves and their work most effectively. We are building an integrated service offering to facilitate effective research information management across the institution with the specific goal of building the University's research impact, balancing short term utility requirements with the long term requirement to preserve the work of our scholars for future generations.

We are well positioned to assist researchers with their publishing decisions, providing journal trend data and potentially high citing alternatives to traditional publishing. It is increasingly necessary for researchers to consider a large range of factors when disseminating their research outputs to ensure that their work gains the highest possible impact. To assist them with this we are providing seminars, workshops and/or presentations to support researchers to manage their research for maximum impact. This can include information on changing journal trends, publishing choices, impact factors, research management, discoverability, research data management, profile management and any legislative requirements for reporting research outputs. Bibliometric analysis will be used to identify researcher performance and to inform researchers of their personal, school, group or institutional publishing impact.

To complement our strong institutional repository which enables all academics to deposit an open access copy of their work to increase accessibility and discoverability, an ePress service has been established. This will further extend the reach and impact of the University's research. The ePress provides a range of tools to manage author submissions through to managing peer-review and publication. It supports audio, video and image capabilities as well as text, enabling opportunities for deeper engagement with journal content and the potential to link research data to published output. Journals published by the Griffith ePress are harvested by major search engines, indices and citation services which will increase discovery and dissemination of Griffith research.

Assistance can be given to ensure Griffith researchers grow their profile to attract partners of international standing both domestic and international. We are working in close collaboration with the University's research office to replace our existing research management system with one which integrates with our digital repositories and other systems. This will provide an opportunity to more effectively profile Griffith's researchers and their scholarly output.

8. Conclusion

Universities are integral to a nation's innovation agenda. The impact of their research has the potential to significantly improve a nation's economic and social outcomes. With this comes increased national interest in stimulating and regulating universities to drive potentially utilitarian aims, and an interest in measuring their quality. Universities must stay true to their core mission of knowledge creation, dissemination and preservation not just for current, but for future generations. They cannot afford to adopt tactical responses to government imperatives or international league tables. As the scholarly information lifecycle transforms, the ability for a university to enhance its research impact is greater than ever, but it is also a much more complex environment. This complexity offers new opportunities for a university's information service providers to further the university's, and the nation's, aspirations – both short and long term. Information service providers are ideally positioned to navigate the complexity of the scholarly information landscape to achieve university imperatives within a national context, through leadership and expertise and collaboration within and across organisational boundaries; to achieve short term imperatives whilst staying true to the long term mission of universities in knowledge creation, dissemination and preservation for future generations of scholars and practitioners.

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