Open Scholarship in Australia: A Review of Needs, Barriers, and Opportunities[*]

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Abstract:

Open scholarship encompasses open access, open data, open source software, open educational resources, and all other forms of openness in the scholarly and research environment, using digital or computational techniques, or both. It can change how knowledge is created, preserved, and shared, and can better connect academics with communities they serve. Yet, the movement toward open scholarship has encountered significant challenges. This article begins by examining the history of open scholarship in Australia. It then reviews the literature to examine key barriers hampering uptake of open scholarship, with emphasis on the humanities. This involves a review of global, institutional, systemic, and financial obstacles, followed by a synthesis of how these barriers are influenced at diverse stakeholder levels: policymakers and peak bodies, publishers, senior university administrators, researchers, librarians, and platform providers. There view illustrates how universities are increasingly hard-pressed to sustain access to publicly funded research as journal, monograph, and open scholarship costs continue to rise. Those in academia voice concerns about the lack of appropriate open scholarship infrastructure and recognition for the adoption of open practices. Limited access to credible research has led, in some cases, to public misunderstanding about legitimacy in online sources. This article, therefore, represents an urgent call for more empirical research around 'missed opportunities' to promote open scholarship. Only by better understanding barriers and needs across the university landscape can we address current challenges to open scholarship so research can be presented in usable and understandable ways, with data made more freely available for reuse by the broader public.

1 Introduction

The concept of the university as an *open society* to advance knowledge stretches back to the Enlightenment, when universities' mission was seen as being dedicated to the production and dissemination of knowledge for public benefit (Popper, 1945). But since then the international university system has become highly competitive, with each institution's quality and ranking being assessed primarily according to classic peer-reviewed research publications set against key disciplines. Yet, today, as academic practices increasingly move online, the monopoly that universities may once have enjoyed as privileged sites for the creation and certification of 'expert' knowledge is being challenged as digital developments allow citizens to find, make and share knowledge in open and networked systems, mediated by technology platforms and companies (Montgomery et al., 2018). Opportunities now exist to reshape how universities communicate their research through inventive, open, and accessible methods that engage a far broader and more diverse public (Scanlon, 2018). Openness in the scholarly and research environment—facilitated by digital or computational techniques or both—manifests in open access, open data, open science, open society, open educational resources, and many other forms as well. Broadly considered as *open scholarship*, this global movement is quickly becoming recognized as a fundamental

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principle of academic research (Australasian Open Access Strategy Group, 2018; Science Europe, 2019; Tofield, 2019).

Open scholarship offers a new and strategic way for universities to bridge the gap between makers and users of research—that is, the 'elite' academic world and civil society—through increased knowledge exchange and public accountability (Watermeyer, 2016; Murphy and Costa, 2018). Building on Boyer's foundational discourse around universities' need to focus on solutions to the nation's most pressing civic, social, economic, and moral problems (Boyer, 1996), open scholarship has been seen as a way to overcome universities' impermeable ivory-tower environment (McKiernan, 2017; Murphy and Costa, 2018), reducing the excessive time lag between knowledge creation and its translation into policy and practice (Leshner, 2015). In response, funders and governments have called for an increasing emphasis on the impact of research, with universities being pressed to realign their overall mission toward one of 'engaged inclusive knowledge societies' providing unrestricted access, use, modification, and adaption of research outputs as widely as possible for the benefit of all (McKiernan, 2017; Beaulieu et al., 2018).

Some of the early international open declarations and standards (Budapest Open Access Initiative, 2002; Berlin Declaration, 2003) focused primarily on open access to scholarly research literature in the form of peer-reviewed journal articles. The Budapest Open Access Initiative defined open access as 'free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself' (Budapest Open Access Initiative, 2002). In this context, open access was understood as a way of strengthening the ethos of research and preventing its results from being locked behind university walls, thereby allowing users to scrutinize results while permitting new research to be built on established findings (Science Europe, 2019).

These open declarations were revolutionary in their time and continue to influence today's open scholarship policy. In more recent years, however, academics have moved online and produce more than just journal articles (Neylon, 2015); scholarly communication is happening in many forms and formats, including on social media and through other networked technologies. Universities are in a transitional moment: research paradigms, methods, and tools are being redefined, and scholarly communication is transforming from a closed, print-centric culture to one of global engagement and open digital sharing of knowledge and data among networks of researchers, institutions, and the broader public (Veletsianos and Kimmons, 2012; Lorimer, 2013). The traditional model of humanities scholarly communication, as in other fields of research, is based on established structures and largely depends on the authority of printed documents (e.g. academic journals or monographs) that are well known to researchers, publishers, librarians, and administrators. Yet, in our digital age, the shift toward digital humanities is changing the way knowledge can be created and shared between scholars, students, the public, and other aligned groups (Arthur and Bode, 2014; Arbuckle and Siemens, 2015; McKiernan, 2017). Humanities research outputs now include large amounts of data, different types of digital archives, multimodal media texts, databases, and complex software and tools in areas as diverse as digital cultural heritage and 'deep' mapping, language and translation technologies, data visualization and modeling, and many other applications (Veletsianos and Kimmons, 2012; Bartling and Friesike, 2014; McKiernan, 2017).

This is reflected across academic and societal developments that are changing the way knowledge is produced, shared, distributed, and developed: online publishing, personal (and often mobile) computing, social media, and citizen scholarship are all parts of this changing picture. The widespread production and adoption of online tools and platforms presents an opportunity for the public and humanities researchers to participate in shared knowledge-based activities, as well as in inclusive and representative public spaces. Ideas asserted in informal venues can be circulated widely via social media, and research articles can be published digitally in open access journals accessible to all (Neylon, 2015). Beyond the viral sharing capacity of the Internet, digital tools also introduce new pathways for the co-development of research with the broader community, opening the boundaries between knowledge creation and knowledge dissemination, which in turn is blurring the traditional roles and responsibilities of academics (Ren, 2015). Within this environment, open scholarship is being redefined as 'an interconnected, equitable, global scholarly ecosystem of well-curated, interoperable, trusted research articles, data and software supported by a diversity of open publishing models' (Barbour, 2019).

Yet, despite the boundless possibilities, the open scholarship movement intended to make universities more engaged and inclusive knowledge societies has encountered significant challenges, especially in the field of humanities (Suber, 2017; Narayan et al., 2018). This article sets the scene by examining the historical context of open scholarship in Australia, looking at national policy and funding arrangements for universities to make research outputs more easily and freely available to the broader public. It then goes on to review the literature around key barriers and issues currently hampering the uptake of national policy looking firstly at the global, institutional, systemic, and financial barriers. While synthesizing these barriers, the article critiques the significant tensions within universities' policies between, on the one hand, the current drive to better connect academics with the communities they serve, and, on the other hand, a continued emphasis on evaluating research excellence according to the quantity and quality of publications (Moore et al., 2017; Alperin et al., 2018). To review these issues, the authors analyze the influence of diverse stakeholder levels: policymakers and peak bodies, senior university administrators, researchers, librarians, platform providers, and publishers. Finally, this article represents an urgent call for universities and senior researchers to set an agenda for greater collaborative action recognizing the central role they can play in our information age to enable open scholarship and maximize public benefit.

2 Methods

This study involves a narrative review building on the multimethod approach of Mays et al. (2005) to appraise the context and collate evidence on different tiers of information required by policymakers, senior academic administrators, early and mid-career researchers, librarians, platform providers, IT developers, and community users. It includes a scoping review of primary research literature obtained using Academic Search Complete, Web of Science, and Google Scholar. A grey literature search of government and nongovernmental organization policy papers, reports, and conference proceedings was undertaken through Google and key network websites. These were supplemented with a secondary search of the references cited in the identified studies.

The search terms were chosen to reflect the core subject and included (Open Scholarship OR Engaged Scholarship OR Public Scholarship) AND (Humanities and Social Sciences) AND (digital technology) AND (national policy). Peer-reviewed articles, books,

book chapters, periodic reports, onetime reports, and websites published between 2009 and 2019 were included. The search was restricted to publications in English.

3 Open Scholarship in Australia

Just as technology was beginning to offer the prospect of almost unlimited access to academic publications, from the early 21st century the costs for subscription to publication packages began to rise vastly, while purchasing budgets remained static (Australasian Open Access Strategy Group, 2018; Barbour and Nicholls, 2019). The open access movement emerged in the context of this crisis: driven by librarians concerned that for-profit publishers were restricting access to scholarly publications and driving up costs at a moment when digital technology was transforming possibilities for content sharing. In 1997, the Scholarly Publishing and Academic Resources Coalition (SPARC), an alliance of academic libraries and other organizations, was established to seek alternatives. This led to global calls for the development of an online public library that would offer the full contents of the published record of research and scholarly discourse in a freely accessible, fully searchable, interlinked form. The outcome was a series of major international statements calling for unrestricted online access to scholarly research outputs (Budapest Open Access Initiative, 2002; Berlin Declaration, 2003).

The concept of self-archiving and online preprint, and the making of online archives interoperable, was first introduced in Australia in 2001 when the Australian National University established an ePrint Repository. Yet, it was Queensland University of Technology that became the first university globally to publish its ePrint policy mandating open public access to its full text works. While numerous universities began developing open access repositories of their research outputs, it was not until 2006 that the government set up the Australian Scheme for Higher Education Repositories, which ran until 2009, to support the development of institution-level publication repositories. Although these institutional web-accessible resources were intended to maximize the visibility of universities' research outputs (Swan and Carr, 2008), repositories were also established with the goal of helping universities to gather the publications and metadata needed to support government assessment of university performance via the Excellence in Research Australia (ERA) exercise. Comparative research achievement, as measured by ERA, was directly linked to the allocation of additional research funds in the form of block grant schemes (Kingsley, 2013).

In Australia, institutional research repositories emerged from and continued to be managed largely by librarians. In 2009, the Council of Australian University Librarians (CAUL) also established the CAUL Australian Institutional Repository Support Service, which was funded by the federal government until 2012, and now continues with support from member contributions, community backing, and partnership with New Zealand libraries. University repositories started self-archiving journal articles, books, book chapters, and reports using a range of software platforms (EPrints, DSpace, Fedora, Digital Commons/Bepress, and Pure), and went on to archive PhD theses through the Australasian Digital Theses program, which are now available via the National Library of Australia's Trove service.

In addition to facilitating access to traditional printed academic documents, in 2008 the Australian government established the Australian National Data Service (ANDS) to support free access to publicly funded research data within the constraints of privacy, copyright, and technology. The implication was that researchers and their host institutions

should make all data collections from the Australian and state government-funded research grants publicly available and easily accessible and searchable, for direct linkage and reuse (Kingsley, 2013).

Building on the work of CAUL to promote open access, in 2010 the Australian government released a Declaration of Open Government (Australian Government, 2010), which was later adopted by the National Health and Medical Research Council (NHMRC) and the Australian Research Council (ARC) in 2012 and 2013, respectively. These policies required the widest possible dissemination of research arising from ARC or NHMRC funded projects to be deposited into an open access institutional repository within 12 months of the date of publication. All investigators must ensure that anyone with access to the Internet can obtain free access to the full text of their outputs from federal government research funds at any time. These policies have been supported through an open access licensing framework introduced to facilitate public access to government agency data and for the release of reports and information through the Australian Creative Commons Version 3.0 licenses.

Recently the Australian government has expanded these policies to include not only open access to 'research literature' but also to research data, metadata, code, and tools for analysis. Such a shift encourages research sharing in the most effectively available format to enable other researchers and members of the community to easily access data, thereby maximizing the benefits that can be derived from the data (Australian Research Council, 2017; NHMRC, 2018). In line with these policies, the Australian Productivity Commission released a similar report calling on all Australian state and territory governments to allow open access to publicly funded research outputs (Productivity Commission Inquiry, 2016).

To support these calls for open scholarship practices, in 2018, the Australian Research Data Commons (ARDC) was established to provide the Australian research community and industry with access to data through eInfrastructure, platforms, skills, and collections of high-quality data. ARDC has focused its work on the building of close partnerships with the ANDS, the National eResearch Collaboration Tool and Resources project, and Research Data Services, with support from the National Research Infrastructure for Australia. Its role is to support the creation of a cohesive national collection of research resources to ensure that data outputs are more easily accessible in a form that allows them to be integrated, organized, and connected. Similarly, the Australasian Open Access Strategy Group (AOASG), supported through membership of some twenty national universities, works to advocate, collaborate, raise awareness, lead and build capacity for open access to all.

Open access has now become a fundamental part of the scholarly publishing and research landscape in Australia (FAIR Working Group, 2017; Benn and Borchert, 2018), aligning closely with growing European calls for research outputs to be presented in more findable, accessible, interoperable, and reusable (FAIR) ways. In 2016, a working group under the auspices of the Universities of Australia Deputy Vice Chancellors (Research) Committee, developed a policy statement that affirms all Australian publicly funded research outputs should adopt the FAIR principles in such a way that anyone can find and re-use research publications and data for further research, policy, development, innovation, education, and public benefit (FAIR Working Group, 2017). These principles have been endorsed by all major Australian peak bodies in this area, including the AOASG, ARDC, and CAUL.

Increasingly, philanthropic agencies are also pledging support for open scholarship, with George Soros' presentation to the World Economic Forum on 23 January 2020 dedicating one billion dollars and calling on others to support the development of an Open Society University Network to support collaboration between universities and to expand access to higher education at a time of growing inequality, with many other national and international not-for-profit funders following in their footsteps and joining the coalition for FAIR principles.

Yet, despite intense interest and significant public and policy concern, the Australian Government has acknowledged a lack of relevant research relating to how these goals might be achieved in practice, especially in the field of humanities, where researchers often value books, book chapters, and monographs above journal articles. To address the needs of the humanities, re.press (https://re-press.org/), an Australian open access publisher of monographs, was established in 2006, followed two years later by Open Humanities Press (https://openhumanitiespress.org/). More recently, the Open Library of Humanities (https://www.openlibhums.org/), a not-for-profit open access publisher, and other initiatives such as those of the ScholarLed publishing consortium, including the recently funded Community-led Open Publication Infrastructures for Monographs project, have been launched to support open access publishing for the humanities. Yet these still lack the authority and prestige of established journals and top-tier publishers that continue to be ranked highly by traditional bibliometric systems against which universities and academic promotions are judged. Although the Open Library of Humanities is trying to address this gap, it relies on financial support from an international consortium of libraries to allow publication without article processing charges.

Thus, while the majority of universities in Australia are publicly funded and groups exist to actively promote open scholarship—such as the AOASG, ARDC, and CAUL, as well as ARC and NHMRC—in practice Australia has gone from being one of the world leaders in open access through the establishment of a set of national repositories, to falling behind international initiatives in open scholarship policies and practice (Council of Australian University Librarians, 2019). There is no centralized effort to drive change as there is for Europe (Open AIRE), the USA (SHARE), or South America (La Referencia). Similarly, there is limited articulation of priorities and impact for Australian researchers and the promotion of their outputs. Therefore, the remainder of this article is focused on a deeper analysis of some of the barriers to the implementation of open scholarship practices.

4 Barriers to Open Scholarship

This exploratory review first examines the global, institutional, systemic, technological, and financial obstacles influencing open scholarship in Australia. The authors then summarize the multi-level challenges confronted across the academic environment and synthesize what the uptake of FAIR principles has implied for diverse tiers of university participants, including senior university administrators, researchers, librarians, platform developers, and students.

4.1 Global, Institutional, Systemic, Technological, and Financial Barriers

Although national and international calls for open scholarship practices to make research outputs fully available to the public are considered laudable, countless barriers currently exist (see Table 1). One clear indicator of the extent of these barriers is that less than half of the universities in Australia have clear policies or pledges to ensure staff align with the FAIR

principles (Council of Australian University Librarians, 2019). In reality, adopting open scholarship practices requires major global, institutional, systemic, technological, financial, and educational changes across the academic and broader community.

At the global and institutional level, university ranking systems continue to be assessed primarily through the use of outdated metrics focused on publication and citation analysis (Haustein, 2016). Moreover, the current system for scholarly publishing is largely dictated by for-profit publishing companies, where the costs for publication in and open access to electronic articles, books, and documents have increased exponentially (Australasian Open Access Strategy Group, 2018). Despite international calls to change research assessment and publishing policies, the complexity of the system, the financial costs imposed by for-profit publishers to make research outcomes openly available, and the lack of incentives offered by universities for open scholarship have resulted in an inertia among researchers to adopt more open, efficient, and equitable ways for engaging with the broader public in the development and dissemination of research (Barbour, 2019). This is exacerbated by the bureaucratic and rigid demands of ARC, NHMRC and other funding body committees that continue to base their evaluations on classic bibliometric criteria, impeding creative, open, and FAIR research.

Thus despite opportunities offered by today's digital landscape to make research more responsive and inclusive for societal benefit, Australian universities continue to place excessively high value on publications in top league journals and books that are ranked and assessed through traditional bibliometric indicators (Narayan and Luca, 2017). Moreover, with no one organization in Australia to drive the required institutional changes, but rather a group of local champions with partial collaboration, efforts to promote open scholarship have been fragmented around siloed scholarly subjects linked with the ERA themes (Narayan et al., 2018), and by academics providing their research outputs to institutional repositories for university ERA accounting, rather than to increase the visibility of their research to make it more accessible to a wider audience (Narayan and Luca, 2017).

At the systemic and structural levels, there is no one centralized open access system or universal shared repository network in Australia, but rather numerous diverse repository infrastructure systems used by different universities (e.g. EPrints, DSpace, Fedora, Digital Commons/Bepress, and Pure), with many of these becoming legacy systems and lacking the modern capacities and new standards such as those provided by ORCID. A recent CAUL study illustrated that only two-thirds of institutional repositories collate information required by grant funder policies, only one-third monitor compliance, and one-quarter use Research Activity Identifiers (Council of Australian University Librarians, 2019). Similarly, only one-third of institutions have a preservation strategy for their repository collection. The ARDC, Australian Data Archive, Australian Urban Research Infrastructure Network, and the Analysis & Policy Observatory provide platforms and repositories with open access to data from diverse sources including from outside of the traditional commercial or academic publishing and distribution channels. Yet, there remains no one access route. Furthermore, these repository systems and platforms have limited focus on the humanities compared with science, technology, engineering, and mathematics.

Table 1. Global, institutional, systemic, and financial barriers to the implementation of open scholarship practices

Institutional/career barriers (Kingsley, 2013; Narayan and Luca, 2017; Narayan et al., 2018; Barbour, 2019)
ERA and academic incentives place emphasis on traditional scholarly outputs, inhibiting the sharing of research through alternative online platforms.
Fragmented silos according to ERA clusters limit collaboration for innovative open source solutions.
Lack of trained staff to fully implement open scholarship policies.
Institutional programs to encourage staff tend to involve one-off workshops with limited impact.
Lack of clear understanding of the value of open scholarship and its importance for community engagement.
Limited advocacy to motivate involvement and a dearth of cross-sector collaboration between universities.
Systemic/structural barriers (McKiernan, 2017; Narayan and Luca, 2017; Australasian Open Access Strategy Group, 2018; Benn and Borchert, 2018; Montgomery et al., 2018; Borchert et al., 2019; Koutras, 2019)
No one organization in Australasia exists to drive change.
Limited protocols mean less than half of Australia's universities have an Open Access or Open Scholarship Policy statement for research outputs.
Lack of legal agreements and guidelines exist to fully implement open scholarship policies.
No centralized open access web presence or universal shared repository network exists in Australia.
Australian repository infrastructure is diverse (e.g. EPrints, DSpace, Fedora, Digital Commons/Bepress, and Pure).
Few universities are using newer generation repository software in their infrastructure specifications.
Limited university repositories monitor compliance with grant funder policies, and only one-quarter use Research Activity Identifiers.
Few institutions have a preservation strategy for their repository collection.
Confusion exists over wording of open access mandates, especially regarding copyright, preprint, and data sharing.
Technological/operational barriers (McKiernan, 2017; Neylon, 2017; Borchert et al., 2019; Wilson et al., 2019)
Lack of collaboration means research platforms are produced primarily in isolation from key stakeholders and users.
Sharing of code and data is more complicated than sharing of articles and difficult to present in a FAIR manner.
Only half of research data is available in open digital repositories.
Limited repository systems and platforms focused specifically on the needs of the humanities.
Nontraditional research related collections—archival library collections, images and multimedia—are less accessible.
Limited guidance exists on how to use preferred file formats to archive code and data.
Licenses required to make the data available are complex and require a level of control with all changes tracked.
Lack of suitable storage systems and infrastructure makes navigating data, coding, and sharing systems frustrating, limiting their usage.
Financial/resource barriers (McKiernan, 2017; Montgomery et al., 2018; Barbour and Nicholls, 2019; Wilson et al., 2019)
Article processing charges and/or book processing charges can be extremely costly.
Lack of infrastructure for open networked knowledge institutions to connect with one another.
Socio-cultural/equity barriers (Hammarfelt, 2017; Laporte, 2017; Koutras, 2019; Wilson et al., 2019)
Majority of open access journals and platforms are produced by prestigious universities or print companies, reinforcing primary languages (English, Mandarin, Spanish, and Arabic).
Restricted approaches to physical spaces of academic libraries and limited openness of academic library practices to make information available to the public.

At the technological and operational levels, the environment is becoming more fragmented as new software is added to support data management and curation (e.g. Figshare, Omeka), leading to a need for sector wide standards for metadata, protocols and language to ensure interoperability of systems (Benn and Borchert, 2018). All too often, these schemas have been produced primarily in isolation with their focus on research disciplines, and lacking the engagement of key stakeholders and users, limiting the progress of innovative cross-sector solutions. Sharing of data is more complicated than sharing of articles and difficult to present in a FAIR manner; as such only half of research data is available in open digital repositories. In addition, limited financial support to develop, implement, and maintain open access to research outputs and data, together with lack of trained staff to promote the uptake of open access and scholarship, confusion around copyrights for printing and data sharing, and institutional concerns over the time and effort required to deposit outputs in repositories or platforms are continual problems (Kim, 2011; Veletsianos, 2015; Narayan et al., 2018).

There is also a need for financial incentives to encourage researchers to make their outputs openly accessible. While some Australian universities are now providing funds for researchers for 'gold' open access to their publications, such support has generally been dependent on publication in top-tier journals, once again placing emphasis on traditional bibliometric standards and favouring commercial publishing companies (Wilson et al., 2019). This further hinders the humanities where there are fewer journals ranked in the top tier compared with those of the sciences, and where there is not yet an equivalent highly ranked not-for-profit open access journal such as *PLOS ONE* published by the Public Library of Science.

At the heart of open scholarship is the drive to build more equitable access to knowledge, through open access platforms and repositories. Yet, this has raised a series of questions around IP infringement and copyright laws, resulting in numerous international agreements and regulations to change copyright protection regimes for the open sharing of data, but with many of these legal agreements still varying from country to country (Koutras, 2019). While similar efforts are underway in Australia, continual legal changes are needed to keep pace with technological evolution for the improvement of citizen assets. Although librarians have been seen as the drivers of open scholarship, the policies of university libraries still restrict public access both to their physical spaces and information on their online databases (Wilson et al., 2019).

Thus, while national and international levers are supporting shifts toward openness and promoting corporate social responsibility among for-profit publishers, these moves must be accompanied by more national, local, contextual, and thematic policies to address practical issues including infrastructure, capacity building, and the central coordination of support organizations to promote open scholarship (Montgomery et al., 2018). Although programmatic measures and detailed policy designs must be developed, the essential and common principles for open scholarship policies need to be developed and supported across diverse micro (individual/researcher), meso (institutional/university, scholarly society, publisher), and macro (national and international system/ funder and government) levels to ensure collective uptake across the scholarly landscape (Knowledge Exchange et al., 2019). While policies are being developed at the macro level, insufficient attention has been given to address the incentives, actions, and influences at the micro and meso levels.

4.2 Barriers to Open Scholarship across the Diverse Levels of University Participants

University staff at multiple levels could play a valuable role in changing the way knowledge is created, shared, and preserved between scholars, students, the public, and other aligned groups (Arthur and Bode, 2014; Arbuckle and Siemens, 2015; Arbuckle et al., 2017; McKiernan, 2017). Yet, international literature suggests that internal issues at each tier of university participants limit the uptake of open scholarship.

4.2.1 Barriers for Deputy Vice Chancellors of Research

Today open scholarship has become recognized as central to universities' overall mission, yet it continues to be given low priority in the face of competing demands. Deputy vice chancellors of research operate in environments where much of their time is spent on strengthening the university's academic reputation and ranking. Studies illustrate that while they promote the importance of cross-sector partnerships and translational research focused on global social issues, the current world ranking system continues to assess universities'

research performance largely through publication and citation analysis (McKiernan, 2017; Moore et al., 2017; Narayan et al., 2018). As such, Australian universities operate primarily to meet short-term goals, leaving them poorly positioned to benefit from new digital developments that make it possible for ordinary citizens to find, make, and share knowledge through open and networked systems, mediated by technology platforms and companies rather than through isolated academic resources (Montgomery et al., 2018). Few universities are using new altmetrics and reward systems with emphasis on the use of digital systems for the open sharing of data, knowledge, and new ideas for societal benefit, resulting in a gap between attitudes toward open scholarship and actual practice (Robinson-Garcia et al., 2017; Toledo, 2018).

While the mission of universities is to enhance collaboration, global evaluation systems continue to focus on individual achievement, limiting the shift toward a more engaged and inclusive university culture with strong support for institutional leaders to promote the implementation of engagement-oriented missions (Beaulieu et al., 2018). Although funding bodies acknowledge partnerships, universities continue to offer a reward structure that promotes researchers according to individual achievements, giving priority to sole or first authorships, and journal articles over digital products or tools developed for community use (McKiernan, 2017; Potts et al., 2017). The long-standing publish-or-perish culture remains one of the greatest constraints to open scholarship (Ren, 2015), with promotion and tenure practices reinforcing academics' preference towards conventional scholarly publications that institutional committees judge favourably (Odell et al., 2016).

Moreover, although deputy vice chancellors of research and senior administrators are clearly aware of the importance of social media as a tool for scholarly communication, few feel entirely comfortable with the changing landscape that is digital, networked, and open. While they accept the need for online engagement activities and for their employees to independently voice and promote their research findings, there is concern over how to guarantee these activities are aligned with the university's brand image and social principles to ensure that the university's reputation is not at stake through poor open online communication by employees (Dermentzi and Papagiannidis, 2018). Lack of clear mandates and confusion over university policy, together with limited support from funding agencies for infrastructure and training in open scholarship, or for activities to attract outside collaborators and seek innovative solutions, as well as fear over legal agreements and costs, has further limited the support of senior administrators for open source solutions (Al-Aufi and Fulton, 2015; Tennant et al., 2019).

University leaders need to commit to changing their culture and policy through long-term plans with clear logistical processes to encourage a more open, engaged environment (Tennant et al., 2019). Central to this will be modifying the current review, promotion, and tenure criteria to acknowledge public engagement and open access by digital means. Universities also need to clearly promote their policies around issues such as communications via social media; open sharing of posters and presentations (e.g. at Figshare; the use of open licenses, e.g. CC-BY); publishing in open access and the use of open peer review; the sharing of preprints (e.g. at OSF); the creation of formats (e.g. using Jupyter) containing open code including XML; and the sharing of notebooks, live data, codes, equations, visualizations, and narrative text (Tennant et al., 2019).

As national and international funding bodies introduce new policies toward open scholarship, unfortunately official changes are generally sent directly to university deputy

vice chancellors of research rather than through direct communication with leaders of repositories and researchers, resulting in a delayed uptake and lack of clarity over what these changes imply for librarians, faculty leaders, and academic staff (Kingsley, 2013). In practice, coordinating these changes across the diverse multi-levels within the university system and their external boundaries has highlighted the complexity of open scholarship, and blurred the redefining of academic roles around how to create, share, translate, and preserve knowledge (Montgomery et al., 2018). Given financial pressures to maximize productivity and the lack of support for university 'champions' of open scholarship to raise visibility, train staff, and encourage collaboration— together with the limited empirical research illustrating the societal impact of open scholarship—university deputy vice chancellors of research tend to dedicate only limited time to addressing these issues (Table 2).

Table 2. Barriers to open scholarship across the diverse levels of university participants

Barriers for Deputy Vice Chancellors of Research (Kingsley, 2013; Al-Aufi and Fulton, 2015; Odell et al., 2016; McKiernan, 2017; Moore et al., 2017; Beaulieu et al., 2018; Montgomery et al., 2018; Narayanetal., 2018; Toledo, 2018; Milligan et al., 2019; Tennant et al., 2019)
Open scholarship is given low priority in the face of competing demands.
ERA and university ranking remain the key focus rather than societal impact.
Limited understanding of need for a paradigm shift to align with the contemporary digital era.
Concerns exist about employees' online voice and the university's reputation.
Mandates are unclear causing confusion over open access and open scholarship.
Lack of support from funding agencies for infrastructure and training in open digital scholarship.
Limited knowledge of how open scholarship practices can enhance public engagement and societal impact.
Limited funds available for employing 'champions' to raise visibility, train staff, and encourage collaboration.
Funding agencies communicate with deputy vice chancellors of research rather than directly with leaders of repositories and researchers.
Barriers for faculty leaders (Gross and Ryan, 2015; Peekhaus and Proferes, 2015; Pinfield, 2015; McKiernan, 2017; Raffaghelli, 2017; Narayan et al., 2018)
Open scholarship practices, especially those that fall outside traditionally rewarded research, can hurt their faculty evaluation.
University evaluation systems/staff promotion continues to focus on citations in prestigious journals.
Limited awareness of and familiarity with advanced digital applications.
Limited funds to support processing charges for open access publishing, especially those of books and book chapters.
Lack of funds for infrastructure and IT staff to develop and maintain digital platforms.
Concern over standards and software licenses for materials to be shared via public platforms.
Limited funds to train staff and students in the use of new digital tools for sharing, coding, and reusing data.
Barriers for humanities researchers (Armstrong, 2014; Rodriguez, 2014; Scheliga and Friesike, 2014; Veletsianos, 2015; Gross and Ryan, 2015; Jamali et al., 2016; Tenopir et al., 2016; Manca and Ranieri, 2017; Narayan and Luca, 2017; Suber, 2017; Montgomery et al., 2018; Narayan et al., 2018; Knowledge Exchange et al., 2019; Lemke et al., 2019)
Limited understanding of the concept of open access, open scholarship and FAIR principles.
Confusion over reasons for self-archiving their work in institutional repositories.
Lack of awareness of services like SHERPA/RoMEO that simplify self-archiving policies.
Misunderstanding regarding legitimacy of online open access and fear of 'predatory' publishers.
Few aware of the Directory of Open Access Journals to identify alternative publication outlets.
Academic promotion still focused on publication with high-status journals and publishers.
Many still consider open access publishing as low quality, not peer-reviewed, and lack awareness of alternatives to traditional outlets.
Less weight placed on alternative metrics to assess their influence on reaching the broader public, e.g. case studies with contextual mapping, timelines, and visualization achieved by these platforms.
Underutilization of platforms like Academia.edu, ResearchGate, LinkedIn, and ORCID.
Lack of understanding that open access can increase viewing, reading, saving, mentioning, citing, and reusing.
Few respond to requests from members of the public or other research centres for access to their research outputs and data.
Lack of awareness that some private and public grants allow researchers to list preprints and count them as evidence of collaboration and productivity.
Lack of knowledge around options like *Knowledge Unlatched Research*.
Lack of training on how to use tools to share code and data (like Git), exacerbated by the limited financial support for infrastructure.

Lack of incentives for researchers to voluntarily share their data and code.
Only senior researchers or tenured staffs willing to pledge agreement to only publish through open access publications and platforms.
Barriers for librarians (Lorimer, 2013; Peekhaus and Proferes, 2015; Holzman, 2016; Australasian Open Access Strategy Group, 2018; Benn and Borchert, 2018; Narayan et al., 2018; Borchert et al., 2019)
Limited opportunities for collaboration with university researchers/research centres and lack of support for advocacy roles.
Excessive time spent on updating the various repositories used by universities.
No centralized open access web presence in Australia.
Institutional repositories are costly and have mixed support from faculties.
Humanities only receive ~25% of library acquisitions.
Limited coverage of humanities by key academic databases, like Web of Science and Scopus, which also only primarily index English language.
High cost for subscription to recognized academic publishers limits investments in open access licensed, electronic textbooks, monographs, and alternative online archives.
The diversity of languages used in the humanities requires numerous selective channels with smaller audiences.
Limited opportunities to promote the benefits of self-archiving and sharing data in repositories for easy access, storage, and preservation.
Continuous changes to legal text of Creative Commons licenses create misunderstanding.
The exponential rise in costs for subscription to commercial publishers.
Barriers for IT and platform providers (McKiernan, 2017; Neylon, 2017; Borchert et al., 2019)
Lack of collaboration between IT staff, librarians, and senior university policymakers.
Limited finance for newer-generation software and infrastructure.
Sharing of code and data is more complicated than sharing of articles and is difficult to present in a FAIR manner.
Limited guidance exists around preferred formats to present content, code, and data.
Licenses required to make the data available are complex and require alevel of control with any external changes tracked.
Limited repository systems and platforms that are focused specifically on the needs of the humanities.
Lack of training and limited resources to support IT and platform provider engagement with other staff.
Barriers for students and community members (Alperin, 2015; Young and Verhulst, 2016; McKiernan, 2017)
Students and communities represent over 50% of online users, but given they rarely cite the research in official publications, academics tend not consider this group as their key users.
Research platforms are produced primarily in isolation without engaging other key stakeholders and users.
Limited collaboration with engaged citizens for codevelopment.
Lack of awareness of current changes and policies to make outputs and data available in a FAIR manner for the broader public.
Skills and self-efficacy in online participation can lead to inequities, especially for community members with limited Internet access.

4.2.2 Barriers for Humanities and Social Science Faculty Leaders

In theory, faculty leaders are in an influential position to build bridges between senior university administrators, academics, students, and the broader community through research, teaching, and service and by promoting university policy, yet they often lack institutional support. Open practices, especially those in the humanities that fall outside traditional reward systems, can hurt their faculty evaluation and future funding, which continues to be assessed according to classical scholarly publishing practices (Peekhaus and Proferes, 2015; Pinfield, 2015; Odell et al., 2016). In humanities departments, a key barrier to open scholarship is that book publication is ‘the primary agent for promotion and tenure’ (Gross and Ryan, 2015, p. 72). However, scholarly books and monographs in the humanities have significantly lower impact when judged by classic bibliometrics ‘due to miniscule print runs and discipline-specific language that limits readership’ (Gross and Ryan, 2015, p. 72). Thus in practice faculty leaders would benefit if they encouraged staff to use open access platforms to increase the visibility of their research and to reach a wider audience, yet they continue to be hampered by institutional ranking systems against which their faculty will be assessed. Further challenges confronted by faculty leaders include lack of awareness about future prospects of open scholarship; concern over their staff’s career advancement; the influence on the faculty’s allocation of research funds based on ERA; problems of authority and trust regarding the scholarly nature of open access journals and digital platforms; lack of funds to

train staff and students in the use of new tools and to support the development of open digital resources; reluctance to include images, or information that may require legal agreements and software licenses to be shared via public platforms; deep-seated incentives toward prestigious academic publishing houses; and limited awareness of and familiarity with advanced digital applications (Rodriguez, 2014; Gross and Ryan, 2015; Raffaghelli, 2017; Narayan et al., 2018).

4.2.3 Barriers for Humanities Researchers

Researchers in the humanities have been notably slow to take advantage of open scholarship (Suber, 2017). This has been due in part to the varied and multifaceted nature of research outputs—books, manuscripts, poetry, creative writing, maps, photographs, art, to news, entertainment, and many other kinds of texts (including in languages other than English)—which often makes their presentation in accessible open formats more costly and complex (Gross and Ryan, 2015; Montgomery et al., 2018; Narayan et al., 2018). Moreover, the academic reward system has never favoured the humanities, where overall citation indices tend to be lower, with studies often focused on more localized contextual issues, or on detailed archives or manuscripts where visible outcomes may be long term (Ochsner et al., 2016; Hammarfelt and Haddow, 2018). Whereas the fields of physics and mathematics have had their own subject-specific open access repository, *arXiv*, and the biomedical sciences have been supported through the *PubMed Central* digital archiving repository, allowing readers free access to either pre-print or post-print versions, it is clear that the humanities have not yet created a publication 'culture' focused on the use of open digital repositories (Gross and Ryan, 2015).

Limited awareness, especially among early career researchers, of the FAIR principles and the importance of open scholarship, both for community engagement and to make research outputs freely available to the public whose tax supports their research, has meant that many humanities scholars continue to place priority on making their research available through prestigious publishing companies that are looked on favourably by academic committees for promotion and future research funding (Odell et al., 2016). This lack of clarity around the concept of open scholarship has meant the self-archiving of their research outputs in institutional repositories has often been perceived as a cumbersome administrative requirement rather than a way of making their work freely available online (Gross and Ryan, 2015; Narayan et al., 2018). Lack of clear understanding of the benefits of self-archiving, together with high workload, and problems of authority and trust, have resulted in wariness and limited the open sharing of data and outputs by some researchers (Narayan et al., 2018; Lemke et al., 2019). Moreover, few researchers are aware of the Directory of Open Access Journals to identify alternative publication outlets or lack confidence in open access publishing, while others are skeptical about low quality open access publishing (Narayan et al., 2018). Although free or low-cost open publishing options exist, article processing charges and book processing charges for open access are often extremely high, effectively limiting their use (McKiernan, 2017).

Today most researchers are aware of social media platforms and services like LinkedIn, ResearchGate, Academia.edu, and Mendeley, among others, yet not all use these tools to promote their work and so miss out on the opportunity to increase their readership and citation counts. Moreover, while these platforms generally allow self-archiving, many lack copyright checks around long-term archiving (Narayan et al., 2018). Thus, although these platforms can help researchers build connections and networks and encourage openness

and sharing, the use of social media by researchers continues to be fragmented (Veletsianos, 2016), partly due to a lack of trustworthiness (Tenopir et al., 2016), although perhaps primarily due to the view that traditional scholarly publications are the only acceptable avenue for sharing their work (Armstrong, 2014). Fear of publication in 'predatory journals' or systems that may influence their track record has furthered the tendency to publish through prestigious commercial printing companies (Montgomery et al., 2018).

Despite the substantial growth in digital environments and online networks for research, few humanities researchers are adopting them in their own academic practice. Although this trend may be, in part, due to a lack of knowledge or familiarity, a substantial cause is the fact that online engagement activities are given limited recognition in career promotion, resulting in a lack of incentives for researchers to voluntarily share their research and data. Those in the academic sector—including researchers, administrators, and library and information specialists—are voicing concerns about the lack of appropriate national and international open digital research infrastructure (Tennant et al., 2016). Open publishing outlets in the humanities currently do not have a business model for sustainability and lack the authority and prestige of established journals run by commercial entities and monographs published by top-tier commercial publishers.

Similarly, while universities do offer staff training on issues of open access, data sharing, and networking, these are generally one-off events and do not engage the researchers with hands-on learning in real-life situations grounded in community-based activities with local leaders or through building links with different faculties or research centres (Beaulieu et al., 2018). There is a lack of awareness among staff of services like SHERPA/RoMEO, which simplify self-archiving policies and licensing conditions, and there is limited knowledge or training on how to use tools like Git to share data (McKiernan, 2017; Narayan et al., 2018). While younger researchers are more aware of reputational platforms, in practice the lack of institutional support, skills, and training, lack of technological tools for sharing and adapting of data, and lack of quality or compatibility of the resources and infrastructure all limit the adoption of open scholarship (Scheliga and Friesike, 2014).

4.2.4 Barriers for Librarians

In Australia and internationally, university libraries are increasingly hard-pressed to sustain access to publicly funded research as costs continue to rise, driven by commercial influences (Maxwell, 2015; Holzman, 2016; Australasian Open Access Strategy Group, 2018). As such, libraries' purchase of book collections, scholarly editions, monographs, archival documents, and other prevalent forms of scholarly expression in the humanities has declined and represents only a small percentage of library acquisitions (Holzman, 2016). University repositories offer free availability to research outputs and data and could provide academic libraries with a way of addressing economic barriers.

University librarians are positioned to play a key role as advocates for implementing open scholarship—educating staff of the benefits of open access journals and platforms and the building of trusted networks to share this information across institutions and communities; offering advice on alternative publishing mechanisms and copyright; helping researchers make their research more openly accessible; providing data on access, citations, and impact to promote positive attitudes; offering technical support to improve discoverability through optimizing data for search engines; and assisting with data storage and preservation. Yet in practice, limited resources and lack of policy and governance have

hampered their achievements (Mercer, 2011; Borchert et al., 2019), with their efforts tending to be focused on the building of institutional repositories to meet faculty mandates and to overcome copyright concerns (Kim, 2011; Armstrong, 2014; Narayan et al., 2018).

Despite the cost in time and funds spent on developing these institutional repositories, many Australian repositories are now outdated and do not have access to systems required by national research funding bodies (Borchert et al., 2019). Similarly, few academic librarians have the time or support to create accessible resources for unreviewed materials such as data sets, primary materials, archival collections, images, multimedia, and the like (Holzman, 2016). Further, critics have noted that although the scholarly literature may now be more freely accessible through institutional repositories, this does not make it comprehensible to all the potential users of that research (Alperin, 2015; Narayan and Luca, 2017). By redirecting some funds from purchasing software licenses in supporting open solutions like open source software and open access publishing consortia (e.g. Open Library of Humanities, https://www.openlibhums.org), libraries could address some of their current economic barriers and have more time available to train academics in the use of these systems (McKiernan, 2017).

4.2.5 Barriers for IT Staff and Platform Providers

IT staff and platform providers, like librarians, are often left out of the process and do not work closely with senior university staff to plan and design future open scholarship infrastructure. The disconnect is evident, with less than a quarter of Australian universities having new generation repository software in their infrastructure specifications and limited collaboration existing between institutions (Borchert et al., 2019). The sharing of code and data is more difficult than publications, especially if they are to be presented in a FAIR manner. Moreover, there is limited research or guidance on what information is needed, how and where the code and data could best be archived, what the preferred file formats are for presentation, what licenses and version control are required, and who should be responsible for managing and reviewing online changes (McKiernan, 2017). Navigating such data is often difficult, and researchers need training and support for the development and use of them, yet current restrictions cause frustration and limit motivation (Neylon, 2017). Furthermore, the design of online resources and apps for the general public often involves legal agreements with research centres or external organizations, and once project funding is complete or researchers move, the domain licenses expire and the online data are not maintained.

4.2.6 Barriers for Students and Community Members

While the concept of universities as ‘engaged inclusive knowledge societies’ involves making information and data more openly available to broader communities, in reality a large percentage of the public cannot access either the documents or the data, as researchers continue to promote their findings through scholarly communications (McKiernan, 2017). A recent study illustrated that 50% of open access platform users in Latin America were students, including high school students, while a further 25% were from public, not-for-profit, and private organizations (Alperin, 2015). Thus, although research can have significant social impact far beyond the university walls, the notion that publications and citations are the primary measure of research evaluation is limited when research is used by the public. While some platforms such as Web of Science, Scopus, ResearchGate, and Academia.edu do assess the weekly number of viewers, universities’ societal impact depends

on commitment to transforming their research into reusable information, sharing, and participating in community outreach (McKiernan, 2017). Without institutional rewards for outreach activities or societal impact, public engagement remains limited.

5 Conclusion

As this article has suggested, there are a range of institutional, systemic, technological, and financial barriers preventing the effective uptake of open scholarship in Australia. Of concern is also the current disconnect between policy officers, senior university administrators, researchers, university librarians, and platform developers, as well as the academic culture and reward system that continues to promote research outputs in prestigious publications over group accomplishments for public good. While this article has focused on the obstacles to open scholarship in Australia, many of these issues are similar to those confronted by other nations.

In today's digital society, open access to information, knowledge and new ideas are our most valuable resource. As international movements are progressively calling for the implementation of FAIR principles to better connect academics with the communities they serve, these must be accompanied by more proactive national, local, contextual, and thematic policies to address practical barriers including infrastructure, capacity building, and the central coordination of support organizations to overcome current barriers to the uptake of open scholarship (Montgomery et al., 2018). While this represents a window of opportunity for universities to become the advocates of change, they must actively adopt and support new practices if they are to ensure research outputs are presented in more usable and understandable ways and with data made freely available for reuse.

While the power of for-profit publishers and the world ranking system for assessing academic performance based on traditional bibliometrics have been recognized as key barriers, the growth of institutional repositories, the implementation of international copyright regulations requiring open access, and moves for corporate social responsibility are opening pathways for more equitable access to knowledge through open platforms and repositories (Koutras, 2019). But in addition to these macro level barriers, university leaders—senior university administrator, professors, faculty deans, and leaders of research centres—must also acknowledge their influential role in addressing the current barriers and providing both evidence-based information and practical advice to policy makers, peak bodies, publishers, researchers, and the broader public, as well as giving greater recognition, reward, and support for staff dedicated to advancing open scholarship practices.

Central to this will be the provision and backing of national and university champions to build engaged faculties that strengthen the links between staff, students and the civil society at global, regional, national, and institutional levels through the adoption of transparent protocols for the creation, use, and governance of these shared resources. In particular, the humanities needs support to voice their researchers' specialist needs and reduce the highly fragmented system. Furthermore, librarians and platform developers need funds to be redirected to enable them to play a more proactive role educating researchers about the value of new open access strategies and shared digital practices, while putting libraries at the centre of open scholarship.

University leaders need to commit to changing the culture and policy through long-term plans with clear logistical processes to adopt a more open and engaged environment

(Tennant et al., 2019). This requires support for staff education, infrastructure, and financial incentives, as well as collaborative efforts to overcome barriers currently hampering the uptake of national policy at individual, faculty, library, university, and national levels. While university repositories are pivotal for the creation of a more dynamic approach to open scholarship, these must be accompanied by advanced networked systems to improve visibility, reduce cost, and increase the speed of accessibility while maintaining the prestige and quality of research outputs and information.

Thus, as the frontiers through which knowledge is being advanced and shared are reshaping the landscape in which academic research can have an impact on society, this article has illustrated the failure of many academic institutions to lead such global advances and redesign their internal practices in line with international calls to promote knowledge translation for societal benefit. This represents a significant missed opportunity for universities to fully benefit from our knowledge society. Universities can and should not only be creators of knowledge but also innovators, opening new fields of inquiry and facilitating different kinds of engagement and knowledge sharing. The circulation of information outside of the walls of the university—or library, publisher, or conference proceedings—is now just as important as the specialist knowledge held within, and this in turn is blending familiar notions of outreach with publication and dissemination of online content. The benefits for the public and for the institutions themselves of this new democratization of knowledge through social media and the Internet more generally are clear to see.

This review therefore represents a call for universities to take further action recognizing the importance of open scholarship in our information age and the need for an academic paradigm shift. While significant challenges exist, universities are part of a vibrant and globally connected information society and are uniquely positioned to promote themselves as open knowledge institutions, because of their liberal values, core knowledge mission, and cornerstone role in our communities. Yet for universities to become fully fledged engaged, inclusive, and open knowledge institutions, there is a need for more collaboration with public, industry, and community sectors to address the current barriers and support different paths according to diverse disciplines and forms of research, to promote open scholarship, and to ensure research is more freely and easily available for societal benefit.

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