SHORT COMMUNICATION

Open Access Institutional Archives:
A Quantitative Study (2006-2010)

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ABSTRACT

Open access publishing is growing in importance, and, in parallel, the role of institutional archives has come to the forefront of discussion within the library community. The present study is an attempt to analyse the present trend of institutional archives worldwide. The factual data of each individual repository was collected from various Directories of Institutional Repositories by using survey method. Data was analysed in terms of quantity of institutional archives increased during last six years, country-wise contents of institutional archives, types of materials archived, subject coverage, software used, language of interface of institutional archives, host domains, and policy of institutional archives. The results of the study suggest healthy growth in terms of quantity of institutional archives' increase worldwide, however, the development is more prevalent in developed countries than developing countries. The subject analysis of the institutional archives indicates that the contributors in the field of health and medicine are more interested to submit their materials in repositories. Currently the institutional archives mostly house traditional (print-oriented) scholarly publications and grey literature, using DSpace software and most of these materials were of English language. However, the policy of content inclusion, submission and preservation is yet to be well defined in institutional archives.

Keywords: Open access, institutional archives, information and communication technologies

1. INTRODUCTION

One of the more recent developments in the field of scholarly communication is the trend towards open access (OA). OA holds promise to remove both price and permission barriers to the scientific communication by using Internet. In fact, OA is a step ahead of "Free Access", which removes the price barriers by providing free access to end users. OA removes the permission barrier as well. There are two ways for researchers to provide OA to their work-by publishing their articles in OA journals or by depositing copies of their subscription-journal articles in open archives [known variously, depending on circumstances, as e-print archives, institutional archives (IAs) or institutional repositories]. According to Wikipedia, an IA may be defined as an online locus for collecting and preserving—in digital form—the intellectual output of an institution, particularly a research institution[1]. For a university this include

materials such as research articles before (pre-print) and after (post prints) undergoing peer review, and digital versions of theses and dissertations. But it might also include other digital assets generated by normal academic life, such as administrative documents, course notes or learning objects. An IA is a collection of digital research documents such as articles, book chapters, conference papers, and data sets. E-prints are the digital texts of peer-reviewed research articles, before and after refereeing. Before refereeing and publication, the draft is called a "pre-print". The refereed, accepted, final draft is called a "post-print". The term e-prints include both pre- and post-prints.

With the increasing use of information and communication technologies (ICTs) and availability of open sources softwares most of the institutions are maintaining such repository or archive to collect, preserve, and make accessible all the intellectual product

created by the scholarly communities of that institutions.

Main objectives for having an IA are:

� To create global visibility for an institution's scholarly research

✻ To collect content in a single location

✻ To provide access to institutional research output by self-archiving it

✻ To store and preserve other institutional digital assets, including unpublished or otherwise easily lost ("grey") literature (e.g., theses or technical reports).

Institutional archives are now become an important new player in the field of academic information management and publishing. The development and growth of IAs arose in response to the major changes in scholarly communication. The new form of scholarship-that is born digital-constitutes an important source for present and future research and teaching. With the emergence of the World Wide Web (WWW) as an effective vehicle for publishing and distributing, the born-digital form of scholarly objects becomes more popular. Additionally, the rapid rise in the cost of commercial scholarly journals was another major impetus in developing new models in scholarly publishing. IAs benefit scholars by providing free access to all scholarly works published or likely to be published in near future. It reduces the gap of 'backlog' by bringing timely access, and increases visibility through freely accessible Web.

2. HISTORICAL BACKGROUND OF INSTITUTIONAL ARCHIVES

With the development of ICTs, a number of alternative strategies to the traditional scholarly publishing system have evolved. Among these, IA model promises to be extremely advantageous to peers everywhere, especially to those who have acute shortage of resources for purchasing scholarly literature. The impetus for IAs was boosted by the Open Society Institute (OSI) in a small meeting convened in Budapest on 1-2 December 2001. The purpose of the meeting was to accelerate progress in the international effort to make research literature in all academic fields freely available on the Internet[2,3]. The first major international statement on OA, which includes a definition, background information and a list of signatories, is the Budapest Open Access Initiative. The other two leading statements are the Bethesda Statement on Open Access Publishing and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. The conception of OA in these three statements, which is often called the BBB (Budapest, Bethesda and Berlin) definition, launched,

inspired, and continues to guide the OA movement. Although institutionally-based, or more typically departmental, 'archives' were known before this, especially in areas such as computer science and economics that were served by NCSTRL and RePEc, respectively, OAI introduced the Protocol for Metadata Harvesting (OAI-PMH) to provide common services that could operate over more general, independent sites[4]. IA adopt the same OA and interoperable framework as e-print archive, but rather than being discipline-based, represent the wide range of research output of a given university or research organisation. The term was coined by Scholarly Publishing for Academic Resources Coalition (SPARC), and has been defined by SPARC as "digital collections capturing and preserving the intellectual output of a single or multi-university community"[5].Crow argues that institutional digital repositories will lead to significant increases in the prestige of the institutions that build them[6]. Stephen Harnad also cites institutional prestige: "Distributed, institution-based self-archiving benefits research institutions in three ways. First, it maximises the visibility and impact of their own refereed research output. Second, by symmetry, it maximises their researchers' access to the full refereed research output of all other institutions. Third, institutions themselves can hasten the transition to self-archiving and so more quickly reduce their library's annual serials expenditures to 10 per cent (paid to journal publishers for refereeing their submissions)"[7]. Pinfield, Gardner, and MacColl also argue that an e-print archive can raise the profile of an institution[8].

Growth in the number of IAs has accelerated since 2002. Despite some lag in time, there has been corresponding growth in terms of number of digital content in IAs, as revealed by the Registry of Open Access Repositories (ROAR, http://roar.eprints.org/). Among repository directories, "on 31 December 2006, OAIster (launched in 2002) listed 726 OA, OAI-compliant repositories worldwide; with an increase of 25 per cent than previous year. In 2006 OAIster listed a total of 6,255,599 records from the repositories it covered[9]. ROAR is one of the authentic sources that identify repositories worldwide. With the increasing popularity of OA materials from worldwide, number of IAs are increasing continuously. There has also been extensive investigation of the role of various types of repositories in the scholarly communications process, particularly in the context of e-prints and author self-archiving, and even, more recently, with respect to institutional policies about author self-archiving; however, these studies really don't illuminate the full range of developments surrounding institutional Archives planning and deployment[10]. To the best of our knowledge, there has been relatively little systematic examination of the actual state of deployment of IAs across the world. It is, therefore, important that a

study be undertaken with the sole purpose of identifying the present status of IAs worldwide.

3. OBJECTIVES

The major objectives of the study are:

✄ To identify the overall growth of IAs since 2006

✄ To examine the country-wise growth of IAs

✄ To identify the leading countries in terms of number of IAs and documents

✄ To measure the quantity of publications under various forms

✄ To determine the prominent subject, software, language of IAs

✄ To identify the policy statement of IAs

4. METHOD USED

Since the study was planed to analyse the growth and development of IA, survey method was found suitable. Our investigation began with one of the most authoritative online directories: ROAR. Additionally, we also looked Directory of Open Access Repositories (OpenDOAR: www.opendoar.org) and OAIster to identify other IAs not identified by ROAR. The access policy for all the directories was checked to know whether all the materials of the aforesaid directories were available free, or partially free. The factual data in terms of number, country of origin, document types, subjects, software used, language, host domain and policy of individual IAs were noted for further analyses.

5. RESULTS

5.1 Growth of Institutional Archives

First, we were tried to find out the growth in number of IAs over the years, but it was observed that a large number of IAs did not mentioned their year of establishment. Therefore, we took data, prior to 2007, from an earlier study conducted by Hitchcock *et al.*[11], and from 2007 onwards from the OpenDoar. This data is based on date of registration in the aforesaid directory. Since the directory was created in 2006 the previous data of growth was not available.

Table 1 shows the growth of IA during 2005-2010 (up to 15 October 2010. In 2005 there were 578 IAs which rose to 726 in 2006, 988 IAs in 2007 and 1284 in 2008 with an addition of 148, 262 and 296 IAs between 2005-2006, 2006-2007 and 2007-2008, respectively. This number reached to 1586 at the end of 2009 with an addition of 302 IAs between 2008-2009. At the time of writing this paper, this number touched 1766 with an

Table 1. Growth of institutional archives: 2006-2010

Year	No. of Archives	Yearly addition of IA
2005	578	—
2006	726	148
2007	988	262
2008	1284	296
2009	1586	302
2010	1766	180

(up to 15 October 2010)

addition of 180 IAs between 2009 and 15th October 2010 (in 10 months only).

5.2 Distribution of IAs by Country

In the next step attempts were made to count the distribution of IAs by country. As mentioned in Table 2 highest number of IAs are now in the United States (373) followed by United Kingdom (181), Germany (141). Here we have listed only first 14 countries having more than 30 IAs individually. Overall, there are as much as 9097162 number of documents available in all these IAs with an average of 5151 documents per IA. The number of IAs per country differs widely both in number of IAs and in average number of documents. As Table 2 shows that United States is also the leader in terms of total number of documents in IAs and average number of documents per IA. It is important to note that Germany got 3rd position in terms of number of IAs but the average number of documents per IA is the lowest in all fourteen countries listed in the table. On the other hand Norway drops to 13th position in terms of number of IAs but secured 5th position in terms of average number of documents per IA. Rest of world has 471 IAs with 17.65 per cent of the total number of documents.

5.3 Types of Contents

Table 3 shows the types of content currently stored in archives. It was observed that although various categories of contents are archived in IAs, the main focus of the holdings of current IAs is on journal articles (36 per cent) followed by conference and workshop papers (19 per cent), unpublished reports and working papers (17 per cent) and books or chapters/section of books (11 per cent). These unpublished records include electronic theses and dissertations, digitised special collections materials, course materials, etc.

5.4 Subject Coverage of Institution Archives

The subject coverage of the IAs and number of documents under each subject is quite interesting. We identified prominent 29 broad subjects. The same is shown in Table 4. As indicated in Table 4 the most

Table 2. Number of institutional archives

Countries	Number of archives	Number of documents	Per cent	Average number of documents per archive
USA	373	4031384	44.31	10808
UK	181	1394424	15.32	7704
Germany	141	175404	1.92	1244
Japan	102	282744	3.1o	2772
Spain	67	93264	1.02	1392
Australia	63	143892	1.58	2284
Italy	56	428064	4.70	7644
France	56	189952	2.08	3392
Canada	54	121932	1.34	2258
Netherlands	47	222733	2.44	4739
India	42	117264	1.28	2792
Sweden	41	68565	0.75	1665
Norway	41	173225	1.90	4225
Portugal	31	48205	0.52	1555
Other	471	1606110	17.5	3410
Total	**1766**	**9097162**		**5151**

Table 3. Types of contents

Types of contents	Number of contents	Per cent	Number of archives	Per cent
Journal articles	3274978	36.00	1123	63
Conference and workshop papers	1728460	19.00	626	35
Unpublished reports and working papers	1546517	17.00	712	40
Books, chapters and sections	1000687	11.00	561	31
Multimedia and audio-visual materials	272915	3.00	407	23
Learning objects	254721	2.80	272	15
Theses and dissertations	245623	2.69	917	51
Bibliographic references	209235	2.30	273	15
Datasets	200138	2.20	77	4
Software	154652	1.70	32	1
Patents	118263	1.29	33	1
Other special items	90973	1.00	290	16
Total	**9097162**		**5323***	

* Number of institutional archives exceeds with the actual number (1766) due to most archives hold several content types.

Table 4. Subject coverage of institutional archives

Subjects	Number of records	Number of archives
Multidisciplinary	3075515	1098
Health and Medicine	1717651	128
Chemistry and Chemical Technology	1272043	36
Biology and Biochemistry	1018408	63
Physics and Astronomy	843155	48
Computer and IT	784791	85
Mathematics and Statistics	685545	45
History and Archeology	574051	105
Geography and Regional Studies	560312	105
Fine and Performing Arts	520411	49
Business and Economics	434451	78
Technology (General)	356504	92
Ecology and Environment	270445	54
Law and Politics	202143	77
Earth and Planetary Science	196673	31
Agriculture, Food and Veterinary	189394	40
Mathematical Engineering	166515	32
Science (General)	138521	106
Social Sciences (General)	127916	88
Architecture	112978	13
Civil Engineering	107865	13
Language and Literature	90402	39
Arts and Humanities General	79217	50
Management and Planning	65341	35
Philosophy and Religion	63981	44
Electrical and Electronic Engineering	62378	21
Library and Information Science	61557	59
Education	39876	55
Psychology	35675	23
Total	**13853714**	**2712**

Note: Number of IAs and records may put in more than one subject category, as a result total number exceeds to the real number of archives and records as mentioned in Table 2.

prominent unique subject under which most of the records archived was health and medicine (12.40 per cent of the total), followed by chemistry and chemical technology (9.18 per cent of the total). Although, the number of records and number of archive under heading 'multidisciplinary' is quite high, the result does not represent any conclusion. Because the subject multidisciplinary is the combination of number of subjects, and to calculate the proportion of unique subject to the total was a complex task. It is interesting to note that the number of archives in the field of arts, social science like history and archeology (105 IAs), social science general (88 IAs), law and politics (77 IAs), etc., were quite considerable. Whereas, the number of documents in the IAs of humanities/social science discipline were quite low than science discipline. The number of science documents is currently far higher than that of in humanities/social science disciplines.

5.5 Software Used

Considerable variation was found while examining the software used to support IAs. As mentioned in Table 5 D-Space is the most used (624 IAs) software in IAs. This was followed by E-prints (291 IAs), Bepress (99 IAs), and Digital Commons (75 IAs). A large number of IAs (311) did not mentioned the name of software they used. Besides the list of software shown in Table 5, there are many institutions which used locally developed systems or content management systems to set up an IAs.

Table 5. Software packages used for institutional archives

Name of software	Number of archives	Per cent
D-Space	624	35.33
E-Prints	291	16.47
Bepress	99	5.60
Digital commons	75	4.24
OPUS	54	3.05
ETD db	29	1.64
Greenstone	24	1.35
Fedora	23	1.30
HTML	23	1.30
Diva Portal	23	1.30
Open Repository	20	1.13
Content dm	17	0.96
dLibra	14	0.79
Unknown	311	17.61
Others	139	7.87
Total	**1766**	

5.6 Institutional Archives by Language

However, English was the most prominent language of interface (Table 6). Of the total 1766 IAs, 1402 IAs were in English. English is followed by German, Spanish and French with 168, 165 and 108 IAs, respectively.

Table 6. Institutional archives by language

Language	Number of archives	Language	Number of archives
English	1402	Ukrainian	16
German	168	Greek	15
Spanish	165	Finnish	14
French	108	Arabic	13
Japanese	103	Turkish	10
Portuguese	64	Catalan	10
Chinese	55	Hungarian	7
Italian	52	Korean	7
Dutch	47	Danish	6
Swedish	42	Hindi	6
Norwegian	41	Latin	5
Russian	22	Others	41
Polish	18		

Note: Total number exceeds with the actual number due to interface of same IAs in more than one language.

5.7 Institutional Archives according to Host Domain

This study also distinguished IAs on the basis of their nature of host organisation (Table 7). All IAs were grouped into the four categories: Aggregating, i.e., an archive aggregating data from several subsidiary

Table 7. Types of institutional archives

Types of IA	Number of archives	Per cent
University-based Institutional	1440	81.54
Disciplinary	212	12.00
Aggregating	74	4.19
Governmental	40	2.26
Total	**1766**	

repositories; Disciplinary, i.e., a cross institutional subject repository; Govern-mental, i.e., a repository for governmental data; and University-based institutional, i.e., an institutional or departmental archive. It was observed that maximum number of IAs (1440) were university-based institutional, followed by disciplinary (212) and aggregating (74).

5.8 Policies for Institutional Archive

An IA is driven and directed by its policies, which determine its identity, quality and direction. It is not sufficient to create an archive merely by putting software on a machine. An archive's organisational model is the sum of its policies and an archive without policies is like a library without a librarian[12]. The principal policy concerns of IA, which are important to know, are its: (i) Content policies: type of material to be submitted; (ii) Submission policies: who would authorise to submit material in the IA; (iii) Preservation policies:maintaining for future use. We tried to find out above mentioned policies for every IA in terms of content policy, submission policy and preservation policy. It was not possible to visit URL of each IA to know the status. So we took relevant data from OpenDOAR. The following parameters were identified to know the status of IAs policies:

- If we were able to find policy information, the status is set to 'Defined'.

- In some cases, there may be a slot for the relevant policy, but all it says is 'not yet defined'. In these cases we set the status to 'Undefined'.

- If there is information on policies, but the particular policy is not covered, the status is set to 'Unstated'.

- If we were unable to find any policy information at all, the status is set to 'Unknown'.

5.8.1 Policy for Content

Table 8 shows that 78 per cent of IAs do not have a well defined policy for the types of records to be deposited in these IAs. Only 19 per cent of IAs have defined policy regarding types of material to be submitted, whereas around 4 per cent found unstated. No policy information regarding type of contents was

given by 1 per cent of IAs and, therefore, their status is unknown'.

Table 8. Policy for type of documents

Policy	No. of archives	Per cent
Defined	315	17.83
Undefined	1393	78.82
Unstated	46	2.60
Unknown	12	0.67

5.8.2 Policy for Submission

Similarly, it is important for an IA to make it clear that who will authorise to submit material to the IA and what are the term and conditions of submission of an item. Table 9 shows that around 77 per cent of IAs do not have a defined policy for the submission of documents. Only 19 per cent of IAs has defined policy for the same. It is unstated for 3 per cent and unknowns for 1 per cent.

Table 9. Submission policy

Policy	No. of archives	Per cent
Defined	317	17.95
Undefined	1380	78.14
Unstated	50	2.83
Unknown	19	1.07

5.8.3 Preservation Policy

Table 10 shows, only 9 per cent of IAs have a defined policy for the preservation of documents whereas 52 per cent of IAs do not make a clear policy for the preservation of documents. Thirty-eight per cent of IAs did not gave any information regarding preservation policy their status is unstated. It may be observed from the above results that about 17 per cent IAs have made clear policies for type of content, submission and preservation. It is a good start and in near future this gap would reduce.

Table 10. Preservation policy

Policy	No. of archives	Per cent
Defined	152	8.60
Undefined	940	53.22
Unstated	654	37.03
Unknown	20	1.13

6. DISCUSSION

While comparing the size of archives between institutions is clearly a very complex problem, probably intractable in the short term, it would be relatively easy to collect estimated rate of repositories growth, which would be helpful in understanding the landscape. From the growth of IAs since last six year, one may visualise the professionals' growing eagerness towards making their scholarly research openly accessible. Only in few years

span, the volume of literature has already increased manifold and this explosion still continues. So it is a great challenge for an e-publisher to archive these huge electronic data for future. At the same time, based on the number of IAs established over the past few years, the IA service appears to be quite attractive and compelling to institutions. IAs provide an institution with a mechanism to showcase its scholarly output, centralise and introduce efficiencies to the stewardship of digital documents of value, and respond proactively to the escalating crisis in scholarly communication[13]. The phrase "if you build it, they will come" does not yet apply to developing countries in context of establishing IAs. While their benefits seem to be very persuasive to developing countries, most of IAs are still in developed countries. An overwhelming number of items from developed countries may need to put critical insight into the ways in which various nations are thinking about the role of institutional repositories. In fact, the problem, 'resource-crunch' is more acute in developing countries than developed countries. However, the efforts from developed countries are appreciable than other countries. When we analysed these IAs according to types of materials it includes, the result of our findings suggest that currently the institutional archives mostly house traditional (print-oriented) scholarly publications and grey literature: journal and conference articles, books, theses and dissertations, and research reports. From this we can at least speculate that OA issues in scholarly publishing may well be the key drivers of institutional archives deployment, at least in the very short term, rather than the new demands of scholarly communications related to e-science and e-research.

On analysing the distribution of subjects in these archives, it may be concluded that the author of the subjects like health and medicine, chemistry and chemical technology, biology and biochemistry, etc., are more interested to disseminate their findings to the wider audience. Due to that, a large number of materials were open accessible to the IAs. It is quite evident that the field 'science' is changing very fast than other discipline and obsolesce of concepts are more prevalent in science discipline. Additionally, the traditional journal system is heavily affected by the problem of backlog. So, submitting materials to IAs before actual publication helps author to disseminate their findings at faster rate. The relatively low-quantity of documents in the field of social sciences and humanities may be an indication that awareness about submission of scholarly text in OA archives amongst humanities/social science academics is not enough, or, they do not find it worthwhile to submit their scholarly text in IAs. However, they perceive many advantages to depositing their work in institutional archives, especially for the reader, not for themselves. The use of Dspace as one of the leading software in these IAs may be due to the fact that DSpace code

already supports self-publishing and self-archiving features. One can rely heavily on DSpace for preservation, metadata, persistent URLs, etc., [14]. Similarly, most of these materials were of English language, is a clear indication that English is the major language in scholarly communication. When IAs were analysed according to host domain, it was found that university-based institutions are the leading type of domains.

The finding of the present study may supports the vision of Stephen Harnad that: "Universities need to mandate the self-archiving of all peer-reviewed research output in order to maximise its research impact for exactly the same reasons as they currently mandate publishing it."[15]. He also argued that OA self-archiving to be mandated by research funders and institutions so that the self-archiving of published, peer-reviewed journal articles (Green) can be fast-forwarded to 100 per cent OA. On the other hand, analysing the policy of IAs, it became clear that still the policy of content inclusion, submission, and preservation are not well defined. There is a need to establish standard policy so that IAs can be used further for information exchange worldwide.

7. CONCLUSIONS

Institutional archives are now clearly and broadly being recognised as essential vehicle for scholarship in the digital world. This is evident based on the continuous growth of IAs around the world. The continued development of IA depends a great deal on our continuing to overcome cultural barriers to their acceptance and use. At present, the most popular concept of archive is post-print archive. So, it is now time for universities of the nation to establish such archive to make their digital collections available and simultaneously to overcome the access barriers within the particular permanently language periphery. At the same time researchers, lecturers and practitioners within institutions need to convince the value and immense potential of IAs. It may be expected that the next few years will see growing connections between IAs as infrastructure and the broader issues that are emerging about strategies and infrastructure necessary to support the management, dissemination and curation of research data (at the national, disciplinary and institutional levels).

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