



Benefits to the Private Sector of Open Access to Higher Education and Scholarly Research

A Research Report to JISC from HOST Policy Research

Dr David Parsons, Dick Willis and Dr Jane Holland

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- The Skills Funding Agency (with whom we hold framework agreements for Good Practice Research; Operational Evaluation; Strategic Evaluation; Offender Learning; Qualifications and Credit Framework (QCF); and Adult Learning) and DWP (with whom we hold three framework agreements, for Ageing and Pensions; General Labour Market Research; Integrating Employment and Skills; and Welfare to Work Programme Evaluation). We also hold a joint DWP/HM Revenue and Customs (HMRC) framework agreement for research and evaluation on Commissioning, Performance and Business Delivery.
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- Sector Skills Councils (SSCs) and Standard Setting Bodies (SSBs). HOST recently completed two projects for the UK Commission for Employment and Skills (UKCES),
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Chapter 1: Introduction

1.1 The review

HOST Policy Research (HOST) has recently concluded an intensive and pioneering study for JISC on the benefits to UK industry and commerce of Open Access (OA) to higher education research outputs. The UK study was commissioned by JISC on behalf of the UK and home nation stakeholders to the UK's Open Access Implementation Group (OAIG). The report and its findings are the responsibility of HOST, but include some extended discussion and analysis following JISC and partners' comments on an earlier draft.

1.2 Background

Knowledge transfer from the higher education (HE) and further education (FE) sectors has been a long-standing issue for public policy. With increasing technological possibilities, there is interest in how 'Open Access' publication may provide greater potential to stimulate impacts from HE research and scholarly study and in particular for innovation and upstream technology transfer. Wider European research has already shown some utility and impact¹ for Open Access in the private sector and this study now seeks to review the position in the UK.

Open Access (OA) publishing has been a feature of research dissemination for two decades. The Public Library of Science (PLOS) briefly defines OA as constituting 'free availability and unrestricted use' but also recognises differences between OA providers in the extent to which permission barriers are removed. A simple distinction has been made² between 'Gratis' OA, which removes only price barriers, and 'Libre' OA, which removes price barriers as well as (at least some) permission barriers. Cutting across this, there are two accepted models of Open Access. The first, 'Gold' OA, involves peer-reviewed publication in an Open Access journal where all costs are borne by the disseminating parties – enabling others to have free access. This includes some major 'open' publishers such as the Public Library of Science³ and BioMed Central.⁴

The second model, 'Green' OA, involves publication in an institutional (eg Harvard University's DASH)⁵ or subject (eg Cornell's arXiv⁶) repository. Compliance with the Open Archives Initiative⁷ standards ensures that repositories are interoperable, with some possibly providing 'post-print'⁸ access, others 'pre-print'⁹ only, and some providing a mixture of both. Such repositories do not carry out peer review themselves but normally host articles that have been peer reviewed elsewhere, with a majority of

¹ For example, specific research in Denmark on the benefits of OA to Danish SMEs and parallel work in Germany (Economix) and Norway (SPD) among others.

² Suber, P. Open Access Review <http://www.earlham.edu/~peters/fos/overview.htm>.

³ <http://www.plos.org>

⁴ <http://www.biomedcentral.com>

⁵ <http://dash.harvard.edu>

⁶ Centred on content for physics, mathematics, computer science, quantitative biology, finance and statistics: <http://arxiv.org>

⁷ <http://www.openarchives.org>

⁸ A post-print is a digital draft of a research journal article after it has been peer reviewed. Post-prints are not always published but where they are may sometimes be the same as the published version, depending on the publisher.

⁹ A pre-print is a pre-peer review draft of a scientific paper which will not yet have been published in a journal.

publishers now giving permission for Green OA,¹⁰ although often with embargoed periods before OA publication is possible.

Gold and Green OA has now deep roots. The BLEND and Quartet projects published open electronic journals in the mid 1980s and, in 1991, the EJournal was first published as an all-electronic, peer-reviewed, multi-disciplinary academic journal. Subsequent watershed developments stemmed from the USA and included the National Academies Press (publisher for the National Academy of Sciences, Institute of Medicine and other arms of the US National Academies) beginning to make available free online full-text editions of their books alongside priced, printed editions in 1994. Three years later the case for OA repositories was made when Harnad (Harnad, 1997) argued that Internet growth made it possible for researchers to maximise research visibility and impact by self-archiving.

A step towards the wider (international) adoption of OA has been cross-national protocols to guide researchers, their host institutions and funding bodies, firstly through the Budapest Open Access Initiative¹¹ in 2002. In the next year this was followed by the Bethesda Statement on Open Access Publishing¹² and later by the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities.¹³

OA was quick to gain currency in some disciplines and domains. By 2004, for example, Kurtz (2004) demonstrated that, in astrophysics, the impact of online unrestricted access was becoming apparent. Then contemporary studies of citation rates were also indicating increasing use (Harnad and Brody, 2004; Antelman, 2004; Eysenbach, 2006), although this analysis is not without its critics,¹⁴ and it also does not always account for substantial disciplinary differences.

What is clear is that this picture of rising currency was not uniform and in many disciplines OA content has been relatively slow to take off.¹⁵ Conventionally this is seen to be limited initially by publishers' agreements but it also reflects authors' discretion and choices for archiving their materials. This has been despite a growing number of host institutions and public and other funding bodies having encouraged, and in some cases mandated, published researchers to do so. Consequently, despite these developments, the Research Information Network (RIN)¹⁶ has identified a lack of access to journal articles, due to subscription barriers, as remaining a key frustration of researchers, including those in the private sector (2006b).

On a larger sample basis, RIN has since suggested the proportion is closer to about 10% of UK scholarly publications available through some form of Open Access model (Research Information Network 2006a) and Bjork et al. (2009) put this globally at just over 8% after an embargo period. RIN has most recently suggested:

'Open Access content may become increasingly important as a means of overcoming researchers' current frustrations, but it is not available in sufficient volume as yet.' (Research Information Network, 2009)

OAIG has a direct interest in better understanding not just the potential and mechanisms for widening the access to OA but also its quality of use. Unpicking this involves understanding a complicated inter-relationship between 'supply' (OA pathways and

¹⁰ For up-to-date statistics see <http://romeo.eprints.org/stats.php>.

¹¹ <http://www.soros.org/openaccess/read.shtml>.

¹² <http://www.earlham.edu/~peters/fos/bethesda.htm>.

¹³ <http://oa.mpg.de/lang/en-uk/berlin-prozess/berliner-erklarung/>.

¹⁴ For example, Davis et al. (2008) found no evidence of a citation advantage for Open Access articles in the first year after publication.

¹⁵ For example, Harnad et al.'s analysis in 2004 noted that only about 10–20% of articles have been self-archived even though by then 90% of the publishers mandated 'Green' OA. This figure was broadly confirmed by RIN, in its 2006 baseline report of UK scholarly journals.

¹⁶ RIN, The Research Information Network, www.rin.ac.uk.

content density) and demand (use and utility). In this, securing benefits from Open Access and enabling them to be realised remains an important demand (and potentially supply) driver, and is reflected in JISC's strategy to support the 'Open' agenda and the establishment of the OAIG.

Past and ongoing commissioned work by JISC has already modelled demand and potential¹⁷ and this has informed OAIG recommendations with respect to identifying information needs. The HOST study focuses on private sector benefits (ie in industry and commerce including traded services) and aims to inform parallel studies of OA benefits in the UK public and third sectors.

1.3 Objectives and scope

The focus of the current study is not on assessing private sector demand, but on identifying, mapping and reviewing practical illustrations of benefits. In particular, the study was asked to look at:

- Identifying and, where possible, quantifying tangible and attributable benefits in Open Access engagement to university research outputs.
- Identifying success factors and recurrent enablers to realising these benefits.
- Establishing illustrations of what and how benefits were realised, the timescale for realisation and transferability of that experience.

The study was also asked to review the quality of available evidence, how this might be addressed and to propose an evidence-based typology of Open Access engagement and benefit realisation over the short, medium and longer-term.

The scope of the project has been highly focused, drawing in particular (but not exclusively) on evidence relating to science and selected technology sectors, and Open Access to, and use of, published and systematically disseminated research-based outputs. OA (and non-OA) use has centred on research outputs from universities and public sector research establishments by industry and commerce. Research funded wholly or jointly (with industry and others) through the Research Councils, and in dual funding through the higher education funding councils, has been prominent. The review has also taken account, where appropriate, of other sources of public funding including mainstream government departments and non-departmental public bodies and agencies.

1.4 Methodology

The study has been conducted intensively and in two phases, which are set out in more detail in Annex A. The first phase of activity centred on establishing contact with a series of key stakeholder agencies, conducting a systematic literature review to set the study in a wider context of evidence concerning Open Access use by businesses and any benefits identified from past research. The second phase of activity extended the evidence and involved:

- Interviews with a series of selected stakeholders and technology orientated business bodies. A total of 14 national and home country stakeholders were consulted, with several providing valuable insights about OA use in knowledge and technology transfer and private sector benefits.

¹⁷ See, for example, Key Perspectives (2008); Houghton, et al. (2009); JISC (2009a & b); Cook et al. (2011)

- Preliminary identification of businesses likely to have an interest in, and experience of, Open Access. These tier 1 (T1) interviews were conducted mostly as semi-structured telephone interviews and a total of 44 enterprises were engaged – divided almost equally between small and medium-sized enterprises (SMEs) and larger businesses including corporate multinationals. The selections were made from a 'long list' of potential T1 interviews emerging from existing working relationships, liaison with Knowledge Transfer Networks and other social media business networks, sector bodies and some of the stakeholder discussions.
- Conducting nine more detailed enterprise profiles of OA use and benefit identification, drawn from businesses identified as having relevant experience. Interviews were with key staff, usually including executives concerned with university relationships and/or research strategy, and often involved more than one functional manager. Interviews were conducted through a combination of face-to-face and telephone discussions.

Annex C sets out national organisations and professional bodies consulted.

The aim was for this fieldwork stage to extend the available knowledge and identify any parallel research and/or possible 'use and utility' case studies among UK-based businesses. The evidence was put together in a progress report (and literature review) and this final report, which has benefited from inputs from the critical friends to the wider JISC review – Professor Charles Oppenheim and Frederick Friend.

It is important to recognise that this methodology, and the intensity of the review, has been geared to providing indicative evidence of business benefits of OA. Its focus on research and technology-orientated businesses has in particular emphasised experiences from enterprises in life and biosciences, advanced engineering and some technology sectors. While a valuable cross-section of such experience has been secured, this is not presented here as representative, or likely to be representative, of all such firms in those or other business sectors.

1.5 The report

This report is set out in five chapters which, following this introduction, look at:

- The study context and, in particular, available (past) evidence of businesses and benefits of engaging with publicly funded research, as well as access to and discoverability of research and business engagement in OA policy (Chapter 2).
- Business engagement with Open Access, including business models, knowledge transfer contexts, awareness and distinctive use of OA and its role and contribution to businesses (Chapter 3).
- Benefits of OA to the private sector including a review of the nature and limitations of the reviewed evidence, benefits and impact of OA, and in-company enablers and constraints to securing benefit (Chapter 4).
- Conclusions and recommendations (Chapter 5).

Supporting annexes are included on the review methodology and T1/2 employer interviewees (Annex A); bibliography (Annex B); and national organisations and professional bodies consulted (Annex C).

Chapter 2: Context

2.1 Introduction

As the previous chapter has noted, OA has been established as a dissemination pathway for university and publicly funded research for two decades and has generated considerable literature about its nature, use and trends in demand. Any consideration of the benefits to private sector businesses of Open Access to publicly funded research outputs must start with a review of this evidence and wider information on the context of the overall value of publicly funded published research (OA and non-OA) to the private sector. Consequently, this chapter looks at:

- Benefits to businesses of publicly funded research.
- Discoverability and publication of research, and access to it.
- Value to business of research outputs.
- Business attitudes to OA and OA policy.

The source material is drawn mainly from other published research and commissioned studies. This provides a backcloth to the following analysis drawn from stakeholder comments and fieldwork with employers, as set out in Chapters 3 and 4.

2.2 Benefits to businesses of publicly funded research

Private sector businesses¹⁸ are heterogeneous components of the economy demonstrating great diversity that cuts across operating sectors, size, operational and ownership structures, underpinning technologies and their operating management capacities and capabilities. As such, their need for, and actual or latent use of, university and scholarly research, varies considerably.

There is a substantial body of work supporting the benefits to the private sector of publicly funded research. However, the causal link between investing in knowledge through public sector-funded HE research and the return on this investment to the private sector is obscure and understanding its characteristics, diversity and robustness remains in its infancy.¹⁹ However, there is an accumulation of studies that provides evidence of tangible economic benefit,²⁰ in particular in terms of product innovations achieved and revenue gained through enhanced sales. This includes the work of Salter and Martin (2001), whose critical review of the literature on the economic benefits of publicly funded research confirmed that virtually all econometric studies of the impact of research in general on productivity find a positive rate of return.²¹

Salter and Martin also cited earlier studies from Mansfield (1991 and 1998), surveying Research and Development (R&D) Executives in US companies and from Beisea and Stahle (1998) in Germany. These studies also confirmed broadly similar results. The

¹⁸ Defined here as non-publicly owned or funded organisations trading products and commercial services in one or more parts of industry and commerce.

¹⁹ Philip Maystadt, President, European Investment Bank, in the preface to EIB Papers, 14 (1), 2009.

²⁰ See, for example, Narin et al., 1997; Mansfield, 1995; Toole, 1999; Tijssen, 2002; McMillan and Hamilton, 2002.

²¹ They are critical of both measurement and conceptual difficulties, in particular the use of simple production function models of the science system which ignore a range of other economic benefits.

evidence from Germany was that around one-tenth of innovations relied on public research and that they accounted for around 5% of new product sales.

The reasons for these benefits have attracted some, although rather less, attention from UK-based quantitative researchers. Martin and Tang (2006) revisited the 2001 study, confirming that businesses achieve benefits in a number of ways from accessing research. Significantly, they also highlight the importance of 'demand pull' and (in essence) innovation strategy, resourcing and organisational focus, stating that:

'...many of the economic benefits from basic research depend as much, if not more, on the approach that companies take to innovation as on the strength of the science base. In other words, these benefits depend on whether companies adopt a positive and far sighted approach to drawing on the results of research...Government policy needs to reflect this fundamental point and to find effective ways of influencing the thinking of companies accordingly.'

Key Perspectives (2008), in their report to the JISC Scholarly Communications Group, concluded that SMEs (and not only those that are research-based) need to use the published journal literature on occasions. This work highlighted the barriers experienced by such businesses, in particular, in understanding how to access appropriate material. The report recommended that advice should be provided to the SME community about Open Access research literature.²²

The lack of homogeneity in the private sector has been reinforced by other evidence and, in some cases, has pointed to what might be seen as counter-stereotype observations. For example, a study for the Publishing Research Consortium (Ware, 2009) concluded that people in small high-tech businesses value information more highly and read more journal articles than those in larger companies.

2.3 Access, discoverability and publication of research

A specific aspect of the JISC 2007 research centred on discoverability of research and Swan (2008) has since looked at the availability of academic grey literature to UK SMEs. This research confirmed that, to smaller businesses, discoverability was a significant problem. It showed that SMEs require access to grey literature of various types and would welcome the chance to use reports, survey results, theses and datasets that universities could provide. However, many such businesses do not naturally consider the university community as a source, instead turning to intermediaries such as trade or professional bodies or simply using standard web search tools such as Google – an approach almost universally adopted by companies in this current study.

Swan also found that some SMEs – not only research-based or high technology enterprises – do need to use the published journal literature but find this difficult because of cost barriers and because only limited access is available through their local university (if at all). Swan (2008) and Martin and Tang (2006) conclude that discoverability and access barriers for many, if not all, SMEs clearly impact on the ability of such businesses to make use of research. This evidence has had a particular influence on the case for stakeholders promoting broader OA content and wider use as a contributor to enhanced business performance.

Ware (2009) found that, in the business community, of those who consider information important, 71% felt they had good access and a clear majority (60%) felt that the situation had improved over the previous five years. The businesses surveyed used a

²² A recent search of the main UK government business advice portal, Businesslink.gov, reveals no reference to Open Access literature.

wide range of access channels but found pay-per-view (PPV) arrangements costly and difficult and 'walk-in' access at a local university impractical or inconvenient. In addition, they highlighted a lack of contextual awareness amongst businesses of the nature of research being undertaken²³ which may impair utility.

Houghton, Swan and Brown (2011) found that over a third of respondents (38%) reported that they always or frequently had difficulty accessing research articles and a further 41% said they sometimes had difficulties. In this research, only 6% said that they never experienced access difficulties. Houghton et al.'s respondents reported an average of 60 minutes of staff time, often at professional level, wasted trying to access each article that presented difficulties. The authors estimated this as costing the equivalent of £64 million per annum for Danish specialist researchers alone.²⁴

The Houghton, Swan and Brown report also reinforces one of the key differences between the academic and business worlds in terms of access to, and use of, research outputs. Much of the academic research is organised into, and disseminated predominantly through, specific discipline or sub-discipline groupings with publications reflecting these distinctions. Businesses, by contrast, rarely focus on the conventions represented by such boundaries and research exploitation is often characteristically cross-disciplinary in its nature.

This has substantial implications for the use of published research, since such companies need sufficient capacities and breadth of access for them to be able to scan widely enough to be aware of multi-disciplinary developments that may be of relevance and then to be able to gain access to specific content. For scanning, the material to which they may need access is likely to be spread across too many titles to render the subscription publishing model a viable and sustainable route to securing new evidence and intelligence, whilst for detail the PPV model imposes significant rigidities and, for SMEs at least, unacceptable costs.

In the specific context of Open Access, the functionality of repositories may impact on discoverability, although the evidence here is essentially anecdotal; low levels of repository use by non-academics may be related to difficulties in navigation for individuals more used to browsing commercial websites where considerable effort has been dedicated to usability. McKay (2007) has highlighted these and related issues, commenting that 'virtually nothing' is known about the end-users of institutional repositories, and there appears to be little subsequent published research in this important area.

As a final observation on the issue of discoverability, it is interesting to note that businesses themselves are seeing the opportunity to exploit the need for better discoverability (although not specifically Open Access). The web service Mendeley²⁵ (launched in 2009) offers integrated academic search and peer recommendation functions; it now claims to list over 90 million academic papers and has over one million members. Similarly, CiteULike²⁶ combines algorithm-based search functionality with social networking recommendation-based technologies, enabling a researcher to build and share a library of relevant papers into which the site automatically extracts citation information and metadata. The user is able to see other researchers who have (publicly) identified the paper as being of interest and thus rapidly build up a network of researchers interested in similar fields.

²³ This point is under discussion between the Technology Strategy Board and RCUK. The opportunity exists for current research to be highlighted to the business community through the TSB's '_connect' collaboration platform (D Coates, pers comm.).

²⁴ This figure is based on average earnings for Danish researchers using FTE figures generated by Eurostat.

²⁵ <http://www.mendeley.com>

²⁶ <http://citeulike.org>

2.4 Value to business of research outputs

Much of the earlier work on the value of research outputs to businesses was brought together by Houghton, Swan and Brown (2011). This watershed research has been referred to by a number of stakeholders in the present study, although for the purposes of this review with some self-diagnosed limitations.²⁷

The study examined levels of access to, and use of, research and technical information by knowledge-based, technology SMEs in Denmark. It identified that 27% of products and 19% of processes developed or introduced during the last three years would have been delayed or abandoned without access to academic research. The impact was substantial – they found that these new products contributed an average of 46% of annual sales and on this basis they calculated that the value of academic research to sales was equivalent to £1.8 million per firm per year and the average value of cost savings was £58,000.

Beyond direct cost savings, access to research articles was seen to have a significant effect on shortening development cycles. Consequently, Houghton et al.'s Danish respondents reported that, on average, it would have taken 2.2 years longer to introduce new products or processes in the absence of access to contributing research. The financial impact was considerable and, had such access not been possible, this was estimated at, on average, a 28% reduction in revenue per company – predominantly in lost product sales. At the same time, the financial impact was seen to have been sub-optimal and, in particular, the difficulties and delays accessing research articles were seen to create business burdens and added costs, as noted above.

Due to the limitations of the sample group, Houghton, Swan and Brown's calculations of financial benefit cannot be taken as representative of SMEs, either in Denmark or elsewhere. However, they provide evidence of the likely significant scale of potential savings, at least to some businesses, through better discovery of and access to research and technical information.

2.5 Business attitudes to OA and OA policy

There is some existing evidence that businesses are accessing research via Open Access sources. Ware (2009) sought evidence to estimate SME engagement with OA and established that 10% of SMEs already obtain content through OA journals and 4% through OA institutional repositories. Significantly, Houghton, Swan and Brown (2011) noted that more than 50% of their respondents used free institutional or subject repositories and Open Access journals monthly or more regularly; among researchers 72% reported using free institutional or subject repositories and 56% Open Access journals monthly or more regularly. The large contrasts between the Ware and Houghton et al. figures is likely to result from the particular focus in the latter's work on highly research-intensive incubator companies in contrast to the broader sample in Ware's research.

Given these findings, the established value of research to business and the growth of Open Access over the last decade, it is perhaps surprising that the importance of OA to businesses does not seem to have a higher profile in the UK where, for many years, there has been strong focus on the need to transfer and exploit knowledge to the benefit of the wider economy. In 1998, the Department of Trade and Industry stated, 'A

²⁷ Page 25 of the report notes that 'this is not a large or random statistical sample and should not be interpreted as representative of SMEs in general or even of knowledge-based SMEs'; nonetheless, many of its findings mirror other research. In addition, incubator companies are often located at or near universities in Denmark and often have close ties to those universities. They may therefore have better access to research than most SMEs and/or greater access needs.

knowledge economy has been described as one in which the generation and exploitation of knowledge has come to play the predominant part in the creation of wealth. It is not simply about pushing back the frontiers of knowledge; *it is also about the more effective use and exploitation of all types of knowledge in all manner of economic activities*'.²⁸

The conclusions and recommendations of the tenth Report of the Select Committee on Science and Technology: *Scientific Publications: Free for All?* (July 2004²⁹) were strongly worded in favour of Open Access. However, these made no reference to benefits that may accrue to businesses and thus the wider economy of more widespread adoption of this means of distribution. The government's response at the time was interpreted as cautious, claiming to aim for a 'level-playing field' for conventional and new forms of scientific publishing but maintaining the status quo through inaction. As noted by Friend (2006), 'Intense lobbying by vested interests was seen as a major influence upon the Government's Response'. Like the original report, the government's response failed to reference benefits to business and it seems the Committee has not subsequently addressed the OA issue.

The contrast between this situation in the UK and that in the USA is considerable. In the USA, Open Access has a much higher profile, with high level support from the business community. In 2004 the United States Chamber of Commerce welcomed news³⁰ by the National Institute of Health (NIH)³¹ that it would require its funded researchers to publish final peer-reviewed manuscripts on PubMed Central 'to make them accessible to the public in order to help advance science and improve human health'.³² However, while the business voice in the USA has been more evident, it seems also to have been more volatile, with the position of the Chamber subsequently changing to oppose OA measures in Congress.

Other evidence suggests that, despite the changed position of the Chamber, business support for OA in the USA remains strong. Organisations such as the Alliance for Tax Payer Access,³³ which includes business organisations, bring together a broad base of support for the policy position of the NIH. This policy was also endorsed in 2006 by the Committee for Economic Development and in 2007 by the NetCoalition, both powerful business lobbies. In 2009 the Commission for Economic Development again endorsed this approach, lobbying in favour of the Federal Research Public Access Act, which would have generalised the NIH policy more widely across the federal government.

In many respects, the attitudes of these companies reflect the movement to open innovation in the private sector; Chesbrough (2003) noted that companies were increasingly making themselves more permeable to the flow of knowledge through a variety of strategies including publishing their own research in the public domain. In the UK, positive support for OA from outside the HE sector appears to have come only indirectly from the business sector through groupings with a special interest in industry–higher education relationships. Consequently, in 2005, the Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA) released the Adelphi Charter³⁴ on creativity, innovation and intellectual property. The charter is strongly pro-OA, with its Principle 7 stating:

²⁸ Our emphasis.

²⁹ <http://www.publications.parliament.uk/pa/cm200304/cmselect/cmsctech/399/399ii.pdf>

³⁰ This was September 2004.

³¹ <http://www.uschamber.com/press/releases/2004/september/us-chamber-applauds-nih-open-access-proposal>.

³² In 1997, the US National Library of Medicine made Medline, the most comprehensive index to medical literature on the planet, freely available in the form of PubMed. Usage of this database increased around a hundredfold when it became free, strongly suggesting that prior limits on usage were impacted by lack of access.

³³ <http://www.taxpayeraccess.org>.

³⁴ <http://www.thersa.org/projects/past-projects/adelphi-charter>

'Government must facilitate a wide range of policies to stimulate access and innovation, including non-proprietary models such as open source software licensing and Open Access to scientific literature.'

More recently, in March 2011, the Engineering and Manufacturing Task Force of the UK Council for Industry and Higher Education (CIHE) issued an endorsement of OA.³⁵ In particular they noted:

'Universities should open their digital doors and use Web 2.0 networking technologies to give advanced manufacturing entrepreneurs and businesses systematic access to university research, rather than lock knowledge away in patents that often lead nowhere commercially.'

This touches upon an issue that is likely to become increasingly important with recent changes to the funding of HE – the tension between the dissemination (through publication) of intellectual property (through conventional *or* OA routes) and the desire of universities to maximise income through commercialisation. While the report 'urges UK universities to open their knowledge banks and to give more of their ideas away free of charge', it also claims that, in spite of many successes, universities are not always managing these tensions well, spending more than £50 million a year patenting ideas, many of which CIHE described as 'commercially worthless'.

On this evidence, universities may increasingly be presented with what they see as a tension, which will be difficult to resolve, between institutional commercial interests and early publication to support the wider community and economic value. This will see them urged to promote early and wide access to research outputs whilst also being indirectly encouraged to delay publication to allow the patenting of any research that could be commercially useful. At the very least, the result of initiating a patent application is likely to delay further the publication of potentially useful research to the market, irrespective of whether or not this is achieved through OA routes. How these tensions are addressed and managed in the sector would seem to be an area that would benefit from further research to identify emergent practice, perhaps also drawing on some contrasting international examples.

³⁵ <http://www.cihe.co.uk/category/taskforces/engineering-task-force/>

Chapter 3: Business Engagement with Open Access

3.1 Introduction

The extent to which the UK-based businesses that were involved in this review engaged with Open Access is dependent on a number of factors. These are explored here. These provide not just a useful context against which to review the findings on achieved and achievable benefits in Chapter 4, but also valuable evidence of the impetus for, and initiatives taken by, UK-based businesses to engage with the publications from publicly funded research. They include:

- The importance of publicly funded research to the private sector.
- Knowledge transfer and use of publications.
- Businesses knowledge of OA and its distinctive use.
- The role of OA and its contribution in business.

The starting point is the context within which academic publishing takes place and the potential importance of disseminated research-related information and intelligence to those businesses. The evidence drawn on here stems in part from the interviews with national stakeholders but mainly from the 44 employers identified and interviewed. These provide valuable insights but we again caution that they were selected for their research orientation and likely experience of OA use and utility, and, as such, are not representative of views of any particular sector or of the economy overall. The final chapter returns to issues of how a wider view might be taken of the contribution of OA to the UK private sector.

3.2 Publicly funded research and business models

The emergence of Internet publishing has clearly had a distinctive and, some might say, disruptive influence on academic publishing channels. Recent years have seen a proliferation of publications, perhaps influenced in the UK by funding-led increases to research capacity and incentives at the heart of the Research Assessment Exercise (RAE) and now Research Excellence Framework (REF). As the volume of available material increases and, with it, the market for academic and professional-facing specialist journals, the challenge to businesses of finding relevant material becomes more extreme.

As in other economic areas, Internet publishing potentially provides a direct route to the market, irrespective of whether or not the market consists of other academic or commercial users of knowledge. However, in this respect academic practice seems slow to change, particularly when publication rates, citation indices and the quality of journals represent key metrics for individual careers and institutional reputations (and research funding). In addition, whilst free at the point of consumption, Gold OA publication sometimes represents a shift in the cost of publication from one place to another, not the removal of the cost entirely, although (as the report by Houghton, Swan and Brown (2011) noted) all OA routes lead to an overall reduction in costs.

The majority of stakeholders interviewed for this study had no strong position on Open Access, reflecting the position of the UK Government as set out in its response to the Select Committee for Science and Technology in 2004. Indeed, several stated that publication strategies are a matter for individual institutions. A number of stakeholders

were unwilling to comment and others were unwilling to participate, one going so far as to say:

'Having read them (the project summary and interview guidance) and considered the study carefully we have decided not to participate in the research. The primary reason for this is that we do not believe that a study which examines only the benefits of Open Access, rather than looking holistically at all impacts, will add constructively to the evidence base that informs policy on scholarly publishing.'

Discussions with the Research Councils revealed an essentially common perspective but mixed experiences on Open Access. All those interviewed now have policy statements encouraging funded researchers to disseminate through OA, although one drew up its statement only in 2011. These promote (as soft encouragement) the use of this publication route but, with the exception of one case, do not specifically require outputs from funded projects to be made available even after embargoed periods for publications on OA repositories. The Medical Research Council (MRC) mandates its researchers to publish on UK PubMed, which it part funds. However, the Biotechnology and Biological Sciences Research Council (BBSRC), also a part-funder, does not similarly mandate this route although the Council suggests that a large part of the resulting output is published there.

The reasons for this position varied. At least two councils were concerned that they should not be seen to intervene in researchers' publication decisions and to emphasise that 'choosing the publication with greatest impact' for dissemination should be an autonomous decision by the authors. Those with extensive programmes for jointly funded industry–council research felt that mandating OA would discourage leading businesses from such investments, with the knock-on effect of reduced research funding and a weakened published evidence base.

More generally among the councils, although there is now a shared position on encouraging OA publication, there remains a reluctance to establish a policy to mandate OA. A recurrent concern emerging from this review was that this would raise issues of measuring compliance which, even with the development proposed on the Research Outcomes System, would be impractical to police. At present, and for a variety of procedural reasons, the Research Councils appear to have incomplete and, in one case at least, 'fragmentary' information about publication outcomes post-grant/award. Although the cross-council strategies and developments may make such information more comprehensive in due course, it is still unlikely to be able to distinguish if and where publication is through Open Access. PubMed represents a clear focus for publications funded by the MRC, as does ARXIV, for many of the mathematical or physical sciences, but in other research areas key repositories are not as distinct.

In an era of shrinking budgets, the cost of maintaining subscriptions is widely noted to be an increasing challenge for institutional libraries (and also for businesses). However, a move to Gold OA would not remove costs but shift them elsewhere within the institution from library budgets to authors or departments. Even where Gold OA reduced those costs it would place a burden on line budgets unless accommodated by more flexible approaches from research funding bodies to support, for example, post-award publication. There were also other concerns and one anonymous interviewee noted that if Gold OA was widely adopted it could mean that a disagreement with a head of department or other funding gatekeeper could result in the ending of the researcher's career through an inability to publish). Some research funders make provision for Gold OA publication costs within their grant awards, but for the others, any costs occurring post-award or additionally may have to be borne by the institution. Publishers' Gold OA charges vary considerably, and a few set very high fees for this route.

Amongst other stakeholders there is recognition that Open Access is likely to be an increasing focus of attention. The Institute for Knowledge Transfer (IKT), for example, commented that, although Open Access is not represented in the institute's business plan, it is an issue 'on the horizon' and could be of benefit to members and others. The Association for University Research and Industry Links (AURIL) made a similar point, commenting that in the past members have expressed an interest in exploring how OA may affect business models and, if members continue to drive an interest in this subject, AURIL will respond accordingly.

In contributing to this review, the Technology Strategy Board (TSB) noted that Open Access as an issue for knowledge transfer was widely discussed. However, it was felt that multiple repositories, whether duplicated by institution or topic, could create confusion about where best to find relevant material. In TSB's view, single credible resources like PubMed will certainly help, whilst multiple repositories may make matters worse. It was acknowledged that duplication could be addressed by standards-based approaches to ensure that search tools work effectively across multiple repositories. However, even if this is the case, there are concerns about usability of repositories which can be opaque and therefore off-putting to non-academics searching for relevant literature. A similar point was made by others at IKT who also saw benefits for users of repositories where new and old research on particular topics can be brought together in one place.

In defence of subscription models, a number of 'proxy' points were raised by some stakeholders on behalf of publishers. Firstly, there is a view that material may not be valued by the reader simply because it is free, although this was not substantiated in any of our interviews with businesses. Secondly, there is an argument that, if people have to pay for the information, they are more likely to make an effort to make sense of it and use it; this was also not reflected in our interviews. Thirdly, if a Gold OA journal continues to attract authors (and publications) this is not a de facto indication of demand for the product or recognition of its value, whereas payment through subscription or PPV is a likely to be a more direct indication that there is a demand for the content.

The same proxy evidence suggested that, as an alternative to Gold OA, Green OA creates a challenge to traditional publishers' business models as it is felt likely that readers would not want to pay for a peer reviewed version if they can get a version that appears the same, for free, although in practice the repository version may (post-print) or may not be peer reviewed (but will probably not be copy-edited or formatted to publishing standards). Publishers would argue that their processes add significant value to users, not only through editing, formatting and consistent peer review, which have a cost, but also in the bibliographic and archive processes that ensure articles are discoverable and remain available in the long term.

Several stakeholders commented that access to papers is only one route for a business to make use of research and that other factors are also important. Not least of these is the organisation's capacity to review, understand and apply the research – an issue touched upon by Ware (2009) as 'context awareness'. Others have since amplified this issue. CIHE, for example, commented that, although OA would make a contribution to wider business use of publicly funded research, it would probably only make a minor contribution until and unless academic outputs became more apparent and digestible to many more companies. These concerns, about lack of familiarity with academic culture and language, inadequate subject knowledge and in particular demands on the skills and available time of business personnel, were also reflected in comments by business interviewees and are considered further in section 3.4 below.

3.3 Importance of publicly funded research to the private sector

Our study clearly demonstrates that, among these companies, although not representative of all businesses and sectors, academic research is nonetheless regarded as important to the majority. This applies across a range of business sizes and sectors in this review and may reflect Chesbrough's (2003) earlier assessment that businesses were becoming more permeable to the flow of knowledge including from university research. Consequently, only two of the 44 participating companies in this review do not make use of published academic research outputs although both of these make extensive use of standards or regulatory-based materials (which are, of course, derived from research):

'...the material which we do sometimes need to see comes from HSE or their German counterpart which is published free of charge.'

Conformance Ltd

'We work in applied software and no longer use academic research. However, we are reliant on corporate material, particularly that provided by Microsoft for its developer network.'

AIS Ltd

A number of respondents felt that academic research was frequently behind their requirements and, as a result, they seek to drive the research focus for researchers through various routes and this has a higher priority than using published material. This view was reflected in around a half of the multinationals engaged in the research, but was not limited to them:

'We tend to approach it the other way around...ie we'll ask people what to research. We have a PhD student from Bournemouth/Bath with us at the moment doing some heavy-weight stuff in CGI, but we've set all the topics.'

Aardman Animation Ltd

Among the companies consulted, all but three made use of published academic work to a greater or lesser extent although, in some cases, the use of academic research is almost peripheral. Fujitsu UK Services, for example, employ a dedicated researcher to support the development and marketing of new services.³⁶ Much of their focus is on commercial and market research rather than academic outputs, although these are used. Through web searching they build up a list of resources – contacts, sites, blogs and articles – but feel that there is now a blur between academic and non-academic materials.

For many larger companies, particularly in the advanced engineering and pharmaceutical sectors, generating and harnessing research outputs is the life-blood of the organisation. They consequently seek to be deeply embedded in, invest heavily in and sustain a global culture of research and development through both their own teams and diverse and often very extensively funded academic collaborations. For many of these companies, this is a crucial aspect of their business strategy (and investor confidence), centred on staying at the cutting edge of new knowledge and translating this into often novel or market-leading products or new tradable services.

The big pharmaceutical sector typifies this relationship with research and university expertise. GSK, for example, is by a considerable margin the largest private sector funder of research in the UK with extensive collaborations, joint and co-operative ventures involving higher education. GSK's research and development expenditure from all sources in the UK topped £1.6 billion in 2009 – representing over 40% of its global

³⁶ The Fujitsu Group also has a global network of dedicated research laboratories which undertake commercial and collaborative research.

R&D spend. However, such a deep and vital relationship to academic expertise is not limited to big pharmaceutical companies. Rolls Royce, for example, currently invests only a little under £1bn per annum in R&D and now invests heavily in nearly 30 University Technology Centres. These provide the company with access to teams of world-class researchers and a critical mass of engineers and technologists working in particular specialisms relevant to current and emerging project needs in the business. Similarly, Airbus works with a group of strategic partner universities, with which it has framework agreements, and also carries out extensive in-house research on commercially sensitive areas. In addition, the company maintains close links with the academic research sector through sponsorship of PhD students, including CASE awards. Ricardo and British Telecom (BT) in the telecommunications sector, which both contributed to this review, shared similar experiences.

Some, but not all, of the companies engaged in this review were concerned not to open access to their research outputs to a wider audience but, instead, to restrict them for reasons of commercial confidentiality or to delay publication in order to ensure that patents are filed:

'Airbus may ask for publication to be delayed in order for the appropriate IP protection to be put in place. In all cases this is agreed before the research commences and embodied in the contract, which will include all relevant confidentiality and non-disclosure aspects.'

Airbus in the UK

However, among the businesses consulted in this review, this was a minority view and others saw a need to accommodate pressures on university staff to secure high value publication and external impact from research, and had developed various protocols with academic partners to do so. Some, such as GSK, recognised that much academic–industry research is pre-competitive in its nature and often funded through business consortia and not single companies, where active publication opens findings to wider scrutiny and review. Others, such as BT and Ricardo, actively worked to stimulate publications including among their own research staff.

For many of the companies in our study, irrespective of scale or sector, academic research is a critical component of their business. SLR Consulting, GL Garrad Hassan and Tech-Trends are all examples of companies that sell their knowledge and for which academic research is therefore an essential input. PlexTek, Moixa Energy Holdings, White Design Green Structures and AppliSci all utilise research to inform or inspire the development of new products and services:

'Research is a critical component of our due diligence process when developing a new idea – we review the academic literature to make sure that the evidence base supports our proposed development. Also, if we only find academic and not commercial research material, it's a good indication that the idea has not previously been exploited.'

Moixa Energy

'Overall we find it easier and more productive to lead and get academics on board for relevant specialist input, saying 'it is easier to design a challenge and to engage with academics to work on it, and then two or three years down the line, there is a paper in it.'

Green Structures

Engagement with published research is not only a matter of securing access to specific aspects of knowledge – or skills. A wide range of companies noted their need to scan widely across a range of disciplines or horizons. For these companies, including for example Rolls Royce, White Design, Ricardo, ST Ericsson and AppliSci, discoverability of

research materials is key and provides the opportunity to apply research in one area to problems in an entirely different sector:

'I need as diverse a range of sources as possible and I am initially looking for a high level view; I search by keyword to identify key papers, reviews and the names of authors, from which I then track back to identify further material.'

AppliSci Ltd

Even companies operating traditionally in one key sector now understand that cross-disciplinary research scanning is essential. Ricardo, for example, sees next generation developments as stemming from the interaction between non-engineering disciplines, including many from areas of technology that are traditionally well outside the normal interface of engineering and technology. BT reflected similar experiences and noted that embedded scanning was vital to their investments in key academic knowledge clusters globally.

3.4 Knowledge transfer and use of publications

The use by businesses of research outputs is influenced by a number of factors, including discoverability, access and the capacity of the organisation to understand and apply the research. Chapter 2 has shown how various authors, notably Swan (2008), have highlighted the problems of discoverability. The evidence emerging from this review confirms this to be a recurrent issue for businesses in diverse contexts, but suggests this does not operate evenly across the business sector. In particular, for larger research-intensive companies this can be less of a problem because of the resources they are able to devote to the process of identifying relevant literature.

Ricardo illustrates this situation. The company has a world-renowned resource in its research library, which is described as a 'knowledge management function for the firm'. It is staffed by professional librarians and supports online technology databases. This facility has been established since the late 1960s and has recently seen major investment by the company: it maintains subscriptions to all of the major automotive technology journals. However, like many other large companies, Ricardo uses a multi-faceted approach to knowledge search and transfer and invests substantially in highly formalised collaborative relationships with university academics as a means to identify emerging areas of interest and researchers who may subsequently become part of its extended network.

In many cases, commercial research budgets are under pressure and collaboration with HE presents a win-win arrangement. GSK, for example, sees such collaboration as 'providing access to academic researchers who have more time than our own scientists to think about the nature of emerging problems', whilst the academics are able to use commercial support to provide access to high quality research facilities. Such views are not limited to corporates. Plextek – a research-orientated micro-electronics SME – reflected the same views that university researchers had the time, orientation and skills to reflect on issues, a 'luxury our own teams just do not have'.

Collaborative arrangements for knowledge transfer are by no means the prerogative of large companies. Research-intensive SMEs also work this way – for example:

'Our approach to knowledge gathering is to conduct Google searches for relevant materials and then establish direct contact with the researchers we identify. In this way we have, for example, established a strong collaborative relationship with Peter Walker, an established authority on traditional building materials at the University of Bath.'

White Design Ltd

'I want a collaborative relationship so that I can follow up with the researcher to clarify what may happen in different practical circumstances. Research is valuable for more than just the content; it is the relationship with the researcher that really adds value.'

Commendium Ltd

Nonetheless, discoverability featured in a large number of interviews, particularly for SME and micro companies:

'Discoverability of relevant research is critical – there is a vast pool of material for which search ability is difficult. If I was still a practicing academic, it would be my job to know the right contacts, the individual researchers and institutions that are active in my field. But as a business person who's not engaged in any form of collaborative R&D, this route is closed to me.'

SLR Consulting Ltd

'Discoverability is a big challenge and I would welcome initiatives to improve the consistency and value of meta-data in order to improve the visibility of papers in search engine rankings.'

GL Garrad Hassan Ltd

For these users and others, including academics, the challenge of discoverability is being tackled by the market through the development of dedicated search facilities. Many of our respondents mentioned their use of Google Scholar as a search intermediary. However, more specialist search opportunities were also mentioned by three of the businesses reviewed. These included new start-up services, themselves in the private sector, such as Mendeley and CiteULike. Both of these companies use a mixture of algorithm-based search and social networking functionality – both are membership-based (Mendeley with around 1 million members, CiteULike with around 500,000) – and facilitate collaborative working. These arrangements seem to be aimed at tapping a distinctive demand for web services to help researchers create, manage and share personalised reference libraries from any location.

Such facilities could be used by, or modified for, business users to streamline search processes and aid discoverability. This would potentially improve the process of identifying possible academic or commercial collaborators and might also provide a basis for developing some form of business peer review (in parallel to academic review):

'I need a paper to be pre-qualified, to align to the issue in which I am interested. Something like "people like you also looked at" would be really useful.'

Fujitsu UK

'Some form of crowd-sourcing approach could be used so that the people from the commercial world would be able to provide a commentary on an individual paper and the presence of a large number of thoughtful comments would provide an indication of the value of that material to non-academic users. In this way papers could be reviewed by business peers, rather than only by academic peers.'

Think Associates

These are imaginative approaches to complex challenges generated by the great mass of published evidence from university and other research. However, the review also showed how even research orientated SMEs can struggle with this for various reasons, with one observing:

'It [the range of publication] is just daunting...sometimes the search possibilities are endless, and you do not know where to start or really have much of an idea about what is worthwhile and what isn't. I am really not sure that we find the best research or best people but how could a firm our size guarantee that?'

Plextek

Once discovered, access to papers can represent a significant problem for many business users and these issues are returned to in the next chapter. To this can be added concerns among many businesses in the review about the ways in which HE institutions present their research to businesses through their websites:

'...in general, on arriving on a university website, the sense that there is research knowledge just a couple of clicks away is almost non-existent, underlining the challenge we feel in finding scholarly research in our field.'

Creative Space Ltd

Like many non-market orientated organisations, universities run the risk of presenting themselves as promoting 'what we do', rather than, 'how we can help you'. At least a third of the companies consulted felt that their greatest challenge was not in discovering evidence but in understanding where best to look for key expertise. Publications were not seen as the most useful proxy for this and SMEs in particular felt isolated from ways of understanding where the best expertise on specific issues was located.

Some of the corporates involved (notably BT, GSK, Rolls Royce and Ricardo) reflected that even their substantial in-house R&D teams were not best placed to make such judgements and that their established collaborations with academia were funded in part because they provided ready access to wider academic networks and the quality of knowledge needed to make such judgements.

3.5 OA knowledge and distinctive use

Our discussions with companies typically showed only a broad general understanding of Open Access publication, often borrowing terminology from online newspapers or software, even amongst those with strong academic backgrounds. For some, the meaning of OA was 'obvious in the non-payment sense'. Overall, the review found some evidence for the use of Open Access journals and very limited evidence for the use of OA repositories – specifically PubMed, which is a globally renowned resource. This at best patchy understanding in the private sector of the role and focus of repositories compounds McKay's (2007) concern that very little is known about the dynamics of repository use.

Overall, the feedback from these businesses was that Open Access materials are encountered 'in the breach'; in effect, they are found almost universally by accident in response to web searching – if material is not subscription or PPV then it is Open Access. The frequency with which 'paywalls' are encountered varies considerably according to discipline but figures of ten PPV papers to every one Open Access paper were not uncommon among our interviewees.

The review found recurrent evidence of very high levels of resistance to PPV, notably among smaller firms. This was largely due to the perceived risk that payment will result in the purchase of an asset that turns out to be of little or no use, to be available to the searcher through another (free) publication or to consist of information that is already

known. Some of the specific experiences of businesses in this area are explored further in the next chapter, along with their 'coping' strategies (workarounds) which have emerged; these are often highly innovative and imaginative but also, for many, time-consuming and costly, especially for SMEs.

As a result, OA materials are very popular. With the exception of large companies who subscribe to resources themselves or pay for PPV directly – or with client budgets to do so – and those with academic collaborations, providing for more ready access to materials, businesses will almost universally avoid PPV. Here, the evidence suggests that SMEs adopt various workarounds to avoid paywall restrictions and, to minimise the risk of purchasing information that may turn out to be irrelevant, seek direct contact with the authors. In other situations, some interviewees reported that they might seek 'proxy' reviews of full publications from, for example, other academic contacts to determine their value before purchase. Other strategies include searching for free versions in other publications, or searching for conference presentations that provide the gist of an article. As noted, contacting the researcher also offers the opportunity to establish an ongoing relationship.

The popularity of Open Access has been recognised by the new generation of search facilities: Google Scholar will often indicate when a free PDF version of a paper is available and Mendeley provides an option to search only for Open Access materials.

3.6 Role and contribution to businesses of OA

Against the background set out above, for many research-orientated businesses, Open Access is not distinct as a model and establishing its contribution to companies remains problematic.

We found no evidence of companies attempting to impose policies of Open Access publication on their academic partners – in general, they recognise the need to publish and leave the choice of journal to the academics. Some, such as GSK, actively encourage their own researchers to publish. If, as is indicated in the available research and outlined in Chapter 1, OA increases citation rates, then there may be a future pressure to publish in OA journals in preference to subscription journals, but this review provides no evidence that this is currently an issue.

Interviewees who had active collaborations with universities and/or Research Councils provided little evidence of rigid and restrictive publication constraints being applied to jointly funded activities, although a resistance to Open Access seems to have been anticipated by the Research Councils. Indeed, those with funded university collaborations seemed to rely on jointly agreed protocols which were felt to encourage publication. Concerns, such as those voiced by Rolls Royce, focused on funded staff or centres at universities sharing directly relevant skills and expertise with competitors. As such, knowledge transfer through publication is seen by such businesses as more readily controlled and less threatening commercially, with spin-off benefits for both parties, and not as a constraint to OA content (and use).

The majority of smaller companies are not directly involved in larger-scale, jointly funded research and have at best peripheral relationships with funding bodies such as Research Councils. Their access to publicly funded research is predominantly through publication. In searching for appropriate sources of information or expertise these businesses strive through necessity or convenience to avoid PPV. As a result the review suggests that direct savings from a wholesale shift of material to Open Access would be modest.

However, such businesses could secure considerable value from intensified use of OA, the most significant contribution coming from its potential to save opportunity costs for businesses. As noted above, while such companies will avoid paying for papers or journal articles and seek alternative access, these processes create substantial opportunity costs for the business. Open Access, by making the full text version of the paper immediately available, has the scope to substantially reduce these costs. The researcher is able to scan the text and is well placed to make an immediate assessment of its value, without wasting time seeking alternative sources:

'As a new start business, we can't afford to pay for papers. With open access resources, this time-consuming and wasteful process is unnecessary.'

AppliSci

This overhead to companies can be substantial. In other research, Houghton, Swan and Brown (2011) commented that, in particular, the difficulties and delays in accessing research articles were seen to create business burdens and added costs, with an average of 60 minutes spent trying to access each article that presented difficulties, costing the equivalent of £64,000,000 per annum for Danish specialist researchers alone. While this level of quantification would require a larger sample than available in this small-scale review, the general experience is substantiated by our research. For example:

'Because I don't currently pay, there would be no financial saving to me if all research outputs were available in Open Access. However, I would get indirect benefits – by being able to access the full text immediately, rather than having to locate a free source, I would save time and my productivity would increase.'

Enterprise Software Architects

'...if all research was available in OA format, this would save only around £300 in PPV fees. However, the bigger saving would come because access to full text versions of papers would enable me to make a more rapid and accurate assessment of a paper's value and I would avoid wasting time in looking for free alternatives. I estimate that this saving in opportunity cost would be in the region of £5,000 per annum.'

Think Associates

'...any increase in open access that makes it possible to save time, by enabling immediate access to content, will be welcomed and would potentially save tens of thousands of pounds annually by allowing staff to become more productive.'

Moixa Energy

'The major benefit (of Open Access) would come through easier and more immediate access to the full content of papers, saving time and effort in working around payment barriers. Such savings could be significant – as a rough calculation, a saving of only one man day per year across the entire company's workforce would equate, in revenue terms, to around £100,000 per annum.'

SLR Consulting

Generalising these experiences is problematic but SLR Consulting's architecture-related engineering activities and consultancies (7112 SIC 2007) provide an illustration. According to the most recent official data (2010), this sector has 55,750 enterprises with an estimated 268,000 employees. SLR's productivity data,³⁷ which may, of course, be atypical, suggests a potential saving on productive staff costs of £16 to £40 million annually to this sector alone. This data is illustrative but adds weight to Houghton et al.'s

³⁷ This assumes that 60% of directly employed staff in this sector are involved in active fee-paying or chargeable service delivery or consultancy. Based on these broad assumptions, the potential saving to this sector alone would be £40.2 million per annum at an average charge-out rate of £250, or a saving of £16 million per annum on a very conservative charge-out rate averaging £100 a day.

assessment that indirect cost savings from enhanced productivity by research-orientated businesses are very substantial.

Chapter 4: Benefits of Open Access to the Private Sector

4.1 Introduction

The previous chapters have set out the context of businesses' engagement with scholarly research, their awareness of OA and the background to its use. This fills an important evidence gap in the UK and sets the scene for this analysis of how industry and commerce are able to benefit from OA, in particular:

- The achieved private sector benefits and impact of OA.
- Success factors and business benefits.
- The barriers encountered by businesses and their coping strategies.

The evidence is drawn from the feedback of stakeholders who contributed to the review but primarily from the fieldwork with 44 companies, comprising actual and potential users. The evidence base should be taken as indicative of private sector experiences. No attempt has been made here to consider the effect on other sectors – which would have required a different and much more extensive research strategy. The research should be taken as exploratory and the following chapters both draw conclusions and set out, at JISC's request, some of the implications for expanding the evidence base.

4.2 Establishing the benefits

This review adopted a 'tracking-back' approach by identifying user businesses and looking to track back through their engagement with publicly funded (published) research, to identify any distinctive OA benefits.³⁸ Looked at simply, the ability to understand and assess realised benefits from 'tracking back' depends on being able to isolate the intervention (ie OA use), its effects (outcomes) and the consequences of those effects (direct and indirect impacts).

The previous chapter demonstrated that, for most firms, attempting to establish the benefits of OA falls at the first fence – isolating its use. In part, these difficulties stem from the ways in which businesses search for academic outputs – especially when intermediary sites, such as Google or Google Scholar, are used. These tools identify resources from diverse sites, often with little or no user consciousness about root sources, and materials have no distinctive branding to identify them as Open Access.

As a result, business users of published, publicly funded research are often not conscious of whether their access to materials is through Open Access or not. For most, the only difference of which they are aware is that access without charge probably represents Open Access (although it may also represent copyright infringement rather than a bona fide OA source). Where the search process is devolved, formally or informally, for example to academic partners or collaborators, even this distinction becomes less clear.

Not all of the interviewed employers were conscious of Open Access, or even understood what this referred to, and most were accidental as opposed to systematic users. This was the case even where such businesses felt that 'OA sources are vastly preferable to the PPV materials'. However, where there was tangible use of OA sources, differentiating

³⁸ Alternative approaches such as control group comparisons or tracking forward (longitudinal) assessments would have raised other methodological challenges and certainly could not have been undertaken within the timeframe.

its effects from those of other sources of information or intelligence was also problematic. For example, OA may enable a business to search for and identify knowledge or expertise in a particular academic team, but such intelligence may either be validated through, or come from, search arrangements which harness other information sources (non-OA publications, professional networks, word-of-mouth referral, etc). While OA can be said to contribute to such a benefit, its distinctive contribution cannot be teased out.

For these reasons the evidence on which we can draw is limited; in practice, it centres on the nine businesses for which we are producing full case studies from the T2 interviews. The rest of this chapter draws primarily on these sources, supplemented in the discussion on 'barriers' by wider evidence from the first phase (T1) interviews. Although the evidence of benefits is drawn from just nine businesses, it must be remembered that nearly all of the 44 businesses interviewed in T1 felt that there would have been positive impacts from use of OA – but they were unable to differentiate these.

4.3 Benefits and impact of OA

The limited evidence base does not provide a platform for classifying OA benefits. However, there are some generic gains and, for at least two-thirds of these businesses, OA has the great benefit of saving organisations time in searching for published material through non-OA sources and in finding workarounds where paywalls or related restrictions are in place (including, for example, some copyright restrictions to distributing material internally). However, with some of these companies estimating that for every OA-sourced paper or journal article identified there are ten which are not accessed through OA, this remains as yet a latent gain rather than one that is often realised.

For some larger businesses that invest heavily in academic–industry collaborations, OA had limited value in terms of cost savings. However, some specific cases emerged which illustrate potential wider benefits:

- GSK – the multinational pharmaceutical and medical care corporate – stated that it derives advantages from the use of OA, however, it is clearer about the potential benefits for OA in disseminating its own expertise, allied with a stronger drive for its own scientists to publish and ratchet up external citations as a measure of business performance and to support its investor profile. This has seen a focus on high impact journals (eg *Nature*) to boost investor confidence in an increasingly competitive and globalised market and as a capacity differentiator between companies. While publications themselves may have limited value to market confidence, the citations derived from these are ready measures of the science-based capability and success of companies. This requires a focus, not just on publications but also on using the publication pathways which are most likely to have sufficiently high profiles – and to secure the widest citation.
- Ricardo is a multinational specialising in product innovation and strategy consulting in novel aspects of engine and power train technologies. The increasingly inter-disciplinary nature of cutting-edge technologies in this area means OA and OA journals are significant sources where search processes are often well outside their normal focus for subscription journals and professional networks. Recently, the company was faced with innovation challenges in their research on cryogenic systems and specifically on cryogen injection but their own research library and conventional scanning had failed to identify any specific expertise. However, supplementary access to the Imperial College repository identified a specific academic team leader, not previously known to them, resulting in a follow-through discussion which led Ricardo to a recently completed

PhD thesis accessed through Imperial. This was a highly focused and sound contribution which went beyond anything else they had been able to locate and was seen to have 'saved us a lot of time and a lot of effort...it focused our direction and stopped us going down more rabbit holes'. The thesis also helped Ricardo to raise other lines of inquiry through its review of related material. The outcome is an emerging focus involving Imperial (and other) academics in developing experimental scale technology to test technical solutions on cryogen injection systems.

Beyond these isolated cases, GSK, Ricardo and the other multinationals were unable to isolate specific impacts of OA use, although they recognised the wider value and use of OA. Smaller and medium-sized companies, however, provided additional examples:

- SLR Consulting – an international process consultancy specialising in energy and waste management solutions – had been contracted to provide expert witness services in a planning inquiry into a proposed wind farm in Scotland. Among the arguments against proceeding with the development, the opposition expert witness quoted research into alleged damage caused by past wind farm developments to peat-bog environments. SLR consultants were able to find the source of this research on the Leeds University repository and, because the material was Open Access, they were able to review the research and recognise that it had been quoted in a highly selective manner. As a result they were able to refute, successfully, these arguments at the inquiry.
- Plextek – a medium-sized micro-electronic company based in the UK and providing design services for global leaders in wireless technology – expressed difficulty in finding publicly funded research. However, in their efforts to overcome PPV restrictions, they identified a key collaborator in a non-traditional area to support a research project concerned with isolating benefits of tele-working in developed economies. Additional demands in the project saw the need to locate a specialist in social aspects of transport – expertise which was beyond the scope of the company's normal technological focus and professional networks – and web searches identified a key authority via the University of Lancaster repository. The successful collaboration led to securing a further and larger scale project for Ofcom, again harnessing the Plextek–Lancaster collaboration. The company felt it would not have been able to find appropriate expertise in the limited time available from other sources.
- AppliSci – a specialist SME supporting big pharmaceutical and healthcare companies with leading-edge research services – had been investigating (for two years) a technical solution to help develop a treatment for a rare infectious disease. Eventually, as a result of an allied web search, they found a critical article in an Open Access journal with directly relevant 'process' evidence. This solution was described as very much 'left field', having been applied in a completely different way to that in which the company is now proposing to use it. This new application is at any early stage of development but is thought capable of opening the way for an entirely new medical application with a market potential estimated at tens of millions of dollars.
- White Design – an architectural practice specialising in sustainable technologies and low carbon buildings design – has developed the Modcell construction technology which uses straw. Because using straw for construction not only saves carbon but also locks it up for extended periods of time, White Design needed to determine the carbon content of this material. The company eventually found the data it needed in an American Open Access paper from the fuel industry. This data enables Modcell to claim, with rigorous research evidence, that its panels are

a mechanism for carbon capture and this creates the potential for a new carbon offset market that could, eventually, be worth millions of pounds.

Rather than providing direct cost savings, the primary benefit of Open Access to these companies was in greatly reducing the time spent discovering and accessing relevant, sometimes critical, material. In the last two examples, the interviewees commented that the papers concerned were so obviously critical to them that they would have paid for access, had this been required. A common theme throughout the discussions was that, by providing access to full text, OA facilitated the rapid identification of solutions which were outside the businesses' normal areas of expertise.

4.4 Enabling business benefits

The illustrations, which are specific to the individual case study companies, do not provide a strong basis for assessing what enables OA to be used effectively, however broad conclusions can be drawn concerning the success factors involved in realising its benefits:

Professional staff time: Intense demands on professional staff with a research role was an issue that cut across large and small businesses. However, the impact was reduced for the larger companies with collaborative arrangements with universities, which could provide for some discretionary resourcing. Smaller businesses rarely had such access and, while OA sources offered potential time savings for professional staff in searching for and securing materials, these remained limited by the extent of OA access to full content of papers and articles – an issue raised previously.

Web search skills: Access to high calibre staff with appropriate disciplinary experience was recognised as a foundation requirement by companies; for many, this experience was needed at PhD or even post-doctoral level, ensuring skills in searching and understanding the research literature. Some of the consulted employers went further, suggesting the need for advanced web searching skills using combinations of keywords to discover knowledge.³⁹ Companies such as Fujitsu, Ricardo and SLR Consulting were clear that this was not necessarily an ability acquired during postgraduate research activities and that some individuals were more talented at searching, and applying their skills in diverse contexts, than others.

Interpretive expertise: Many of the same companies identified the ability of the 'searchers' to interpret complex research data provided through OA or non-OA as vital to its effective use. While postgraduate trained researchers were better placed here, this did not conventionally provide the cultural and language skills needed to interpret some papers. This is, of course, the classic role of the information scientist, and it is surprising that more use of information scientists was not made by these companies, especially where the research involved content beyond an individual's foundation specialism – increasingly common for businesses operating at the boundaries of technologies. Some of the consulted companies, such as Ricardo and BT, felt that such individuals were 'born and not trained' and were precious assets to businesses. Others, such as Rolls Royce and Moxia, described the need for 'technology translators' with the ability to understand problems and solutions in diverse areas of technology, identifying likely relevant content from university research publications and brokering this to project teams in-house.

It seems that, for many businesses, these enablers are closely inter-related and, without them, companies' ability to use wider OA content effectively and to address issues of discoverability will be compromised.

³⁹ This has relevance to areas of JISC's resource discovery work. See, for example, the report *Information Behaviour of the Researcher of the Future* (JISC 2008c).

A final observation is that, at present, the main enabler for companies in harnessing academic publications is not in making better use of OA, but in having the skills and knowledge to develop and employ coping strategies when encountering paywalls. This is predominantly, but not exclusively, an issue for SMEs.

4.5 Barriers and coping strategies

The review sought wider evidence on barriers to effective use of publicly funded and published research. Here, the major constraint was payment-controlled access to academic papers where access is dependent on the publisher's business model. Where access is open, the full text can be quickly scanned and utility determined but where access is behind a paywall the user must make a value judgement about the likely return on their purchase investment. Some observations included:

'...the risk of paying, only to find that the content does not reflect the abstract or is not relevant to our needs, is too great to bear at current prices.'

Life Sciences, Market Analysis Company

'I pay for not more than 20% of the articles I locate but around 60% of them subsequently prove not to be useful – in most cases the abstract did not provide sufficient information for me to have accurately gauged the value of the paper.'

Think Associates

'We need to scan widely and review the value of multiple papers which makes PPV potentially very expensive, particularly when there is no guarantee that the content of an individual paper will actually be of use...[As a result] I have never paid for a paper.'

Moixa Energy

'...there is too much risk that we will already have the information through other sources or it will prove to be irrelevant. Although the cost of individual papers is relatively small the direct cost can be substantial if it proves necessary to buy a large number of papers in order to find only one or two that are valuable and, in addition, this can involve a significant opportunity cost in wasted time.'

SLR Consulting Ltd

For large companies with subscriptions and research budgets, this does not emerge as an issue in this review. However, for many others it is a significant potential cost, with the consulted SMEs almost unanimously acknowledging that abstracts rarely give sufficient information to inform decisions about relevance or to justify payment. This suggests that, for many research-orientated businesses, there is seen to be too much risk that either they will already have the information through other sources or that PPV will provide information which is irrelevant to their specific needs.

Although the cost of individual papers is relatively small, this can be much higher for papers in edited or special collections. In any event, cumulative costs can be substantial if it proves necessary to have to buy a large number of papers in order to find only one or two that are directly relevant, and this in turn can involve a significant opportunity cost in wasted time. Furthermore, businesses such as SLR Consulting reported that copyright restrictions on papers often mean that the article cannot be stored on the company's servers and thereby made available more widely to colleagues.

PPV is an obstacle, even for some workers in multinationals, unless they hold company credit or charge cards – which may not be the case for those involved in routine searches and review. Without a direct charging mechanism, PPV becomes a substantial

hurdle because their company's expenses system makes recovery of relatively small sums a time-consuming matter:

'When I do determine that a PPV paper has value, I will pay for it but I have a procedural problem in recovering costs incurred by relatively small, online payments.'

ST Ericsson

'The bureaucracy involved in reclaiming such expenses is simply not worth the effort.'

Fujitsu UK

For many smaller businesses, where there is a need to scan across a range of disciplines, journal subscriptions are simply untenable:

'This need to work across disciplines makes journal subscriptions, which are already excessively expensive, even more unattractive.'

AppliSci

Even when papers have been accessed, there are still major hurdles for businesses seeking to extract value from research. Reflecting the discussion about enablers, several stakeholders referred to companies needing to have the skills, knowledge and time to review papers and determine their relevance. Similarly, several interviewees commented on the difficulties experienced by business people in understanding academic culture and language:

'We try to push authors further in their discussion and conclusions to explain and disaggregate what this research means to different professional stakeholder groups eg architects etc...where this is done, it makes the papers more accessible to business because most research papers are not written in language that is familiar to business people.'

Editor of a construction research journal

The same concern was raised by others. CIHE commented that making use of research involves not only effective distribution but also tackling the issue that the content can be problematic for companies to get to grips with 'unless they have handfuls of PhDs who can interpret'. Among businesses, reflections included:

'I often need help translating the academic material into a form that I can use commercially although in my case this is partly due to lack of time. To help overcome this problem I now work with a small group of associates who are all academics and who I will pay on a consultancy basis when I need their services.'

Commendium Ltd

'There is a need for a translation role between academia and business, the cultures are different; Masters students think that they have to write in an academic style while businesses need to understand why academic research gets done in certain ways.'

White Design

'(Our Technical Fellows)...act as 'translators' of...what does this mean for me, and what is the essence of this for solving this problem or this need.'

Ricardo

Put together, the evidence suggests that private sector businesses seem much more aware of constraints to effective use than success factors.

Chapter 5: Conclusions and Recommendations

5.1 Introduction

The study has come at a critical time in the evolution of OA arrangements for publishing publicly funded research in the UK. The UK is an international focus for high quality research from universities and publicly funded institutions, and recent government initiatives have recognised the importance of continuing to stimulate this capacity through science budget funding. OA provides the potential for greater discoverability and use of publicly funded research-based assets, and this focus on the business benefits which may arise is consequently important and timely. The findings, as set out in the previous chapters, are brought together here in series of cross-cutting conclusions concerning:

- Understanding the backcloth to OA use and utility in the private sector.
- Identifying and realising the benefits of OA in the private sector.
- Recognising the enablers and constraints to securing benefits.

The review was also asked to review the wider implications of the findings in terms of both the quality of the available evidence and suggesting ways in which the stakeholders who have come together in the Open Access Implementation Group (OAIG) might take this evidence base forward, and the implications for policy-makers. This chapter consequently concludes with preliminary recommendations for consideration by OAIG on how Open Access engagement might better benefit the private sector over the short, medium and longer-term.

5.2 Understanding the evidence

A substantial body of research literature establishes the benefits to private sector businesses of publicly funded research. Mansfield (1991,1995,1998), Beisea and Stahle (1998) and other studies⁴⁰ provide evidence of tangible economic benefit, in particular in terms of product innovations achieved and revenue gained through enhanced sales. The work of Houghton et al. (2011) confirmed these conclusions and also drew out the benefits of access to research in terms of shortening product and service development cycles. This study confirms the importance placed by businesses on access to scholarly research and its broad impact in terms of product, service and process innovation although its sample provided little direct evidence of shortening development cycles.

The work of Martin and Tang (2006) confirmed that companies benefit from access to research in a variety of ways depending on their approach to the use of research – a finding reinforced by this current report which confirms that OA has a clear potential to provide significant benefit to organisations that operate in open innovation environments where they are required to scan widely and across multiple disciplines. Such innovation is critically important to the UK economy and affects not only science and technological sectors but also the service and creative sectors (NESTA 2009).

Swan (2008) and Key Perspectives (2008) confirmed that a wide range of companies, not merely those that are high-technology or research-based, need to use academic research (including academic grey literature) and both studies highlighted the barriers experienced by businesses in accessing appropriate material. This work confirms these

⁴⁰ See Narin et al 1997; Toole (1999); Tijssen (2002); McMillan and Hamilton (2002).

findings, emphasising the value of access to research for companies from a wide variety of sectors, operational models and sizes. This research also strongly confirms that businesses experience multiple difficulties in attempting to access relevant research outputs – primarily discoverability and paywall barriers.

For SMEs in particular, subscription to multiple journals is prohibitively costly and consequently this dominant model for funding dissemination of academic research is not viable for most private sector enterprises as a means of securing the research evidence and expertise to support knowledge and technology transfer. These problems continue to make the exploitation of research outputs sub-optimal, since SMEs either neglect available evidence or incur substantial opportunity costs in trying to find ways around paywalls.

Open Access publishing provides a way of opening much more university and scholarly research to the business sector. This potential has been enthusiastically promoted by many in and around the business sector in the USA, but seems yet to gain much currency in the UK. Support for a business case by government and its agencies in the UK appears also to have been more cautious. The main protagonists have been bodies with wider interests in industry–higher education relationships, such as RSA and CIHE. Other stakeholders, including many involved in this review, find it difficult to take a robust stance on the promotion of OA or on how universities should manage the tensions between institutional commercial interest (in relation to Intellectual Property, including patents) and wider community and economic value through the promotion of access to research, whether or not through OA.

The situation in the UK could be characterised as one of inertia, and academic publishing practice is changing only slowly. Publishers continue to maintain, with some justification, that their editorial and review processes, as well as bibliographic and archiving practices, add value to original papers. Gold OA is a particular challenge to traditional pathways, and by shifting the cost of publication from library budgets to researchers, funding or host institutions, some fear that it may introduce dangers of effective censorship where researchers are involved in disagreements with colleagues who control publication ‘gateways’.

Green OA, although widely permitted in current publishing models, is being steadily taken up by academics, in part because of encouragement by traditional funding bodies (notably the Wellcome Trust and the Research Councils). This route also challenges publishers’ business models as access to pre-prints may remove the motivation to buy post-print copies. However, this review, as with other studies,⁴¹ provides little evidence that this would affect demand in the private sector where SMEs in particular are strongly resistant to PPV and the vast majority of business users will seek free copies of papers through the coping strategies outlined above.

This review reveals that the OA model is not widely understood among business users. This may stem from a combination of reasons but an unclear comprehension of how to access OA, even among its current users, and a lack of critical mass of OA content are probably the main influences. At the same time, the motives that should drive greater OA use – and value – are widely evident from this review. Difficulties in discovering relevant research are commonly cited by interviewees in this study although discoverability may be assisted by the emergence of new, commercial search engines that focus specifically on academic literature published through OA and non-OA routes. These also offer potential benefits for businesses through the application of social networking features that could enable the development of recommendation processes to provide business review functions in parallel to academic peer review.

⁴¹ See Cook et al. 2011.

Access barriers are also widespread, with high proportions of papers seen to be located behind paywalls. For large companies with substantial budgets and mature approaches to building and sustaining industry–university relationships, this is not a barrier. For most other research-orientated businesses, it is highly significant. Individual item costs may be small but for companies that scan widely across different disciplines, or those that need to access large numbers of papers, the cost of PPV may be prohibitive. Reluctance to pay is compounded by the fact that academic abstracts are seen as poor at providing the information businesses need to establish the value of the article or its author(s), and it seems few SMEs will risk limited discretionary spending and budgets to pay for something that may well be irrelevant, already known or free elsewhere.

As a result, most businesses spend considerable amounts of time working around paywalls. This is likely to be a substantial productivity cost to those businesses which do not have the opportunity to exploit some of the wider knowledge management strategies used by larger research-orientated companies. The review suggests that, at a time of accelerating pressure on SME competitiveness, a shift to Open Access would create significant cost savings by enabling businesses to review more quickly the relevance of individual papers and act accordingly. By boosting discoverability OA may also add value directly to levels and speed of knowledge transfer in this part of the economy.

5.3 Realising the benefits of OA in the private sector

The evidence suggests that Open Access consequently has the potential to contribute to more effective use of scholarly output and this potential will rise if, as current citation evidence suggests, the critical mass of available OA material rises. At present, however, very few companies seem to target OA sources despite their evident value. Their focus is on intermediary searches through facilities such as Google and Google Scholar. This means that OA content is effectively encountered by accident as businesses search for relevant research-based information or intelligence.

Despite this, OA can occasionally result in significant contributions for individual companies, some of which can be substantial in terms of knowledge transfer. These include the potential for shortened product development cycles, and ease of access to wider cross-national sources of evidence. The latter emerges from the businesses engaged in this review as of increasing importance in a world in which the innovation potential of non-UK clusters of research and research expertise is of rising significance to UK businesses. Nonetheless, for most businesses the main potential benefit of OA would seem to be the productivity gains set out above from streamlining the search process and identifying relevance in academic outputs.

The difficulties of identifying such impacts make it impractical to estimate the scale of these effects. Given the targeted nature of the business examples on which we have focused, any such attempt could also be very misleading without broader evidence – an issue returned to in the final section of this chapter. However, one theme emerging from the review is that OA is an important tool for securing research that occurs at the edge of technological development – a requirement which, even in multinationals, challenges traditional approaches to identifying research evidence and expertise.

A goal of this study was to develop a preliminary typology of use and achieved or potential OA benefit across the private sector. The evidence indicates a need to distinguish between organisations' motivations for wanting to use research results (or expertise), their varying capacities for accessing the results and their ability to relate the contents to organisational needs. Taking account of this we propose seven broad categories of actual and potential OA beneficiaries:

Type A – **Corporate Research Leaders** (eg GSK, Airbus, Rolls, Ricardo, BT):

Characterised as being at the forefront of technology and innovation and embedded in an R&D culture, with in-house research capabilities, strong and diverse collaborations and sustained capacities with HE internationally. Many of these companies no longer have research libraries. They use academic collaborators particularly as sources for pre-competitive research or for specific areas of scientific or technological knowledge-building at TRL Levels 1 to 4, and also as validators of that research and to identify wider networks within HE. They have extensive budgets to pay for both subscriptions and PPV. OA currently has limited value to the efficiency of their R&D delivery and its use is mainly devolved to academic collaborators. However, some use is retained in-company for identifying new knowledge to set external collaboration agendas, raising company and investor profiles through disseminating research outcomes, assisting problem solving and also in identifying new clusters of (HEI) knowledge to keep the currency of their devolved expertise.

Type B – **SME Research Leaders** (eg White Design, Aardman Animation, GL Garrad Hassan):

Specialised and often niche leaders of technology, characterised by having small-scale active collaborations with HE which may be as co-resourced, externally funded activities. They are mostly likely to see research as income or direct support to R&D services (eg design) to corporate leaders, and/or to commission contract research to meet specific needs. They lack budgets to pay (widely) for papers, may use in-house experts to find research outputs and often use academic collaborators as sources of research material and validators of that research. OA sources are not used systematically but have potential for improving the breadth of cross-technology searches, for raising productivity of in-house teams by avoiding labour-intensive workaround strategies to avoid PPV, and for shortening project and development cycles through these efficiencies.

Type C – **Corporate (Divisional) Research Followers** (eg Fujitsu UK Services, ST Ericsson):

Users of research-based knowledge for adaptive creativity These may be multinationals that can retain significant research-based functions operating mainly at TRL Levels 3 to 4 and above, characterised by using knowledge to inform or inspire service or product development through incremental improvements in existing technologies. Academic collaborations are more likely to be ad hoc. These companies have significant budgets and are willing to pay for research/PPV access, although the effort involved in recovering such expenses may render the purchase 'not worth the effort'. OA benefits are mainly geared towards increasing the density of scanning for related applications and current near-market research innovations, with productivity gains for existing search processes.

Type D – **Innovative Creativity SMEs** (eg AppliSci, Moixa, Think Associates, Imaginist, Green Structures, White Design, the Architects Practice):

Often smaller companies or micro-enterprises that reframe process and technological problems to arrive at innovative new solutions. They are characterised by being cross-(and sometimes multi) disciplinary. OA is widely exploited alongside other traditional sources of academic research, as these firms rarely if ever pay for access; they have an enthusiasm for establishing ongoing relationships with selected researchers and commonly make direct contact with researchers to obtain copies of papers that are not available through OA.

Type E – **Knowledge Sellers** (eg SLR, Tech-Trends, Versa Professional Services):

Typically consultancies, knowledge service companies and sector market researchers; perhaps also companies or bodies providing professional or trade publications. These are often smaller SMEs or autonomous (smaller) divisions of larger companies affected by sector aggregation to build knowledge clusters. They are characterised by having a strong reliance on academic research but no in-house or collaborative research programmes; they may use subscription journals in specific areas but will pay for research only if convinced of its value.

Type F – **Knowledge Users** (eg Available Light TV, Plextek, Gooder, Two Four Group, Cassely):

Typically, ICT service and media companies, varying in size from micro-businesses to larger SMEs. These companies are characterised by having an occasional need to use academic research to inform a specific project; they will pay for research only if convinced of its value and/or if project budgets permit. OA has the potential to radically increase use of and access to HE research at marginal investments, with a potential contribution to increasing market share.

Type G – **Non-users** of published academic research (eg Conformance, AIS):

These are companies who have no use for published academic research, for whom Open Access would have no perceived value to their business processes.

There is, however, considerable overlap between these suggested categories and, in the context of this research, these distinctions may apply across different divisions of larger companies. We caution this is an experimental typology, based on very limited 'market' evidence and testing the model on a wider range of practice may see scope for refinement or consolidation.

5.4 Enablers and constraints

Enablers of and constraints to OA use are closely inter-related, and what may be success factors for one firm, where a coping strategy has evolved to tackle a rigidity, may remain a barrier for another, where no such workaround has been put in place. Many firms that are knowledge rich but time poor, particularly research-orientated SMEs, see much to gain from more extensive use of OA and the main barrier to this seems to be a lack of OA content.

At the same time, there are some consistent enablers to more effective use of OA. These include the quality of web search skills available to the firm; for many SMEs these will be in-house and often framed at PhD or even post-doctoral level, ensuring skills in searching and understanding the research literature. A key enabler in this is the ability to frame sharp and incisive web-interrogation approaches and the advanced use of keywords in search engines. Some enterprises also see great value in the ability of selected staff to act effectively as cross-disciplinary translators and mediators of the knowledge that they discover – an aspect of discoverability that seems not to have been previously highlighted by those promoting OA use and benefits and for which information scientists are ideally suited.

For many businesses these enablers are closely inter-related; without them their ability to use wider OA content effectively and to address issues of discoverability will be compromised. However, the review cautions that these perspectives on enablers and constraints need to be placed in context. The main enabler for firms in harnessing academic publications was not making better use of OA but in having the skills and

knowledge to develop and employ coping strategies when encountering paywalls. What is clear is that most firms have become very innovative in finding ways around PPV but at substantial opportunity cost in staff time.

5.5 Implications for OA development

The review has provided the first substantive and business-based evidence for how the private sector can and does benefit from OA. The evidence, although novel, remains small-scale: our survey sample was cross-sectoral and not representative in terms of the range of sizes of organisations in the UK. The findings and the implications proposed here for policy and development should consequently be interpreted with caution.

These findings paint a complex picture, drawn from a wide variety of situations and from the needs of businesses that are far from homogeneous; they show little knowledge among key stakeholders concerning OA needs and use. They also show that the questions framed by OAIG cannot be looked at in isolation. OA materials are not distinctively branded and there is consequently little transparency regarding their use by the private sector. The evidence strongly suggests that dedicated use of OA resources is not common and OA use is most frequently ad hoc and 'accidental' in its occurrence.

This 'accidental use' makes identification of direct benefits difficult and the quantification of those benefits effectively impossible, at least until use of OA is more mature and extensive. However, there is strong evidence of significant indirect benefits to businesses through savings on opportunity costs. In addition, as identified by Houghton et al. (2011), there will be savings attributable to reduced product and process development times and the identification of investment opportunities.

For the private sector, OA use and utility is seen as part of a much bigger picture, representing just one facet of knowledge exchange and transfer between universities and industry. Relationships between HE and industry emerge as more important than direct and full access to papers – and initiatives in Wales and Scotland seem to emphasise relationships building over publication access/discoverability. However, there are synergies and there is an important role for OA in helping SMEs to start to build relationships (ie possible collaborations) by more widely scanning publications for HE capabilities.

While a debate on knowledge transfer mechanisms is an important focus for many of the stakeholders involved in this review, the OA perspectives as yet seem to have little currency. This review concludes that they will continue to do so and lack a more appropriate profile without an external policy stimulus. Paradoxically, for some of the stakeholders with rather more interest in OA use and impacts, it nonetheless remains a 'small side show in a much bigger event', in the words of one interviewee. Another suggested that '(OA) was only a bit player until and unless academic outputs became more apparent and digestible to many more companies', and this was seen to require a change of culture in HE.

This is not to say that there is no distinctive focus for OA as a policy lever in knowledge transfer or HE responsiveness and reform. Indeed, the review suggests that there is potential for real benefit in any debate recognising and supporting the role of research-orientated SMEs as engines of innovation. Such businesses emerge as commonly hampered by a lack of research-related information resources. Here, OA could make a distinctive self-driven contribution to open innovation, in particular by removing the payment bottleneck and associated opportunity costs to securing much of the published information from publicly funded university and scholarly research, but also by supporting newly emerging social network tools and text mining applications that will aid discovery.

5.6 Implications for policy

There is some scope for policy developments to stimulate supply as a starting point in realising the apparent demand potential among some businesses, notably SMEs. A number of areas for development emerge, all of which seem capable of stimulating OA supply via policy decisions. These mostly, but not wholly, centre on actions on, or on behalf of, the Research Councils and should be considered further in the context of the recommendations of the *Heading for the Open Road Report*⁴². They include:

- a) Mandating publicly funded university researchers to ensure that publication outputs are made available immediately after any embargo period on appropriate repositories. There is no evidence from this review that it would impede jointly funded research activity involving industry if suitable protocols were harnessed to protect research with commercial sensitivity, and it is likely to substantially increase supply and/or access to research articles/papers – as encouraged by earlier JISC reviews.
- b) Such requirements could substantially extend content and access, but would raise compliance monitoring issues. These would need to be addressed in parallel by Research Councils and others against the background of ongoing developments to develop output databases.
- c) There would also seem to be scope for Research Councils and other funders to make provision for Gold OA publication costs within their grant awards, and to provide for carry-over or post-award support for any costs occurring after the conclusion of research. Any assumption that such costs would need to be borne post-award by individuals or the host institution seems untenable against a background of pressure on university budgets. The more realistic approach, already adopted by the Wellcome Foundation, is to include the costs of OA publication in the funding awarded and this extra funding is not bounded by time or activity limits.
- d) A number of consultancy-based companies commented that greater transparency about currently funded research would be useful, as a way of indicating technology trends in particular. We understand that this is under discussion between the Research Councils and the Technology Strategy Board, with a view to information being made available through ‘_connect’.

Such developments may emerge unilaterally among the councils and other funding agencies, but a collective response would have to be driven by a wider external policy stimulus to OA and a re-assessment of the role that funded research in higher education should play in open innovation.

OAIG may also see scope to work with policy-makers to encourage developments in institutional repositories that may raise the profile and utility of OA-accessed content. There would seem to be scope for HEIs collectively or individually to review the functionality of repositories against the feedback set out here on distinctive business needs. In particular, there is scope for reviewing how abstracts of papers and articles are formed and how these may have greater relevance to businesses faced with challenges of interpreting relevance and utility. OAIG may also see scope to review these and other opportunities directly with university representatives, and these might include, for example:

- Establishing enhanced and industry-friendly functionality in repositories and business-friendly search interfaces.

⁴² Cook et al. (2011).

- Providing post-print (and possibly other) content with lay summaries which are accessible to business readers.
- Providing centralised advice and guidance to academics in writing content that can enhance impact by being more industry-friendly and accessible.
- Improving access to metadata (ie more business-focused aggregations).

The impact on business of such enhancements would need to be monitored, perhaps with a focus on some trial business-friendly sites or parts of repositories. While these changes may go some way to enhancing access and use of OA, it is also possible that such monitoring would identify the need for more fundamental changes including, for example, approaches to (and classification used for) meta-tagging of content.

These developments may serve to boost OA-based access to published materials but will also raise issues for SMEs in terms of their capacity to harness this. For example, new models may be needed to facilitate self-help and skills training on intelligent web-based searching and/or using academic mediators. The focus and scope of any such development remains unclear but it may provide a useful pilot activity to improve knowledge transfer and open innovation within public policy.

The evidence now available – including some published as OA – presents research-orientated businesses with growing challenges. The review provides evidence to support the calls by CIHE and others for a renewed focus on scholarship to complement the emphasis on ‘new’ and leading-edge research, and in particular the value of reinterpreting research for wider use by non-traditional users. Leaving this for firms to tackle on a piecemeal basis does not serve knowledge transfer well and SMEs in particular may not have the expertise and time to address this.

The Knowledge Transfer Networks perhaps provide a mechanism for this to be addressed as they develop further. There may also be scope for this to be tackled as a technology watch service, for which there are previously funded precedents that could be revisited for their effectiveness. Such ‘mapping and review’ papers could themselves be made available through Open Access.

Not all contributing developments need a policy stimulus, and some may emerge from market rather than policy developments. In particular, there may be scope for harnessing technology for quasi-peer review of published material by business, for example through forging new or modified ‘generic’ search engines and/or social networking tools. This might use comment features to enable businesses to identify and tag work that is of particular interest (in effect, business-to-business peer review), although the mechanisms for achieving this are as yet unclear. Similarly, existing crowd sourcing ‘membership’ services aimed largely at researchers could also easily be extended to meet any distinctive business demand for enhanced, international and cross-disciplinary ‘point of use’ searching for research (or researchers).

The evidence from this review may also encourage other ‘market’ responses, some by publishers themselves, where there would seem to be considerable scope to improve the business utility of the research that they publish, whether OA or not. This may be a contentious area if it leads to costs, but this review suggests that the usefulness of outputs would be enhanced, for example, by providing non-academic synopses of papers, or perhaps by inviting business representatives to provide commentaries or through improved collaborative relationships with trade bodies. There may also be scope for exploring the potential of adding arrangements for business-based peer review of some publications.

5.7 Next steps

We recommend that these development and policy issues could be usefully reviewed by OAIG and other stakeholders. In particular, we would encourage OAIG to review the potential of these proposals and to bring these together as a forward agenda to stimulate the profile of OA issues within a wider knowledge transfer context. Within the specific context of this review, these issues may be seen to have most immediate relevance for funding through the Research Councils or through Research Council–Industry joint collaborations. However, the principles underpinning enhanced use and value of OA apply to other public funding routes for university and scholarly researchers, including by other funding agencies, government departments and non-governmental departmental bodies that could enforce Open Access through contractual terms when commissioning research.

While we believe there is scope for early consideration of the proposals set out here, , we are conscious that this research offers a provisional assessment. While there is sufficient evidence here to identify the major challenges to securing the benefits of OA, the research has been necessarily limited in its focus and scale. An essential part of a forward agenda by OAIG will be to start to extend this evidence base. The main emphasis for this would seem to be to secure a broader range of evidence (including from other business sectors), and to support a robust estimate of scale and quantification of business benefits. This might be addressed by longitudinal (ie ‘tracking forward’) impact assessment, but on the evidence of this review this would encounter substantial challenges, not least in relation to commercial sensitivity in target businesses. Instead, we recommend that the evidence base be extended by a cross-sectoral survey-based approach with a suitably large and representative sample of UK-based enterprises.

Such an approach would not only allow for wider sectoral contrasts, but also provide a baseline of use and utility, which could be used for sectorally-based projections of achieved and potential cost savings from OA. A model for this has been cautiously set out in Chapter 3 and could usefully be extended to other sectors with appropriate baseline evidence. A broader evidence base could also add significantly to the process evidence and to a better understanding of the roll-out potential, by looking at issues such as:

- What is the awareness of OA and OA pathways, and current levels (and trends) of use in different organisation contexts?
- Are some OA pathways (or specific repositories) seen as more effective than others in supporting knowledge flows and discoverability?
- Does OA make more material open to search engine indexing and improve discoverability for businesses?
- What (tested) aspects of available repositories act to enable or constrain OA use and utility?
- What (tested) aspects of organisational or professional capacity act to enable or constrain OA use and utility?
- Does OA have a direct contribution to make in the support of open innovation by SMEs (and how)?
- Do new search tools or networks have use/a role in supporting businesses in discoverability and exploiting OA more cost effectively?

- Are knowledge transfer services likely to add value to SMEs in finding and interpreting academic materials – making more effective use of OA?

We conclude that more OA content and improved functionality of repositories can benefit all research-orientated businesses – but is set to be of greater added value to SMEs in particular. Promoting OA may consequently help address the substantial imbalance between large corporates and SMEs on resource availability, maturity and breadth of HE relationships. We hope this review will enable stakeholders to support such promotion through a stronger evidence base, and commend this report and its proposals to JISC and OAIG.

Annex A: Methodology

The research has been exploratory in scale and centred on providing indicative evidence of business benefits of OA and also reviewing implications for further analysis. The methodology involved a four-stage intensive study conducted between May and the end of July 2011:

- Stage 1 – Inception, planning, design and steering.
- Stage 2 – Scoping study with stakeholder interviews and research review.
- Stage 3 – Selection and two-tier conduct of Open Access impact case studies.
- Stage 4 – Collation and reporting.

Stage 1 – Inception, planning, design and steering: The project required an intensive start to planning and this was supported by an inception meeting in early May. This included an oral brief from the project manager and a discussion about the precise shape of the fieldwork, synergies with related projects and HOST's proposals for selecting stakeholders and employers for the study. The discussion enabled HOST to prepare a fuller statement of approach and a detailed 'Framework Plan' and began the process of research design and case identification. The inception meeting also discussed an information schedule for the review and the inter-relationships with the critical friends, which were then being appointed to the wider study. A mid-point review meeting was subsequently held and attended by Professor Oppenheim and Professor Friend.

Stage 2 – Scoping study with stakeholder interviews and research review: The evaluation aimed to make best use of existing information about and evidence of projected or realised benefits of Open Access. This involved:

- A systematic literature review, going beyond the Houghton report to include existing JISC and other sources identified through bibliographic and web searches. Related documentary inputs from stakeholders were also included. This was brought together in a stand-alone literature review and supporting bibliography (Annex B) which was the focus for much of the mid-point review meeting.
- Approaches to, and briefing and conduct of semi-structured discussions with OAIG stakeholders. This involved approaches to 22 national and home country stakeholder bodies in England, Northern Ireland, Scotland and Wales – although some retained UK or wider briefs. Stakeholders are set out in Annex C and included Research Councils, Technology and Knowledge Transfer Bodies, business and HE representative and interest groups, selected OA publishers, learned bodies, executive stakeholders and other key national (and home country) stakeholders with an interest in OA policy and scholarly inputs to knowledge transfer. A total of 22 agencies were contacted and briefed either by email or telephone. Four subsequently declined to take part, feeling that they had little or no evidence to contribute to the review. Four others, who were approached and agreed to take part, were unable to complete arrangements made for discussion – including arranged interviews within the three months of the review – and were, as such, unable to take part.
- Following a request by JISC at the inception meeting, the study adopted an additional 'sectoral' stakeholder focus on selected innovation-centred sector bodies. A smaller number of bodies were approached by email or social networking sites, mainly for the purpose of identifying possible case studies. This

included e-liaison with selected Technology Strategy Board Knowledge Transfer Networks (KTNs), to provide a route to relevant businesses/networks, business advisers, technology transfer offices and groupings and similarly selected Knowledge Transfer Partnerships.

Useful evidence was provided by most of those consulted in this process, but only in two cases were those interviewed able to suggest likely case study businesses with direct experience of OA benefits. The stakeholder review also suffered from an unusually high drop-out rate of agencies, although this may have been affected by some knowledge transfer stakeholders not being well positioned to comment on the very specific subject matter of the review. Others, who might have been in a position to provide possible employer profiling, were unable to take part due to other priorities and commitments over the three months of the review. The study was able to secure a range of employer experience but may have been able to do so more cost-effectively had it retained the original proposed focus on sector bodies as intermediaries in identifying relevant business experiences.

Stage 3 – Selection and two-tier conduct of Open Access impact case studies:

This was the most resource-intensive part of the review with identification of relevant business experience shaped through a combination of: the HOST teams working relationships in target sectors; Stage 2 inputs including stakeholder interviews; and harnessing available online and other networking and dissemination channels. Possible employer experience was identified on a progressive basis as the study evolved and at the mid-point review an interview focus was agreed reflecting the secondary evidence. To help to define relevant case studies we conducted a two-tier approach:

- Tier 1 (T1) interviews were arranged with identified relevant businesses and semi-structured telephone interviews conducted with identified lead contacts in those businesses. These provided for brief reviews of the technological, process and innovation contexts of the organisations concerned and any Open Access engagement and known benefits. We had anticipated contacting a total of 30 organisations but in the event these T1 interviews extended to 44 enterprises – reflecting the difficulty of securing appropriate and tangible business experience. These firms are listed below – excluding six who did not wish to be named.

Aardman Animation	GSK
Airbus UK	Imaginist Company
AIS Ltd	LR Consulting
A SME builder	Moixa Energy
AppliSci	Oddy builders
Available Light	Plextek
A Bio-technology market analyst	Ricardo
BT	Rolls Royce plc
Building Engineering Company	ST Ericsson
A construction research journal	Steve Gooder
Building Research Establishment	Tech-Trends
Casseley	TFL
Commendium	The Architects Practice
Conformance	Think Associates
Creative Space	Two Four Group
Fujitsu UK Services	Usable Buildings Trust
Garrad Hassan	Versa Professional Services
Global Pharmaceutical Company	Wallingford Hydraulics
Green Structures	White Design

- Tier 2 (T2) interviews were anticipated to involve ten to twelve of the T1 organisations identified as higher quality in terms of achieved benefits and impacts and with more transferable experiences. In the event, few enterprises matched the selection requirements, which were extended at the mid-project review to reflect wider relevant experiences. A total of nine case studies were conducted – and also a further eight ‘cameo’ shorter profiles. Each T2 enterprise involved follow-up personal interviews with key staff – including executive directors of some multinationals and also staff directly engaged in scanning activities and academic relationships. These explored experiences in more detail but were generally unable to gather any quantitative evidence of achieved benefits from Open Access engagement.

Tier 2 organisations were prepared as detailed, contextualised and stand-alone case studies – verified where possible with lead interviewees. At the time of writing, these are being verified with interviewees and will be made available as a case study pack to support the revised final report. Case study examples have been forwarded with this report to JISC.

Stage 4 – Collation, reporting and support to dissemination: The evidence has been collated following verification (as above), and presented in the mid-project progress review and this final report to JISC.

Annex B: Bibliography

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Annex C: National and professional bodies consulted

Association of University Research and Industry Links
British Biotechnology and Science Research Council
British Chambers of Commerce*
Confederation of British Industry*
Council for Industry and Higher Education
Federation of Small Businesses*
Engineering and Physical Sciences Research Council
Higher Education Funding Council (England)*
Institute of Knowledge Transfer
Intellect
Interface
Medical Research Council
National Environment Research Council
Northern Ireland Executive
Open Access Scholarly Publishers Association
Operational Research Society
Oxford University Press
Public Library for Science
Royal Society of Chemistry*
Scottish Executive*
Science and Technologies Facilities Council
Technology Strategy Board
Universities UK*
Wellcome Trust*
Welsh Administrative Government

In addition 44 private sector business contributed to the review in T1 and T2 interviews (see Annex A).

* Organisation unable to provide evidence or otherwise not contributing during the course of the review.