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Title

The impact of Resource Discovery Services (RDS) on usage of electronic content in UK academic libraries: selected results from a UKSG-funded project

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Abstract (100 words)

Resource Discovery Services (RDS), also called Web-scale Discovery Services, have attracted considerable attention in recent years. This article aims to provide an environmental scan of the adoption of RDS in UK higher education libraries and provide an analysis of RDS resource usage data to gauge whether RDS have an impact on the overall usage of e-journals and e-books. Findings show that there appears to be a positive impact in most cases, although the extent of this impact varies across libraries and publishers. There is undeniably a degree of complexity in the usage analysis owing to the multi-dimensional nature of the environment.

Keywords

Electronic resource; academic library; usage; discovery; Web-scale discovery service; digital library

1. Introduction

Resource Discovery Services (RDS), also called Web-scale Discovery Services (WDS), have attracted considerable attention in recent years, and many Higher Education (HE) libraries have acquired – or are in the process of acquiring – such systems. There is arguably a significant cost involved with acquiring and implementing RDS, and academic libraries understandably want to exploit the system to its full extent and secure the whole range of benefits promised by RDS suppliers. Anecdotal evidence suggests that opinions on the impact of RDS on academic content are divided. Librarians seem to be embracing RDS systems while

publishers and content providers may be sceptical about the impact of RDS on content usage.

It is important for the academic library community to have more information at their disposal about the potential value of RDS, but, to date, there has been little research that gives a rich picture of the RDS landscape in the UK, nor is there substantial evidence of the impact of RDS on the usage of electronic resources. This paper aims to address these two gaps in the literature.

The aim of this article is therefore twofold: firstly, to provide an environmental scan to establish the extent of the adoption of RDS in UK HE libraries, and to highlight attitudes and perceptions; secondly, to provide an analysis of resource usage data to gauge whether RDS have an impact on the overall usage of electronic resources, i.e. e-journals and e-books. Database usage is not covered in this article. A preliminary database usage analysis is available in Spezi, Creaser, O'Brien, and Conyers (2013).

2. Literature review

2.1 Information seeking

The digital information environment has drastically changed information seeking behaviours within the HE sector. Over the last 15 years, there has been considerable research conducted on how library users' information seeking behaviours – that of students, in particular - have evolved and adapted to the changing information environment.

Recent research shows that, increasingly, users do not start their discovery on the library portal but elsewhere (OCLC, 2009; Gardner and Inger, 2012; Inger and Gardner, 2013), most probably on Google or Google Scholar or similar general search platforms. Not only does discovery happen elsewhere, but workflows have also changed, from local sources (e.g. library) to networked sources (e.g. Internet-hosted platforms), leaving traditional library services outside those emerging networked workflows (Dempsey, 2012). This suggests that the academic library has become, to some users, the last port of call (ACRL Research Planning and Review Committee, 2012): they come to the library (virtual or physical), only if they have not managed to get hold of the resource they want in any other way.

User behaviour studies are still trying to underpin new behaviours brought about by mobile digital technologies and understand user preferences in terms of format. For example, there are still some uncertainties about e-book usage as indicated by Rod-Welch, Weeg, Caswell, and Kessler (2013) who suggested that e-book acceptance is still developing. They indicated that print books remain overall the preferred format for staff and students, with 79.6% of the 334 survey respondents rating print books as their preference, while 20.4% chose e-books. The authors, however, found that preferences vary according to the task at hand: print books are particularly popular for reading for leisure while e-books attract more use if the aim is to complete an

assignment or for research. In addition, Prensky (2001)'s 'Digital Natives' and 'Digital Immigrants' dichotomy is now challenged by many authors and Connaway, Lanclos and Hood (2013) suggested that a 'Visitors' vs. 'Residents' dichotomy may be more appropriate. In this new framework, 'Visitors' represent people who use the tools the Web offers for a specific purpose or task at hand, without leaving any social trace of themselves online, while 'Residents' seem never to disengage with the Web, spending a significant part of their life online. Looking at a cross section of the student population - notably 'Visitors' and 'Residents' – the authors have shown that motivations and forms of engagement with information seeking and access tools vary across the academic community as a whole, i.e. across first year undergraduates, second/third year undergraduates, postgraduates and PhD students, and faculty. Furthermore, Mi and Weng (2008) attribute the ineffectiveness of OPAC searches conducted by students to the need to use Boolean logic, instead of the implicit 'AND' logic used by search engines. Mi and Weng (2008) claim that this is why students have generally embraced search engines so rapidly, adding that *"customers [as information consumers] have wholeheartedly embraced these products [Google, Amazon and similar companies] because of their ease of use and quick delivery of 'good enough' results. Researchers do not need to take information literacy classes to learn how to use an online search engine"* (Mi and Weng, 2008, p.5).

The traditional model of resource organization by formats seems to have been overstretched with the introduction of electronic resources co-existing with print, to the point that each collection/type of resource would require its own search portal with specific and tailored functionalities. For instance, before RDS, users often had to search resources independently (e.g. OPAC, separate databases, individual collections such as e-book platforms or newspaper collections) to find all the relevant information on a topic. With collections locked in silos and dependent on separate search platforms, anecdotal evidence suggests that conducting a library search had become truly 'clunky', slow, time consuming, and often labour-intensive, thus affecting greatly the overall user experience.

Further, the volume of electronic resources available has been growing at a fast pace – for example, in the UK, SCONUL statistics show that the average number of e-journal titles in academic libraries increased from some 9,000 in 2007-08 to 193,000 in 2012-13, and the number of e-books from an average of 8,000 to almost 30,000 in the same five-year period (SCONUL, 2014; SCONUL, 2009). In the US, e-resources accounted for 13% of total expenditures in ARL member libraries in 2000, increasing to 51% by 2008, while in 2013, e-resources represented 69% of the collection budget at the University of Montana Mansfield Library (Samson, 2014).

In this context it is not surprising that information seekers turned to search engines from the moment electronic resources were made available. With their single entry point to search across the range of electronic resources, search engines seem to offer a more satisfactory (i.e. quicker) search experience, possibly at the expense of

quality if users stop, as it is often alleged, at the first results page provided by their search engine of choice. The latter point is often termed 'satisficing' and represents the decision process whereby users determine they have found enough relevant quality information and so stop searching for more. In their qualitative study, Prahba, Connaway, Olszewski, and Jenkins (2007) found that students – both undergraduates and postgraduates – stop looking for information when they feel they have met the requirements for the assignment at hand (number of citations & number of pages required; research questions answered; and time available); the information they have is sufficient, accurate and preferably cited in other sources; and they have understood the concepts discussed. With regard to faculty, Prahba et al. (2007) found that criteria influencing whether they should stop searching for more information include time available; fulfilment of scholarly and research needs; exhaustive use of synonyms and keywords combinations.

Electronic resources arguably have undeniable advantages, primarily convenience and ease of access, which in our modern world seem to be the guiding criteria (ACRL Research Planning and Review Committee, 2012). This is echoed by Franckle and Saundin (2012), who established that students find that searching for information in print resources is more time-consuming, and by Connaway, Dickey and Radford (2011), who claimed that convenience of access is critically important in students' evaluations of resources. Not only do electronic resources offer greater accessibility than printed resources, but they also offer greater currency, particularly with the development of online publishing ahead of print. In their longitudinal study of undergraduate students, Warwick, Rimmer, Blandford, Gow, and Buchanan (2009) have shown that students have a marked preference towards using the Internet to source information for the academic task at hand rather than using the varied and complex range of library resources. Moreover, students exhibit 'strategic satisficing' behaviours (Warwick et al, 2009), whereby they tend to reproduce known and successful information searching strategies (i.e. within their comfort zone, what the authors call 'cognitive economy') providing them with sufficient information in little time, and they are reluctant to develop their information searching skills and expertise further, unless required by the task at hand. Another important point in Warwick et al. (2009)'s studies is the refutation of the common assertion that the Internet searching skills ascribed to the new generation of students should naturally translate into expertise in general information seeking.

Discovery is essential for users to fulfil their information needs, and discovery is increasingly happening in many settings, often outside the library realm, as reported above. In light of this, Schonfeld (2014), from Ithaka S+R, asked whether it is reasonable for libraries and library directors to hold a vision of the academic library as a starting point in the information search journey. Such conservative vision, explains the author, may actually reflect libraries' desire still to be perceived as adding value in a rapidly changing information landscape, and hence justifying their

positioning within the parent institution, rather than being perceived as a mere licensing intermediary.

RDS systems aim to emulate the Web-searching milieu in a bid to win back users – since there are clear indications that this is their preferred way to search for information - and offer them a better range of academic resources than they could find in the open Web. They offer a solution to the issue of ‘clunkiness’ of library searches and siloed resources in that they enable library users to search across collections and formats from a single entry point. They mimic a Google-like search box and, as with search engines, are operated with natural language instead of the rigorous – but not always intuitive - controlled vocabulary of traditional library search systems.

RDS are often perceived as the next-generation metasearch tool (Walker, 2015). Federated search tools were the first to address, albeit only partially, the issue of compartmentalization of resources, allowing users to search simultaneously across different databases. RDS are differentiated from federated search tools in that they can search across all types of pre-defined collections and formats, and in the way search queries are processed to retrieve material. Walker (2015) claims that the reason why RDS have been so popular is because they *“offer superior performance, much wider search scope and no limit on the number of results retrieved by the system”* (Walker, 2015, 86).

2.2 RDS stakeholders: the complexity of the relationships

There are generally four parties involved with RDS: the end-users of the system; the libraries where it is set up; the content owners and providers; and the RDS suppliers. Relationships between stakeholders are extremely complex (Spezi et al., 2013) as each party has a set of requirements and objectives that are not necessarily shared by other parties. Moreover, even within one group of stakeholders, requirements and objectives can differ from one agent to another (e.g. libraries can have different requirements based on their collections), which can complicate and obscure the detailed understanding of how those RDS systems work and their associated benefits and drawbacks. Further complications may arise in the business and contractual relationships between stakeholders when one party is involved in more than one role, typically in the information supply chain where a content provider may also be a discovery service supplier via their common parent organization (Spezi et al., 2013).

In dealing with such complex contractual and business relationships, the establishment of best practice is essential for stakeholders, in particular HE libraries and RDS suppliers on the one hand and publishers/content providers and RDS suppliers on the other. Dialogue and collaboration between the various stakeholders are regarded by Kelley (2012) as cornerstones in terms of advancing practice in this area.

The complexity of the relationships between stakeholders in the area of discovery services makes it even more important for standards to be agreed upon and best practices defined. This is echoed in the Open Discovery Initiative (ODI), a National Information Standards Organization (NISO) sub-working group, which stresses the need for clarity in resource coverage, indexing and relevance ranking, as well as transparency and neutrality about those processes, in order to open up the dialogue between the various stakeholders, facilitate interaction between different parties and support best practice in the area of discovery (NISO, 2014). Standards are essential to exploit the system to its full potential. In 2007, a UKSG-driven initiative investigating link resolvers (Culling, 2007) had already highlighted the lack of understanding and cooperation between RDS, link resolvers and other agents in the serials supply chain, and produced a set of recommendations for link resolvers, open URLs and knowledge bases to facilitate interaction between systems, including the definition of standards to work within.

2.3 Impact of RDS on content resource usage

Recent literature in relation to RDS has primarily been concerned with the technicalities inherent to the introduction of RDS in HE settings. The focus is often on selection, implementation processes and initial impact on libraries, and the impact on users in particular. A comprehensive overview on the issues of selection and implementation is provided in Vaughan (2012), while Thorburn, Coates, and Stone (2010), in a report for Jisc, provide a detailed account of the implementation and evaluation process of Summon at the Universities of Huddersfield and Northumbria. These are still early days of RDS and libraries are still grappling with understanding their RDS fully and fine-tuning it. There is an increased interest in evaluating performance and comparing RDS systems and other discovery tools, particularly in terms of search effectiveness (Asher, Duke, and Wilson, 2013).

RDS use and impact is an emerging topic within the RDS domain, with issues of performance evaluation and impact naturally following on from issues of selection and implementation. There are a number of case studies looking at the impact of the implementation of an RDS at particular institutions, but the evidence across the HE sector at national and international level is limited. Case studies of institutions having implemented Summon as their discovery service have shown that there appears to be an increase in full text downloads after the implementation of the RDS (Way, 2010; O'Hara, 2012), which the authors attribute to the RDS. In parallel to this *"dramatic increase"* (Way, 2010, p.219) in full text downloads an overall decline in the use of Abstracting & Indexing (A&I) databases is also reported (Way, 2010). From the experience at Grand Valley State University, Way suggests that their Web-scale discovery service (Summon) has had a definite positive impact on the usage of library resources and user behaviour, the latter in encouraging users to *"interact with and discover the wealth of information available within library collections"* (Way, 2010, p.219). A similar trend with Primo at the Open University of Hong Kong is reported by Lam and Sum (2013), although the authors do acknowledge that a direct causal

link with the implementation of the RDS is difficult to evidence. This alleged decline in A&I databases is being investigated by Heterick and Levine-Clark (nd) via access to the JSTOR platform via multiple sources. Findings show that there does indeed seem to be a decline in the number of requests for full text articles via the JSTOR platform, although the authors remain cautious with this finding owing to the fact that the results were not found to be statistically significant. The impact on A&I is indeed a complex matter and although studies tend to show a negative impact of RDS on the use of A&I, Calvert (2015) reported a “*demonstrable increase in the use of abstracts and A&I*” (Calvert, 2015, p.18), as well as a strong growth in e-journals use at Western Carolina University. A series of surveys conducted in 2010 and 2012 by the National Federation of Advanced Information Services (NFAIS) (2012; 2014) reported that A&I services participating in RDS indicated that overall there may be an increase in content usage, enabled through a perceived broader exposure of content via RDS, but there were also growing concerns about issues such as loss of brand identification within the RDS environment, drop in revenues, low search results ranking for their content and accuracy of usage statistics.

Of particular interest to the topic of usage and impact is the large-scale comparative study on online journal usage at institutions set up with an RDS being conducted jointly by Levine-Clark, Price and McDonald (2013). The scope of this study is however limited to publisher-hosted journal content; it does not examine the usage of any other type of resource. Initial findings suggest a very mixed picture is emerging, with general trends showing important variations between institutions and content owners and providers, with for instance some publishers experiencing an increase in article downloads while others are experiencing a decline (Levine-Clark, Price and McDonald, 2013). The authors also looked at variations by type of discovery service. They acknowledged however that local conditions and context seem strongly to influence levels of usage, making it more difficult to analyse and interpret the usage statistics.

Our work is part of this emerging trend of investigating whether RDS have an impact on academic content usage, and ultimately understanding the nature of the impact.

3. Methodology

The original research was commissioned by UKSG, in collaboration with Jisc, in 2013, and consisted of three phases:

- an online survey of UK HE libraries to determine the RDS landscape,
- a series of case studies of publishers, content providers and libraries to collect the required usage data for the evaluation of the impact of RDS on content usage, as well as gather the views and perceptions of participating libraries and commercial agents on the impact of library discovery technologies such as RDS on content usage,

- a series of interviews with stakeholders to obtain a bigger picture on the perceived impact of library discovery technologies and an insight of where the sector is going.

3.1 Survey

Invitations to complete a Web-based questionnaire were sent to UK academic and research library directors, by SCONUL (the Society of National, College and University Libraries) on behalf of the research team, in summer 2013. The objective of the survey was threefold: firstly, it enabled the research team to determine the RDS landscape, and in particular how many HE libraries were already using RDS; secondly, libraries were offered an opportunity to volunteer to take part in the subsequent case study phase; thirdly, the questionnaire enabled the research team to elicit views and perceptions about RDS use, which informed greatly the nature of the questions asked in the library and publisher/content provider case studies.

A total of 58 usable survey responses were received from a wide range of HE institutions, providing a good mix of teaching-led and research-intensive institutions. Two responses were received from national libraries, as well as one special library, and one HE college in the Republic of Ireland, giving a total of 62 institutions available for the analysis. Full details of the survey methodology, and a copy of the questionnaire, are given in Spezi et al (2013).

3.2 Usage data

The usage analysis is based on the data received from six participating libraries and four participating publishers and content aggregators. The case study libraries varied in size from 10,000 to 29,000 Full-Time Equivalent (FTE) students, and came from across the UK; four (identified as A, B, D and F) are teaching-led institutions while two (C and E) are research intensive institutions. Case study libraries were required to provide usage data for 2 years pre- and post-RDS implementation at their institution. Publishers and content providers were asked to supply usage data for the corresponding period for each of the case study libraries; unfortunately, they were not always able to supply data across the whole period for all their resources (for instance, e-books or e-journal usage data prior to a certain date). The publisher usage data have been incorporated wherever possible in the analysis.

Time series techniques have been used for analysis, as monthly usage follows the cycle of the academic year. The analysis is therefore based on a 12 month moving average (i.e. the average usage over the preceding 12 month period). Further, in order to facilitate comparison and interpretation, institution size has been taken into account by taking usage per FTE student. As libraries had different dates of implementation of their RDS, data were re-configured to record time relative to the month of RDS implementation, and all graphs are presented relative to the month of RDS implementation in each library.

- The trend for usage in month *m* is calculated as the average usage for the 12 months up to and including month *m*.
- Usage per FTE student in month *m* is this figure divided by the number of FTE students as reported to the UK Higher Education Statistics Agency (HESA) for the 2011-12 academic year.
- Relative usage per FTE student in month *m* is the difference between this figure and the usage per FTE student in the month in which the RDS was implemented.

3.3 Stakeholder interviews

A series of interviews were conducted with a selection of stakeholders (two RDS suppliers, one content provider and a senior member of the Jisc's Digital Infrastructure team) to provide additional contextual information. Details of the findings are presented in the project report presented to UKSG (Spezi et al., 2013). They provided additional contextual information and an overall picture of the RDS sector. They also helped triangulating the findings from the questionnaire and case studies.

4. Findings

This article focusses primarily on findings from the survey and the library case studies. Individual libraries, publishers, content providers and RDS suppliers – and their representatives - have been anonymised in the study to preserve confidentiality, owing to the commercial sensitivity of the data and views expressed in this research.

4.1 RDS implementation landscape

Findings from the survey indicated that UK HE libraries have eagerly embraced and massively implemented Web-scale discovery systems, with over 77% of the libraries surveyed having already implemented an RDS (48 out of 62), while a further 11% (7) reported being in the process of implementing an RDS (Figure 1). There is undeniably a chance that the survey may have been subject to an unavoidable self-selection bias - i.e. attracting predominately respondents that were particularly interested in RDS - to the detriment of a more representative sample of the wider UK HE library population. However, even if this is the case, it still denotes a massive adoption of RDS, given that such discovery layers are still a relatively new product in the library scene. This suggests that UK academic libraries are definitely manifesting an appetite for discovery layers that allow users to search across (almost) all resources via a single search box, thus finally breaking with the compartmentalisation of resources by type and format, i.e. print books; print journals; e-books; e-journals; individual databases, open access resources, etc.

RDS implementation started as early as 2007-08, when federated search was the only tool at the time enabling users to search simultaneously across various electronic collections and databases. Based on the survey data, it appears that RDS implementation may have reached its peak: there were, indeed, as many RDS

implementations in 2012-13 as in the previous 3 years combined (2009-2012) (Figure 1). The survey responses also indicated that the UK library discovery market appears to be largely dominated by 3 products: Ebsco's EDS, Ex-Libris' Primo and Serials Solutions' Summon (Figure 2). Other RDS included AquaBrowser, Blacklight, Encore, Endeca, VuFind, WorldCat Local, only used by one or two libraries each.

Figure 1: RDS use in academic libraries

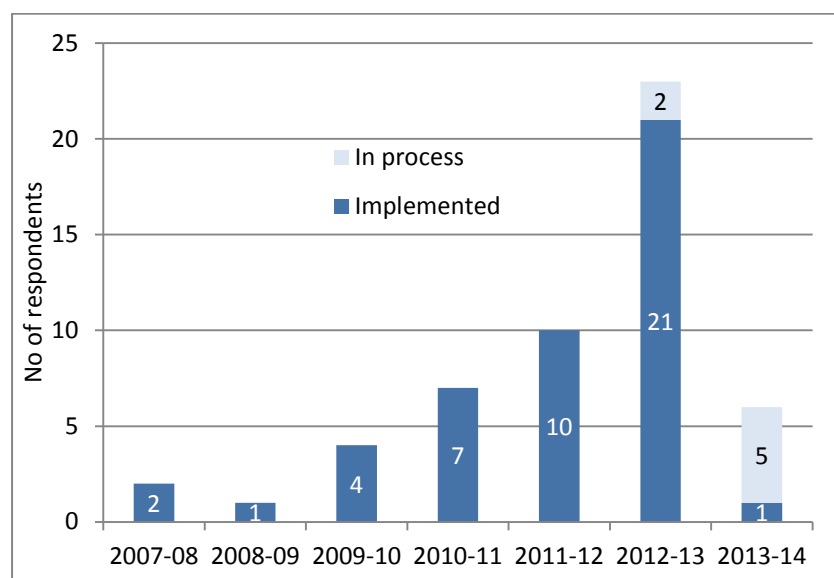
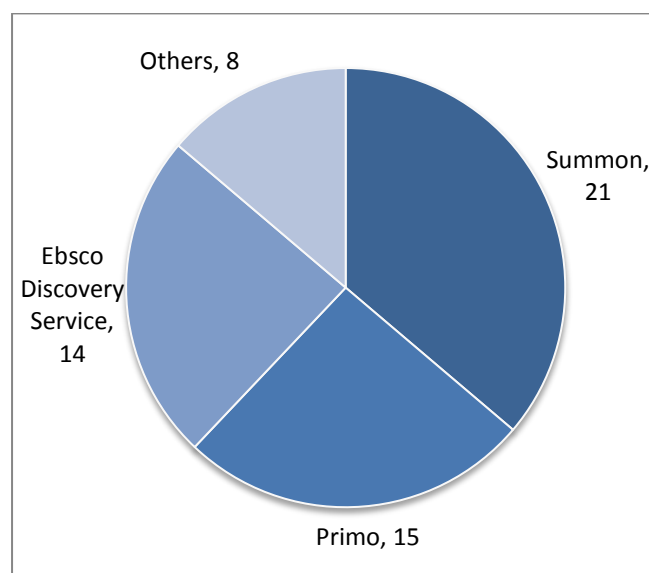
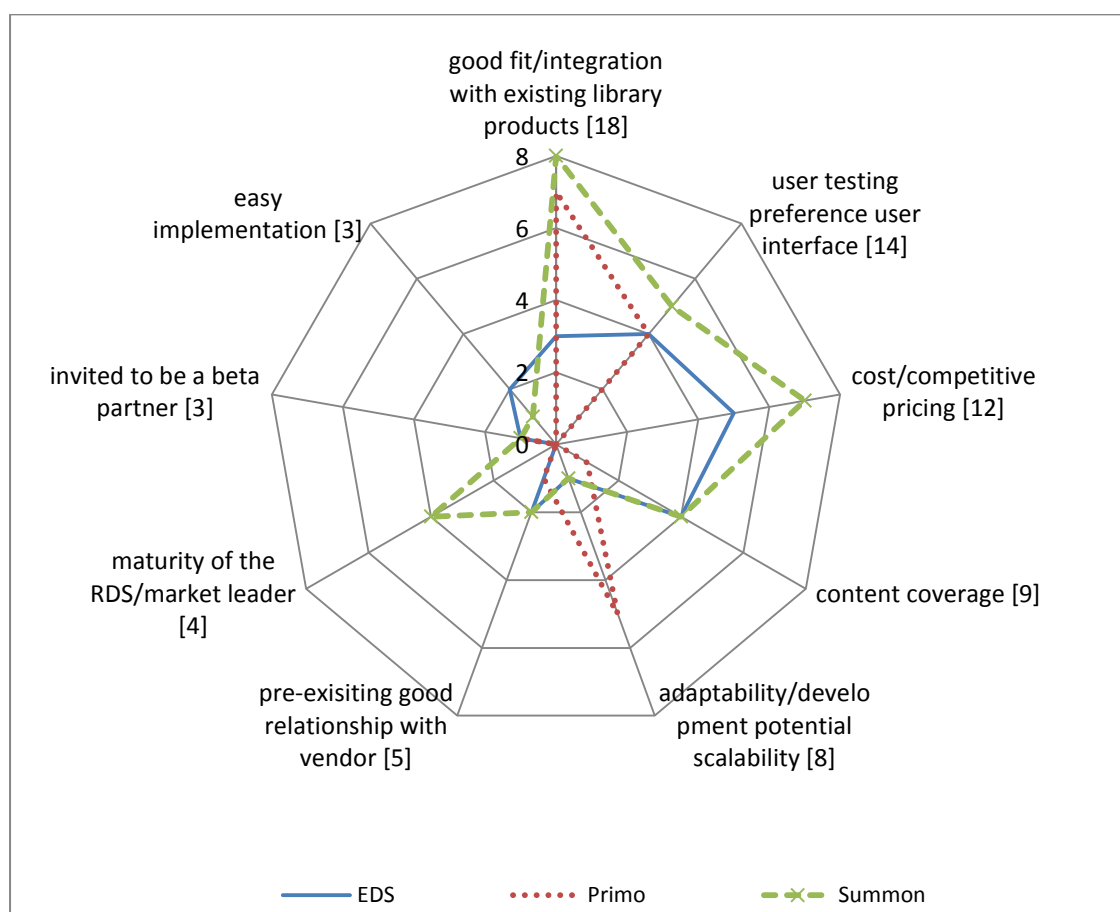


Figure 2: RDS products used by UK HE libraries



When asked to comment about the reasons for choosing a specific RDS, libraries reported many varied reasons underpinning their selection, with the main considerations including the cost of the RDS, the user interface and compatibility with existing library products and systems (Figure 3).

Figure 3: Reasons for choosing a specific RDS (free text survey comments)



The relationship between the RDS and the online catalogue, commonly designated as OPAC, remains ambiguous. Almost half of all survey respondents (25 out of 54) considered their RDS as a replacement for their OPAC. However, only 14 (out of 54) no longer offered access to their OPAC. This issue was followed up in the library case studies and librarians reported very mixed views about whether they considered their RDS to be a replacement for their online catalogue. They often reported that they had to continue to offer access to the online catalogue for some library transactions that could not be completed via their RDS, such as book reservations.

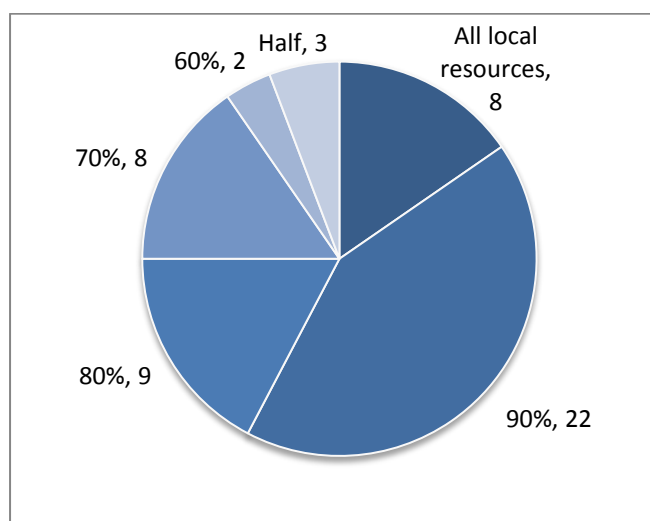
The data gathered via the questionnaire and interviews, as well as supplementary evidence gathered at conferences and workshops, indicate that, overall, libraries are extremely happy with their RDS, although they do recognise there are some limitations and teething problems associated with RDS implementation and use.

4.2 Resources included in RDS

Estimates of resource coverage in the survey responses were generally high, with just over 90% of survey respondents having at least 70% of their local collections in their RDS (Figure 4). Survey respondents were given an opportunity to provide free text comments in relation to the issue of RDS resource coverage. There is an indication that all content included in the OPAC has generally been transferred to the

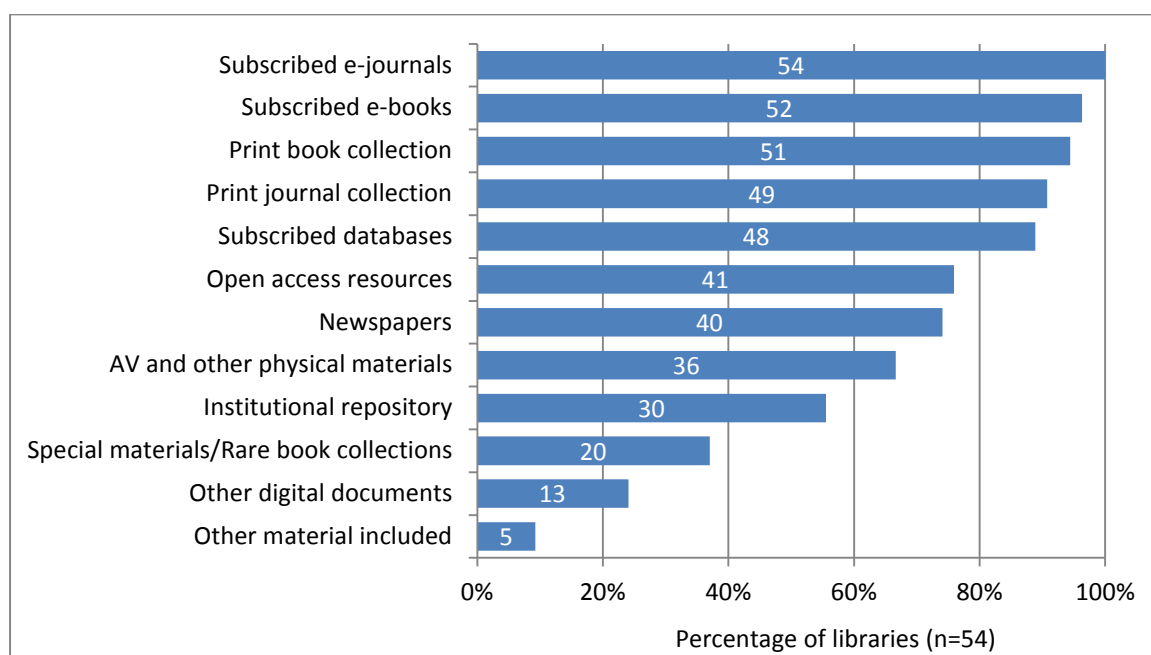
RDS, hence the large chunk of local collections (including print collections, for instance) reported as being available in the RDS.

Figure 4: Proportion of local collections included in the RDS



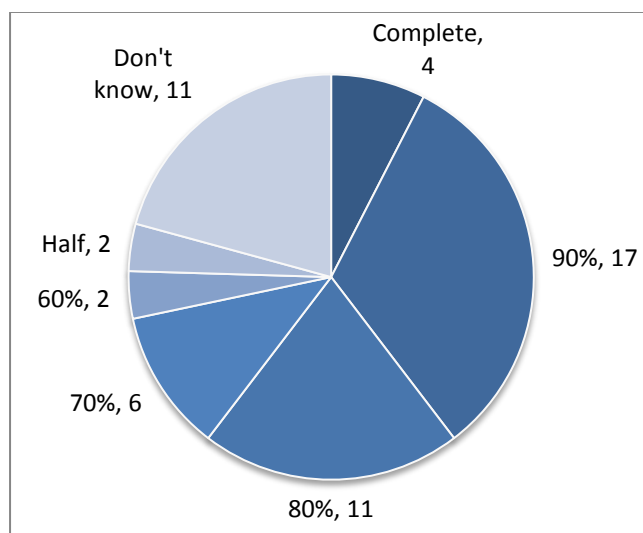
All survey respondents reported that their subscribed e-journals were included in their RDS, and over 90% of respondents also included subscribed e-books and their print collection (Figure 5). The specific issue of exactly what content was included in the RDS was further explored in the library case studies, particularly in relation to non-licensed content and whether libraries should include content for which they had no subscriptions. Views and opinions on the subject varied greatly: on the one hand, it was felt that if non-licensed content was retrieved and displayed via the RDS and users could not access the content, but only read the metadata, this could generate some frustration for users, and consequently some libraries were in favour of including only licensed content in their RDS. On the other hand, enabling users to discover the full range of resources useful for their learning or research, within the library's collections and beyond, was perceived as a good thing, although it was noted that the retrieval of non-licensed content was actually diminishing the chance of retrieving licensed full text content, which may also cause dissatisfaction and frustration amongst users.

Figure 5: Types of content included in respondents' RDS



When asked about the match between the resources the library subscribed to and the resources that were included in their RDS' central index, the majority of survey respondents reported that the match was 80% or better, with 4 respondents – out of 53 – indicating that they felt that all their licensed resources were included in the RDS (Figure 6). However, the analysis of the free text survey responses revealed that libraries actually find it very difficult to gauge the extent of the coverage of their RDS in comparison to their licensed resources. This was further corroborated in the interviews with librarians who participated in the library case studies. For instance, when the research team tested an 80% figure provided by one of the case study libraries in the survey, the interviewee explained *“that of course was plucking a figure out of thin air! I have no idea what our real coverage is. I was just trying to make allowance for the fact that it doesn't include newspaper content, it doesn't include some of the market reports, and as I said it doesn't really cover Lexis and Westlaw which are key resources for Law, so that's why I came with the figure of 80%.”*

Figure 6: Correspondence between licensed electronic resources and resources included in the RDS's index



Some of the libraries surveyed reported having included the different types of resources in stages, with a primary focus on the inclusion of resources deemed essential - such as e-journals, e-books, material available in the OPAC and databases - for the launch of their RDS. Other types of resources, e.g. repository material, special collections etc., were often included at a later stage, when funding and human resources became available. Some institutions reported having deliberately not included (or delayed the inclusion of) some resources in their RDS; for example, open access material (including content in the institutional repository), free bibliographic collections or non-full text databases, archive or special collections and newspaper collections. Various reasons were put forward for explaining the rationale underpinning such decisions, ranging from technical problems (for instance, problems with linking the RDS to the institutional repository platform), to low priority status, to a risk of 'cluttering' the search results with less academic resources (particularly in the case of newspaper collections).

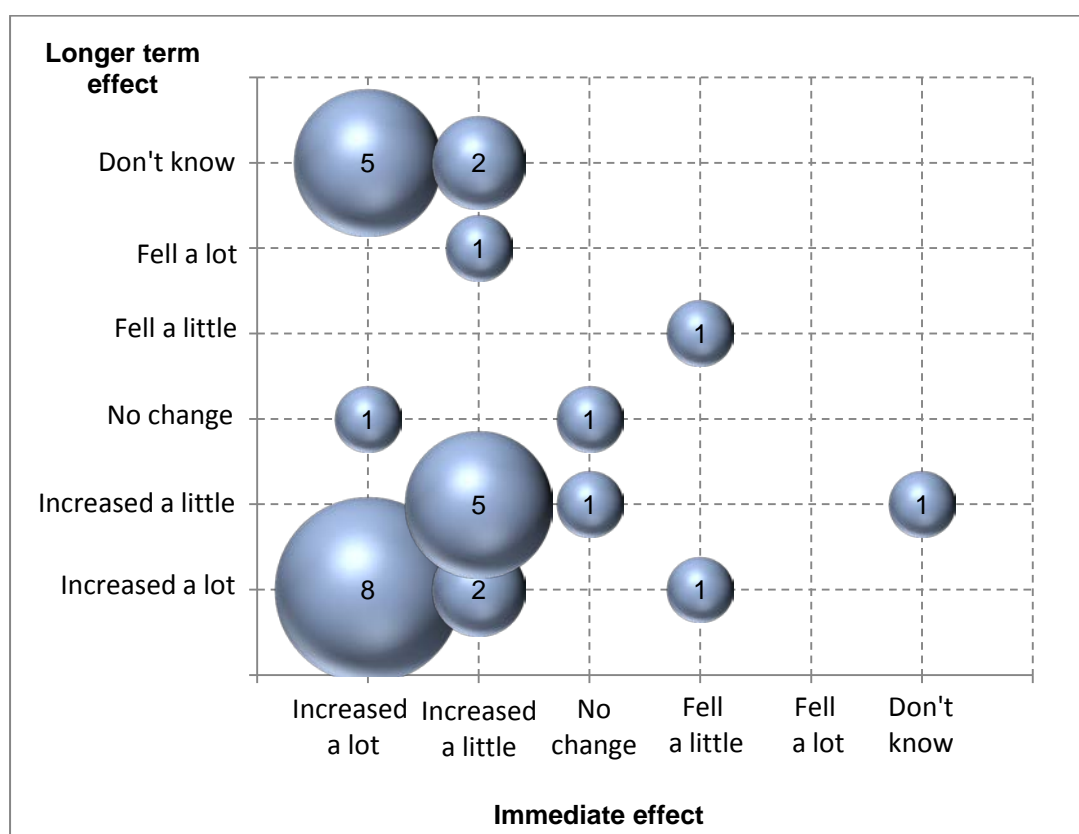
The impact of the index on the discoverability of local content varies greatly depending on which collections and resources libraries decide to include in their RDS. The discovery of local and/or subscribed content is probably an institution's primary focus, and the huge volume of resources indexed in RDS sometimes created so much 'noise' in the search results retrieved, that local content - which had been bought, catalogued and indexed - was submerged and eclipsed by results from other resources such as newspaper articles or book reviews. Consequently, the latter type of material was often deliberately excluded from the search - wherever possible - by the case study libraries. Another example reported by a case study library regarded the inclusion of the HathiTrust Collection, which includes millions of print books digitised from around the world, and which could hamper drastically the discoverability of print books held locally, as titles from the HathiTrust Collection were surfaced in great number by the RDS.

4.3 Analysis of resource usage

4.3.1 Resource usage: libraries' perceptions and analysis

In the questionnaire, librarians were asked whether they felt the implementation of the RDS at their institution had affected resource usage, both immediately after implementation and in the longer term. Looking at the pattern of perceived change reported by the 29 survey respondents who had already implemented their RDS and expressed views on this, the majority felt that usage had increased at least a little both immediately after implementation and in the longer term (Figure 7). It is worth noting that 18 respondents replied '*don't know*' to both questions (short term and long term impact), which indicates that they were not specifically looking at content usage statistics, nor did they have a marked interest in content usage analysis at the time. We can infer from this that usage analysis is not yet a priority for one-third of the libraries surveyed, as they get to grips with other - more essential - aspects of RDS implementation and maintenance.

Figure 7: Long-term and short-term impact of the introduction of RDS on usage of electronic resources

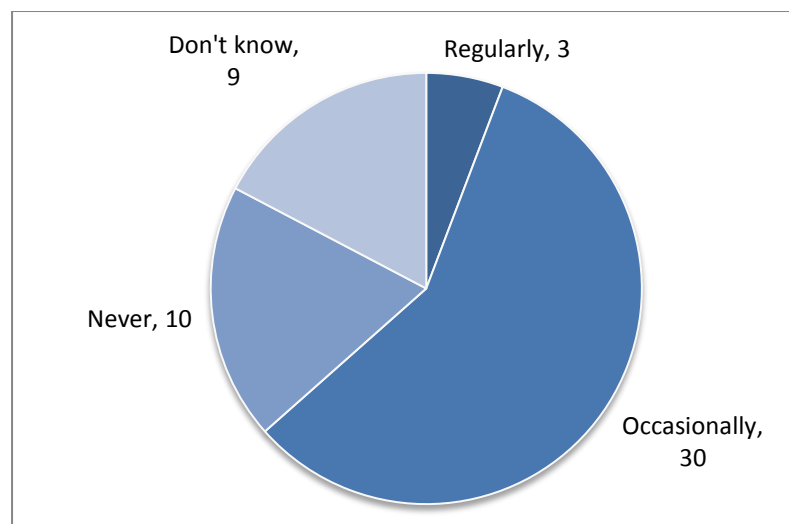


Although the majority of libraries keep usage data on the resources covered by the RDS, only 57% (31 out of 54 respondents) use analytic software to analyse usage: 18 used Google analytics, 13 used the RDS' built-in tools, while three used Excel and five mentioned the Journal Usage Statistics Portal¹ (JUSP). Only 6% of libraries reported that they compare trends in data relating to usage of the RDS with sources

¹ <http://jusp.mimas.ac.uk>

that show actual usage of the target resources themselves on a regular basis and just a little more than half (30 out of 52 respondents) reported doing so occasionally. Ten libraries said they never made such comparisons (Figure 8). This is another strong indication that systematic usage analysis was not seen as a priority by surveyed libraries. The case studies suggested that lack of staff time and expertise to conduct such analysis was one possible reason, with one respondent reporting that they were *“still quite new to handling the RDS stats - seems like lots of complications to interpreting them!”* while another noted *“it can be difficult and time consuming to do the comparisons.”* Other participants indicated that their library was concentrating first on implementation and usability of their RDS, and analysis of usage was something they would look into further down the line when the service was up and running satisfactorily.

Figure 8: In house analysis of RDS usage data



For those libraries that indicated that they collected statistical data on the use of the resources discovered via their RDS, searches, followed by full text downloads and hits, were the main sources of evidence (Figure 9). Although libraries reported using predominantly searches as the main indicator of usage, there was an indication in the survey's free text comments and from the case studies that they were very much aware of the limitations, but were constrained to use this type of evidence for lack of anything better. Librarians often commented that they did not think that search or session-type data were particularly meaningful indicators, since RDS tended to search across almost all databases for every single search keyed in. Libraries indicated that more useful metrics would be indicators that provide information about how users are interacting with the resources retrieved by the RDS, and more particularly how many of the results returned proved useful. It is always difficult to characterise what is a *useful* resource; but at the simplest level this may be captured through record views and ultimately through clicks-through to the full text download, although one cannot be sure that a paper that is downloaded is actually read and used in the creation of new knowledge.

Figure 9: Statistical data collected by libraries

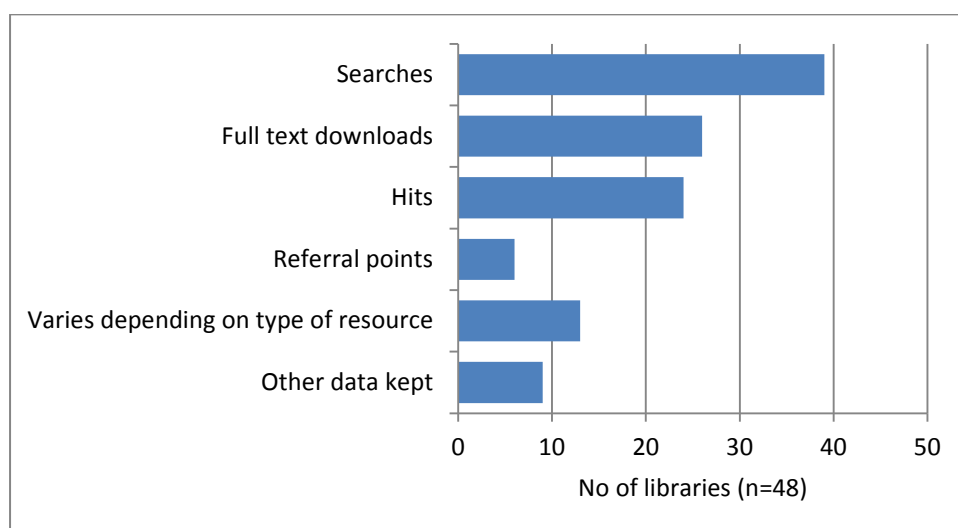
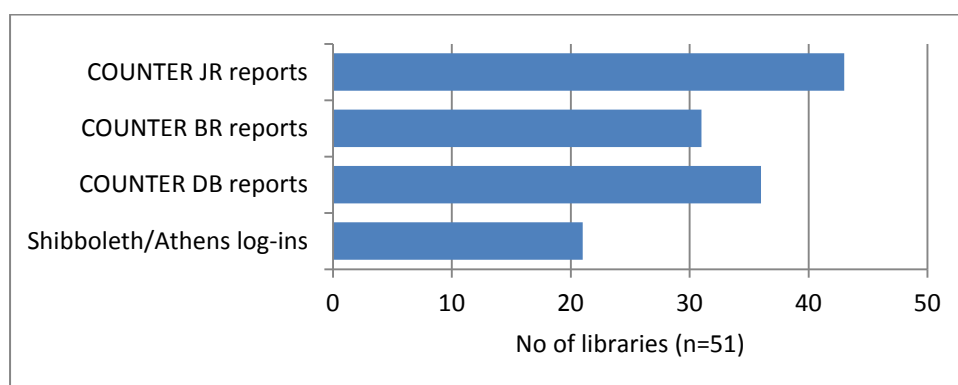


Figure 10: Sources of usage data



Libraries reported using mostly COUNTER2 reports for e-journals (JR), e-books (BR) and databases (DB) (Figure 10). Alternative sources of data included non-COUNTER vendor reports, statistics from individual data providers, local intranet statistics etc.

Several case study libraries also expressed an interest in getting a user profile for their resources - for instance, how much usage of a resource is coming from undergraduates, postgraduates or faculty. Such a level of granularity was not seen as being completely out of reach in the near future, if it was possible to integrate a single sign-on between the RDS and Shibboleth - or similar federated identity access management systems - and to extract such information using authentication tools such as RAPTOR³. Indeed, just under half of the survey respondents reported that they were already collecting more fine-grained information about usage per category group of users via Athens, Shibboleth and EZProxy log-ins. Three libraries reported using RAPTOR for analysing category groups, and five others indicated they were planning to do so in the future.

² <http://www.projectcounter.org/>

³ <http://iam.cf.ac.uk/trac/RAPTOR>

4.3.2 Statistical analysis of e-journal and e-book usage

The overall aim of the study was to provide an evaluation of the impact of RDS on the usage of academic resources, based on COUNTER reports for e-journal full text requests (JR1), e-book section requests (BR2) and database searches (DB1) provided by the six participating libraries (A, B, C, D, E, F) and the usage data for the corresponding period - wherever available - supplied by four of the participating publishers and content aggregators (W, X, Y, Z).

The COUNTER data showed that the ways in which RDS interact with some databases can produce extremely high total search figures, for example by simultaneously searching multiple databases which may, or may not, contain resources relevant to the enquiry. In this paper, we therefore present only the analysis of e-books and e-journals usage, as these data were not affected by this issue. Library collections do not remain static over time, and changes in licensed content within the collections were identified as an important factor influencing the total usage of licensed resources. In order to control for this variability, the analyses presented here are based on those titles which were held in the library collection throughout the period of interest.

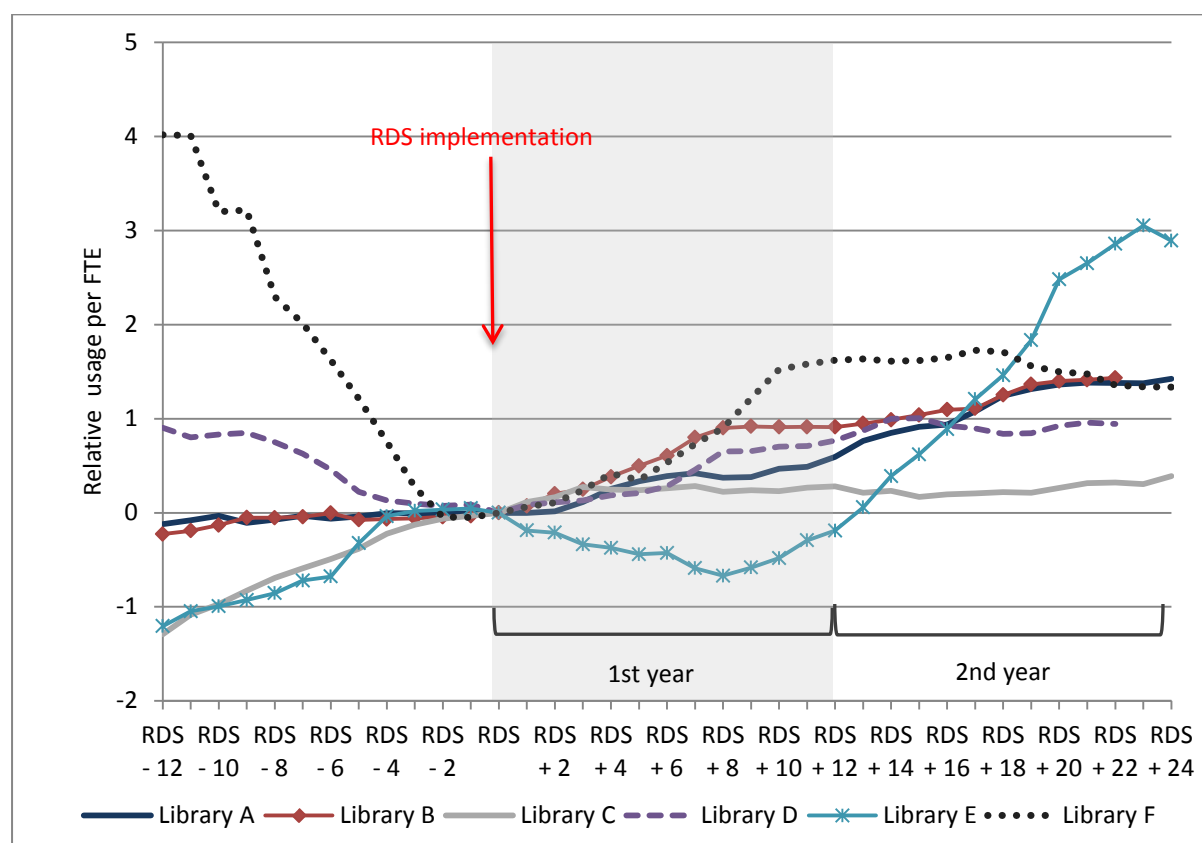
4.3.2.1 E-journal usage analysis

The trends in journal usage per FTE, relative to the introduction of the RDS in each of the six participating libraries, are reported in Figure 11. Over the three-year period considered (one year pre-implementation and two years post-implementation), we observe the following:

- Libraries A and B were recording steady e-journal usage before implementation of the RDS, with a marked upward trend following implementation, suggesting that the RDS has increased journal usage at these libraries.
- Libraries C and E were both recording increasing usage before implementation, but their patterns following implementation of the RDS vary. Usage at Library C appears to have levelled off, while usage at Library E fell during the first year following implementation, with a marked increase in the second year.
- Libraries D and F were recording falling usage prior to the implementation of their RDS, and in both, usage increased in the first year, with a levelling off in the second year following implementation

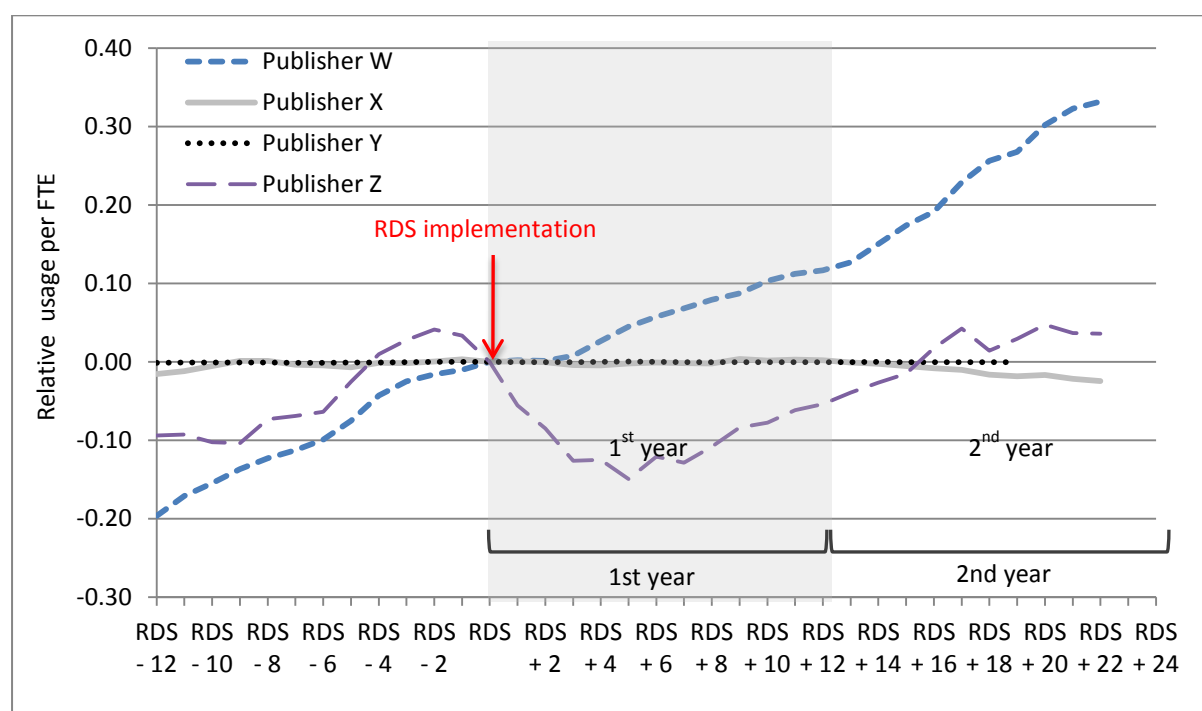
It is therefore a varied picture that emerges from the e-journal usage data supplied by the case study libraries, although there is an indication of a pattern of overall increase in usage of academic journals across all participating libraries, which suggests that there is a positive effect on e-journal usage from having an RDS, although the extent of the increase varies from one library to another.

Figure 11: E-journal usage for each library



From the publishers' perspective, the picture is less clear-cut, with little evidence of any clear effect from RDS implementation overall (Figure 12).

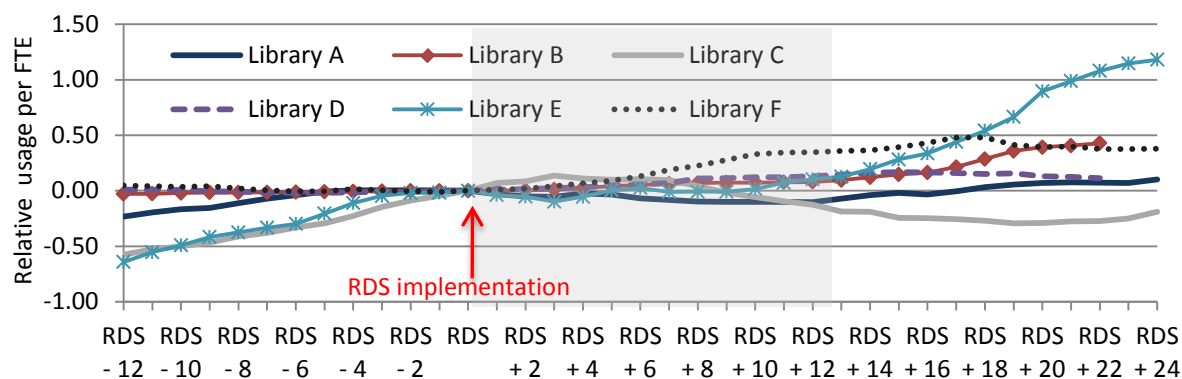
Figure 12: Publishers' overall journal trends



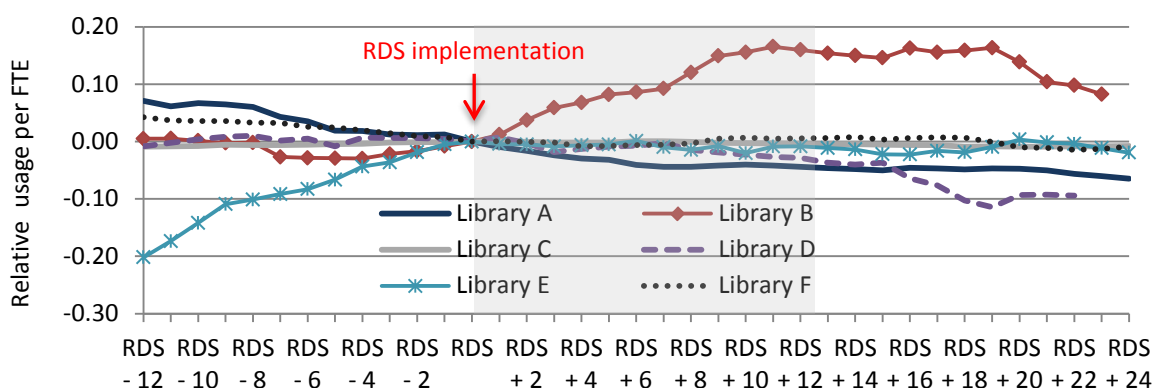
Furthermore, the detailed analysis of the publisher data available for each of the six libraries shows that not only does overall usage after RDS implementation vary between libraries (Figure 11), but also that not all resources/publishers are affected in the same way (Figure 12). The picture for publishers is indeed very mixed when looking at individual library usage for each publisher (Figure 13). For instance, for publisher W, e-journal usage has increased steadily overall, but not in all the libraries supplied, and in one (library C), usage fell following their RDS implementation (Figure 13). The interpretation of the usage data for these four publishers is a complex matter, not least because other factors – e.g. change of platform - may have influenced the usage of these publishers' resources over the period. Furthermore, the variations in usage per FTE shown in Figure 13 are on a very small scale, particularly for publisher Y who is a small and specialist publisher (in comparison to some others in the study) and for whom variations are per 1,000 FTE. Those small-scale variations mean that, for instance in the case of publisher W, the increase in usage recorded for that publisher in Figure 12 is actually a very slight increase in absolute terms: the increased usage is actually about one download per month for every three FTE students. It is therefore extremely difficult to draw any conclusions, based on the publisher data available.

Figure 13: E-journal usage by publisher

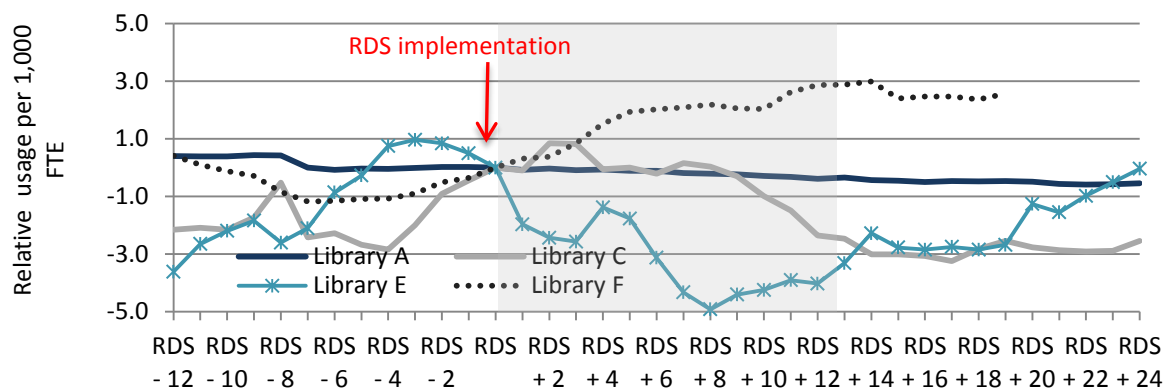
Publisher W



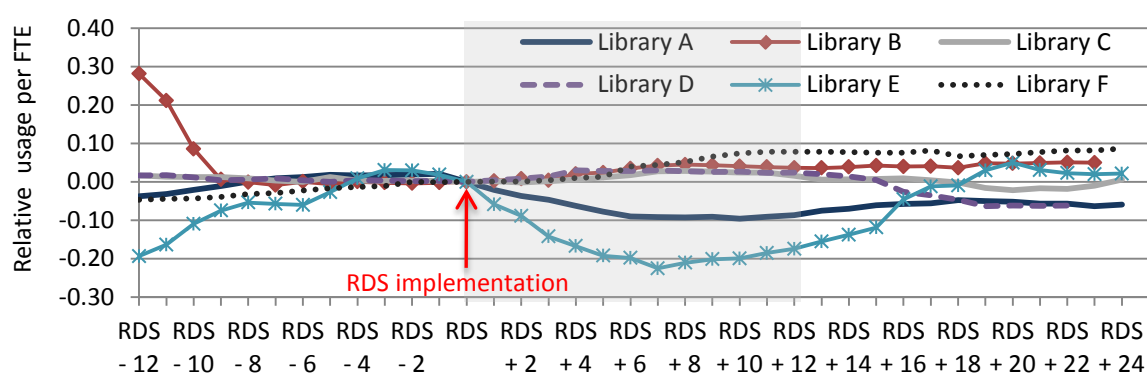
Publisher X



Publisher Y



Publisher Z



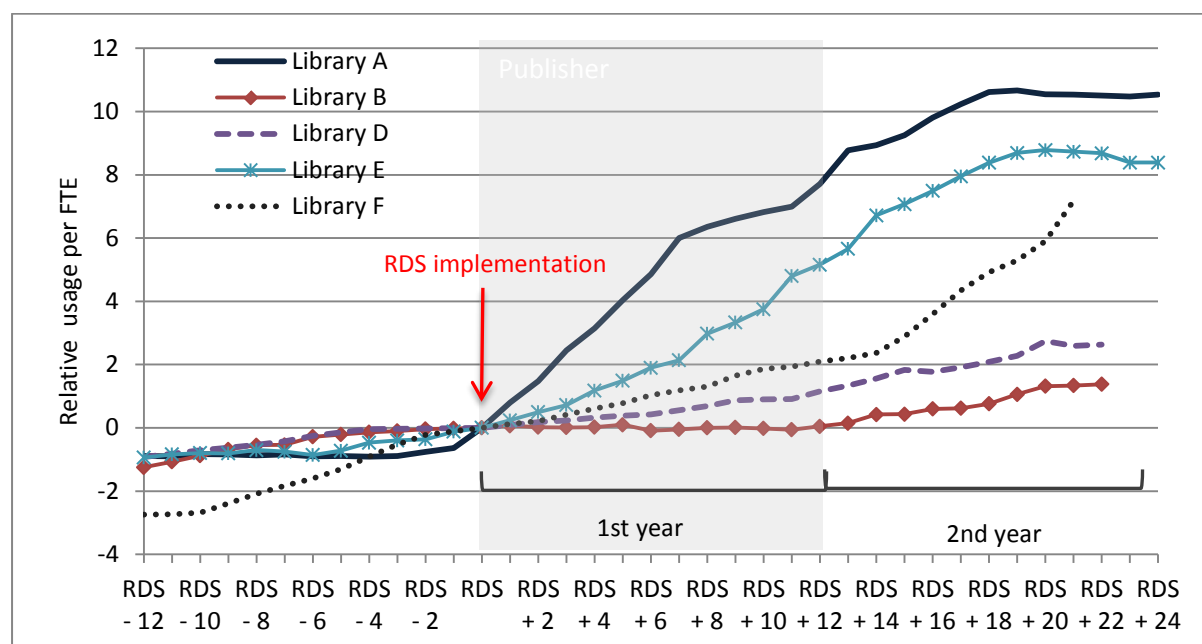
4.3.2.2 E-book usage analysis

The e-book usage analysis is based on the BR2 data received from five of the six participating libraries. Only one publisher was able to provide sufficient e-book usage data for analysis, so this has not been presented here. As for e-journals, other factors can affect usage of e-books, particularly increased availability. E-book availability in academic libraries has increased markedly in recent years, and in order to mitigate this issue and strengthen the results of the statistical analysis, the e-book usage data analysis was conducted on subscriptions that were constant over the period.

Figure 14 shows the e-book usage per FTE, based on the data provided by the libraries, for a constant set of e-book titles. Over the three-year period considered (one year pre-implementation and two years post-implementation), the following was observed:

- All the libraries were recording increasing usage of e-books prior to implementation of their RDS.
- For libraries A and E, usage increased markedly following implementation, suggesting that the RDS may have increased discoverability of these resources.
- At libraries D and F, usage continued to increase at the same rate following implementation, although at library F there was a more rapid increase in the second year following implementation of the RDS.
- At library B, usage initially stabilised, but began to increase again in the second year following implementation.

Figure 14: E-books usage – constant titles



5. Discussion

Findings show that UK HE libraries have eagerly embraced Web-scale discovery services, reaching a possible peak in RDS implementation in the 2012-13 academic year. The one-stop-shop experience RDS offer meets the observed changes in users' information seeking behaviours. Amongst those changes is the fact that students are indicating a marked preference towards using search engines and the Internet to source information for their academic endeavours (Warwick et al., 2009). In addition, the single search box, emulating the search engine experience, brings a new dimension to information searching via library portals, bringing down the walls between library collections. It addresses many of the challenges and shortcomings posed by OPACs – some of which are discussed in Mi and Weng (2008) - and other portals of individual collections or resources. There are, however, still uncertainties about whether RDS are going to replace OPACs in the near future. Findings show that the UK RDS market is mainly covered by three products. Other than cost, libraries' decision for choosing a specific RDS is often determined by the current ecosystem in place: libraries tend to show preferences for products that will fit or integrate smoothly with their current suite of products. If the short-term benefits are real, libraries are, however, at the risk of locking themselves in the longer run in a single ecosystem that may not necessarily evolve the way libraries want, as detailed in Spezi et al. (2013). A typical example of this issue in everyday life is given by an ecosystem such as Apple (iPhone, iMac, iPad, iTunes etc.): users can encounter problems when they want to start using an app or software that is not fully supported by these products.

Very high levels of satisfaction with RDS were reported by libraries in Spezi et al. (2013) - both in the survey responses and in the case studies, despite some obvious flaws. Examples of those shortcomings include the fact that not all the library-subscribed content is included in the RDS' central index or the fact that libraries actually find it difficult to gauge the extent of their RDS coverage in comparison to their licensed resources. Additional shortcomings - detailed in Spezi et al. (2013) - include issues derived from the perceived lack of cooperation between vendors and RDS suppliers. This is because those limitations are overshadowed by the gain in user satisfaction provided by the single search box instrument, which has drastically simplified the way users can now search library collections and greatly improved users' experience of the library overall.

With regard to the RDS usage analysis, the findings clearly underline a lack of activity in this area at participating libraries, although the general perception was that libraries felt that usage of electronic resources had increased since the implementation of their RDS, and particularly for electronic journals and e-books. There were some notable exceptions, for example, Library A had observed a steady increase of JR1 activity over the past 10 years and had expected to see the trend plateauing out at the time of the implementation of the RDS: *"there is only so much the users can consume."* However, they recorded an unexpected 17.5% increase in

their JR1 activity in the year following the implementation of the RDS. This positive impact of RDS on journal usage could also be seen in the cost per download of a dozen of their core services (accounting for 74% of their JR1 activity) which went down by 19% in the second year after implementation of the RDS due to this increase in usage.

This resonates with the few experiences reported in the literature of RDS impact on resources usage, notably Way (2010), O'Hara (2012), Lam and Sum (2013). The detailed analysis of usage data provided by the case study libraries indicates that, overall, the implementation of the RDS at each library has had a positive effect on the usage of e-journals and e-books, although the precise extent of this effect cannot be quantified, owing to the diversity of influencing variables (other than growth of content itself, which we have controlled for as much as possible). The data analysis also suggests that not all libraries have benefited from the RDS to the same extent, although gathering evidence to understand the reason(s) for the variation from one library to another was beyond the scope of this research. Furthermore, the analysis of the aggregated data provided by participating publishers suggests that the effect of RDS on usage levels may vary significantly from one publisher to another, and possibly across resources, e.g. journal titles or packages. The findings indicated that publisher W experienced steady usage increase overall while the publishers X, Y and Z experienced a more modest increase, with even a decrease in usage for publisher Z in the first 12 months.

In summary, there tends to be an overall increase in usage of both e-journals and e-books after RDS implementation, although the impact varies greatly across institutions and publishers. This increase in e-journal usage echoes the primary findings from the Levine et al. (2013) study, who also noted a general increase of e-journal usage after RDS implementation, as well as a variance in the extent of this increase across libraries. Levine et al. (2013) also found that the impact across publishers varied greatly, with some publishers reporting an increase in article downloads while others are experiencing a decline.

Findings show that this increase in usage is greater for e-books than for e-journals. Reasons for this are unclear; and investigating them was beyond the scope of this research – for example, it may be that libraries are encouraging and pushing the use of e-books via their RDS because RDS make e-books more findable (RDS discoverability effect); users may be developing a growing appetite for e-books (format effect); the number of e-books available at each library is certainly growing continuously over the period (availability effect - which we have controlled for by basing the analysis on the constant titles available in the data sample).

Although a positive association between RDS implementation and increase in usage levels of e-journals and e-books was found, it was not possible to characterize this any further, based on the available data. One of the issues is that there is a variety of other variables influencing usage levels, which adds complexity to the statistical

analysis of resource usage. This echoes findings in Levine et al. (2013) who suggested that local conditions and context also strongly influence levels of usage. Because of such complexities, quantifying the extent of the effect is challenging, as is evidencing a direct causal link. Lam and Sum (2013) were confronted by the same problem in relation to evidencing a robust causal link.

The case studies show that it took longer than anticipated for libraries to get their RDS up and running, as well as to familiarise staff and students with its use. It is strongly believed that a deeper analysis of the positive association between RDS and usage levels of electronic resources aiming at identifying a causal link would need to cover a longer period of time post-implementation than the two years available for our study. As RDS become embedded in libraries, a longer time series should be possible.

Perceived improved user satisfaction, enhanced user experience in searching library collections and, often, increased resource usage are the main benefits libraries may garner from adopting RDS. However, those discovery tools are also imperfect (customisation; matching of the entire library-subscribed resources; lack of cooperation between stakeholders, etc.), and are still being developed. In terms of the lessons learnt from this study, it became clear at an early stage in the project that there is no unified approach to compiling and using all the different usage data libraries collect and receive from their RDS supplier. This suggests that the academic library community would greatly benefit from developments undertaken by COUNTER - or other similar agencies - in this area, notably through the development of a COUNTER code of practice stipulating standards and protocols for RDS specific data.

6. Conclusion

RDS represent a significant investment for institutions; as such they need not only to be perceived as bringing added value to the library's presence in the parent institution, but this must be demonstrated with evidence. As they become increasingly prevalent there is a pressing need to understand better their role in both information seeking behaviour, library resource management and their impact on usage of academic content. This paper has brought some insight into these questions. Furthermore, it has shown that there are many variables potentially influencing usage levels of e-journals and e-books, and the extent to which each variable influences usage levels has still to be defined. Electronic resource usage is a multi-dimensional environment, which adds complexity to any usage analysis. Research in this field would certainly greatly benefit from additional detailed usage studies based on a more extensive set of data (richer data), better quality data and the use of a control group.

It is believed that the results of this research will be of interest to a variety of stakeholders, including the academic library community at large, publishers, content providers, RDS suppliers, and other stakeholders in the information supply chain.

7. Acknowledgements

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