The Changing World of Academic and Scientific Information Distribution: Advances in Institutional Repositories

NII Institutional Repositories Program

Phase 2 Report

November 2011

National Institute of Informatics

NOTE: The following contents are excluded from the English version: Presentation on case examples of the practices by commissioned institutions, Topics Interviews, Appendix.

Executive Summary

1. An institutional repository (IR) is a set of services provided by an academic institution to its community for the purpose of acquiring, organizing, preserving, and disseminating academic resources in digital form created by the institution and its members. Such repositories are becoming more common worldwide as part of the move toward open access in the distribution of academic content.
2. In Japan, ever since the first institutional repository was compiled in Chiba University in 2003, IRs have continued to grow in quantity and quality. The development of IRs up to the 2007 academic year was covered in *New Horizons in Academic and Scholarly Communication: NII Institutional Repositories Program Phase 1 Report*, published in December 2008.
3. The present report covers Phase 2 of the Institutional Repositories Program (2008 to 2009 academic years).
4. In Phase 2, the NII openly invited academic institutions to apply for support under the program in either of two categories: Area 1: Further expanding IRs and creating content, or Area 2: Building new services through collaboration among IRs. The program also supports research and development aimed at enhancing the usefulness of IRs.
5. In Area 1, the NII commissioned 68 institutions (54 national universities, 2 other public universities, and 12 private universities) for the 2008 academic year and 74 (54 national, 5 other public, 13 private universities, and 2 research institutions) for the 2009 academic year. Thanks in part to this support, as of March 2010 there were some 175 IRs in Japan, including shared repositories. This number is the third highest among the world's nations. The number of archived materials had reached 870,000 and continues to grow today.
6. In Area 2, the NII supported 21 projects on 10 themes. The project content was diverse, including subject-based repository R&D, functional enhancement through system development, digital publishing support, community formation including human resources development, repository assessment, strategies for publicizing repositories, and e-Science.
7. Nearly 90 percent of national universities now have IRs. Among other public and private universities, however, the rate is only around 10 to 20 percent. Promoting shared repositories is seen as one way to increase these rates.
8. During phase 2, the number of IRs, the materials archived in them, and the number of accesses have all increased significantly. Institutional repositories are also making inroads in the world of academic and scientific information distribution. The NII Institutional Repositories Program can be said to have contributed greatly to these trends. This program is an example of collaboration between university libraries and the National Institute of Informatics as an Inter-University Research Institute. For the further development of this program, introduction of leading-edge digital technologies, global alliances, collaboration with researchers and academic societies and with the SPARC Japan project, as well as human resources development to support these new functions, are all important; but there are many issues to be resolved to these ends. We hope this report will be useful for identifying and solving such issues on the way to making future advances.

I. The Second Phase of CSI-Commissioned Projects

1. Phase 2 Accomplishments

An institutional repository (IR) can be defined as a set of services provided by an academic institution to its community for the purpose of acquiring, organizing, preserving, and disseminating digital resources created by the institution and its members.

Against the background of the Open Archives initiative mainly in the West, IR introduction is proceeding among universities and other academic institutions around the world as an advancement on digital archives, aimed at eliminating barriers to accessing academic information. In Japan, the number of institutions introducing IRs and the materials in them have continued to grow, with support first from the NII Institutional Repositories Portal (NII-IRP) Project starting in 2004 and then from the National Institute of Informatics (NII) commissioned projects program, both carried out under the Cyber Science Infrastructure (CSI) program. By the end of Phase 1 (2005 to 2007 academic years), 102 academic institutions had established IRs in Japan containing 278,511 materials. At the end of Phase 2 (2008 to 2009 academic years), the number of institutions with IRs grew to 175 and the number of materials stored had reached 874,587.

These figures attest to the steady growth in quantity. The number of materials currently stored in IRs, however, is a mere fraction of the total produced by Japan's universities. The pace of growth will need to be stepped up much further in the future.

1.1 CSI-commissioned projects under the NII Institutional Repositories Program

As part of its work to enhance academic information infrastructure, NII is now providing support for the development of IRs and collaboration among individual universities. This program maintains and builds on the attainments of earlier content-related projects and recognizes that IRs, now being developed around the world as a new channel for dissemination of academic and scientific information, are essential components in the provision of next-generation academic information infrastructure.

The present program has its origins in the NII Institutional Repository Portal project conducted in the 2004 academic year. Based on the outcomes of that project, the NII provided commissioned support for projects by 19 universities in the 2005 academic year. Besides the creation of IRs themselves, the NII was able to gain further experience in system development and operation. The project scope was expanded in the 2006 academic year, when an open call for applications was issued to all national, other public, and private universities in Japan. Two categories were created under which universities could seek support: Area 1, "Further expanding IRs and creating content," for providing assistance in the establishment of new IRs, and Area 2, "Building new services through collaboration among IRs," aimed at obtaining concrete results to drive further development of IRs in Japan.

Phase 1 of the program, through the 2007 academic year, has been written up in the report, *New Horizons in Academic and Scholarly Communication*. The 2008 and 2009 academic years are Phase 2 of the program. The results are described below.

(1) Applications and results in Area 1: Further expanding IRs and creating content

Area 1 promotes the creation and operation of IRs that make best use of their universities'

distinctive attributes. The aim is for universities to meet their social accountability by enhancing their capacity for information dissemination and raising the visibility of their educational and research activities. Following on Phase 1, national, other public, and private universities were invited to submit project applications. The program provided support for projects by 68 universities in the 2008 academic year and 74 institutions in 2009. Details are given in Part II below.

(2) Applications and results in Area 2: Building new services through collaboration among IRs

As in Phase 1, Area 2 projects take empirical approaches to technical and systemic problems relating to the creation and operation of IRs, aiming to achieve practical outcomes toward the resolution of these problems. The program provided support for 10 continuing projects and 11 new projects in Area 2. Details are given in Part III below.

(3) Screening of proposals

Multiple examiners (Library Liaison Working Committee members) screened proposals in both areas, using a 5-point scale to evaluate the proposals against a number of different criteria, then conferring to come up with a final decision.

1.2 ILL

The offering of content in IRs has resulted in a drop in inter-library loans (ILL), a service long carried out between university libraries, and has clearly shortened the time required to obtain information from libraries.

Koyama et al. (2011) report a dramatic decline in NACSIS-ILL use between 1994 and 2008.[1] The spread of e-journals as a result of "Big Deal" bulk subscriptions led to a marked drop in ILL use for overseas journals. Duplication of western academic articles declined from around 670,000 in 1999 to around 290,000 in 2010. Among individual publishers, duplication of articles from Elsevier's 149 journals peaked at around 65,000 in 1998. Since then the number has continued falling, to nearly a third at 22,000 in 2008. Although duplication of Japanese articles continued to increase even after 1999, the number peaked at around 530,000 in 2006 and began dropping. By 2010 it had declined to around 440,000 copies. The likely cause of this phenomenon is the spread of IRs in Japan and the increase in available content. It is hoped that future studies will shed light on the details.

At the same time, ILL usage shows us only one part of overall use of information sources. A 2010 report by Sho Sato[2] gives partial results of an Area 2 project on access to IR content itself, "Article accumulation and data compilation for quantitatively analyzing the effects of deposition in institutional repositories on academic article distribution (Hokkaido University, Kyoto University, University of Tsukuba)." According to that study, the average number of accesses to content stored in IRs is more than 5 for those of Hokkaido, Kyushu, Kanazawa, and Fukui universities, despite the different sizes of these schools. Presumably this includes many users who are not affiliated with academic institutions, and a certain portion of these users are assumed to have been using ILL previously in such cases.

The IRcuresILL Area 2 project, led by Otaru University of Commerce with the participation of Hokkaido, Chiba, Kanazawa, Osaka, and Hiroshima universities, surveyed log data to determine which resources were frequently requested through the NACSIS-ILL system. The project, aimed at integration of IR with ILL document delivery service, also sought to address the awareness gap between people in charge of IR and ILL services. This

gap is key to resolving the issue of how to position IR in relation to university libraries and academic information distribution.

2. The Spread of Institutional Repositories

Institutional repositories as seen in *University Ranking*

In *University Ranking*, published by Asahi Shimbun every year since 1995, a new item "Institutional Repositories" was added in the 2010 edition.

The 2012 edition of *University Ranking* has 82 items for indicating the features of universities other than the difficulty of being accepted via entrance exams. The categories for these items are "introductory" (2 items), "information disclosure" (4), "general" (7), "education" (27), "career opportunities" (9), "research" (11), "financial" (2), "society" (14), and "entrance exam" (6). The institutional repositories item is classified under "education" along with university libraries.

The ranking for IRs is based on the number of stored papers and the number of downloads (April-September).

The inclusion of "institutional repositories" in *University Ranking*, a publication by a major media company that university officials cannot ignore, shows how far IRs have made it into the public consciousness.

The figures for number of stored papers and number of downloads, however, fluctuate greatly from year to year. It should be noted that the data in *University Ranking* is that provided by the universities themselves. The wide variation in numbers reflects the lack of standard measures for both papers stored and downloads.

Details on the problems of data compilation and standardization will be left for III.3.5 Creating assessment standards for institutional repositories. That big media are taking up IRs on an on-going basis is helping to raise public awareness of IRs, which should make it possible for universities to take bold steps toward information dissemination. At the same time, care must be taken not to allow assessments based simply on numbers to distort the intended purpose of IRs.

3. Policy Statements on Institutional Repositories

3.1 Science and Technology Basic Plan

Among policy-level statements, the first that must be noted is the appearance of institutional repositories in discussions in the 4th Science and Technology Basic Plan. Institutional repositories are indicated among policies for promoting the formation of international-level research environments and infrastructure. The national government, the document states, "shall be committed to promoting the establishment of IRs in universities and public research institutes along with the systematic collection and storage of papers, observations, experimental data and other educational and research results in digital form, as well as encouraging open access to these resources."

The story of how IRs came to be taken up in this policy statement turns out to be quite interesting. Institutional repositories first came up in the Expert Panel on Basic Policy of the Council for Science and Technology Policy in its third meeting on December 16, 2009. In a discussion on how to make research results more visible to the public, panel member Noriko Osumi, a Tohoku University professor, suggested making use of a scheme like IRs, which

libraries in particular had lately made considerable progress in establishing.

The next time the panel met, follow-up materials on IRs were presented including a written explanation and graphs showing the number of academic papers archived in facilities such as JAIRO (introduced below) and the number of universities registering papers in them. An oral presentation noted that institutional repository initiatives are being carried out mainly by the National Institute of Informatics, with many participating universities and rapid growth in the last few years. In this way the statement noted above ended up being included in the panel's policy proposal.

It can be seen as a case where the results of Phase 1 and 2 CSI-commissioned projects in university libraries came to be regarded as valuable by university researchers in a position to propose policy, and they were able to influence government policy decisions.

Not to be overlooked here is the role of JAIRO and IRDB content analysis functions. The gathering of metadata in JAIRO and ease of visually confirming the status of Japan's IRs using the content analysis function seem to have been highly useful for decision making. Being able to see the progress of a project in real time must have had a strong impact on those charged with making decisions.

3.2 Council for Science and Technology

Prior to drafting of the Science and Technology Basic Plan, the role of IRs as a means of promoting academic information dissemination and distribution was deliberated in the Working Group on Scientific Information Infrastructure, Research Environment and Infrastructure Committee, Subcommittee on Science, 5th Council for Science and Technology. In a report issued in July 2009, "Further development of university libraries and distribution of academic information (summary of deliberations)," the working group noted that "as digital archiving of academic information proceeds, universities are creating IRs and making progress in boosting their own capacity for information dissemination."

On the current status of IRs, the report points out that "while Japan ranks high among countries in number of institutions and the stored papers vary in content from journal papers to dissertations, research results reports, and teaching materials, a major feature is that around half of the materials are papers in university research bulletins."

The report then points to the CSI-commissioned projects being implemented by the NII in cooperation with universities and others as a measure for promoting IRs, noting that these projects are popularizing and advancing IRs.

It goes on to indicate the need for further enhancement and promotion of institutional repository establishment, while pointing out that "some universities may find it difficult to build and maintain their own independent repositories due to administrative structural, technical, or other problems." It therefore proposes the establishment of a jointly operated repository system for shared use by institutions.

In line with this proposal the National Institute of Informatics decided to introduce the system resources necessary for operating shared repositories, and funding for this was included in a supplementary budget for fiscal 2010.

Next a report on "Further development of university libraries (summary of deliberations)" in December 2010 discussed IRs from the standpoint of training university library staff. The report noted that in collecting, organizing, and making available content for an institutional repository from scratch, the true strengths of university libraries are demanded. That is, the

new tasks they are being called upon to perform in actively acquiring materials, for which they must focus their ingenuity in various ways, such as negotiating with faculty and working to convince universities, require that they exercise their collection skills in the original sense. The report goes on to praise the way university library staff members in the process of setting up IRs have demonstrated their skills, putting to good use their ties with other universities, their expertise, and their experience. The work of university library staff on IRs through CSI-commissioned projects is seen as a new library service that raises their level of expertise in research assistance.

4. Progress of NII Projects

4.1 Overview of Phase 2 projects

Alongside the CSI-commissioned projects, support is provided in the following three areas under the NII Institutional Repositories Program.

(1) Content enhancement

- Providing research bulletin content (metadata and full-text PDF files)
- Obtaining comprehensive license agreements on use of content from Japanese academic journals in IRs
- Lobbying SPARC Japan partner journals

(2) System interoperability

- Establishing the "junii2" metadata format
- Developing and providing JAIRO, the academic institutional repositories portal

(3) Community formation

- Training academic portal staff and holding reporting meetings and open house workshops
- Providing assistance to the Digital Repository Federation (DRF) project, which supports IR-related community activities

4.2 Phase 2 progress

In discussing Phase 2 progress, the unveiling of JAIRO deserves special mention.

(1) JAIRO release

In Phase 1, JuNii+ was provided as an IR portal supporting bulk searches of metadata stored in the institutional repositories database (IRDB) of all IRs. It has a number of weaknesses, however. These include the need to install plug-in software prior to use, the limited number of search criteria, and the Japanese-only interface, making it inadequate for information dissemination outside of Japan.

As a successor to JuNii+ designed to address these issues, JAIRO (Japanese Institutional Repositories Online) was developed. Trial release was made in October 2008 and official release on April 1, 2009. With the official release of JAIRO, JuNii+ services were terminated in March 2009.

IR metadata is being collected from IRs based on applications from IR operators in each institution. As of the end of March 2010, metadata for 874,587 materials had been collected from the 148 targeted IRs.

At that time usage of the service had reached approximately 6,400 detail views per day. Looking at types of content, materials most frequently accessed were research bulletin papers (cumulative accesses: around 1.28 million) followed by academic journal papers (cumulative accesses: around 490,000).

Progress was also made toward data and system interoperability with other services. Some examples are the following.

- Data linking with CiNii and KAKEN was begun (October 2008).
- Google searches of JAIRO content became possible (June 2009).
- JAIRO was added to the integrated-searchable archives of PORTA (National Diet Library Digital Archive Portal) (June 2009).
- Support for external interfaces (OpenURL and OpenSearch) was implemented (December 2009).

For enabling multilanguage searches, an automatic translation function was added (May 2009).

(2) Library Liaison Working Committee WG

A working group was formed in the 2009 academic year, consisting of Library Liaison Working Committee members and university library staff, to address various issues in cooperation with university libraries and the NII.

4.3 Coming developments

(1) Phase 3 CSI-commissioned projects

Phase 3 CSI-commissioned projects will be implemented in light of the Phase 2 results and with the following three basic principles in mind.

(a) Phase 3 will cover the three-year period from the 2010 to 2012 academic years, during which commissioned projects will be continued.

(b) In addition to Areas 1 and 2, a new Area 3 "Support for community activities" will be created for supporting community activities in academic information distribution.

(c) For universities contemplating new IR establishment, a repository system infrastructure (shared repositories) will be built during Phase 3 and made available as an option for system provisioning.

(2) Shared repositories (provisional name)

Nearly 90 percent of national universities now have IRs. Among other public and private universities, however, the rate is still around 10 to 20 percent. According to the report *Science Information Infrastructure Statistics of Colleges and Universities* for the 2009 academic year, of surveyed schools responding that they do not intend to set up IRs, 39 percent gave difficulty of obtaining operating funds as a reason, and 42.2 percent said they lacked personnel with the necessary expertise. This indicates that there are many smaller schools that would like to build a repository but are unable to do so.

In response to this situation, the Working Group on Scientific Information Infrastructure, Research Environment and Infrastructure Committee, Subcommittee on Science, Council for Science and Technology, in its July 2009 report, "Further development of university libraries and distribution of academic information (summary of deliberations)," pointed to

"the need for creating a jointly operated repository system for shared use by those institutions unable to build and operate IRs on their own," in order to promote the establishment of IRs for disseminating research results of universities and others and advance the cause of open access.

The NII drew up plans for test operation of such a shared repository during the 2010 academic year and for studies toward full-scale introduction.

References

1) Kenji Koyama, Yoshinori Sato, Syun Tutiya and Hiroya Takeuchi. "How the digital era has transformed ILL services in Japanese university libraries: a comprehensive analysis of NACSIS-ILL transaction records from 1994 to 2008." *Interlending and Document Supply*. 2011. Vol. 39, no. 1, pp. 32-39. [in Japanese]

2) Sho Sato. "Various aspects of academic information distribution based on repository log analysis. Institutional repositories and the university library mission: Information dissemination from the Japan Sea region." Kanazawa University Library, Kanazawa University 150-year anniversary lecture symposium series (special event). [in Japanese]

Feb. 17, 2010. http://hdl.handle.net/2241/104513

II. Area 1: Further Expanding IRs and Creating Content

1. Setup

1.1 Commissioned institutions: Steady growth in numbers of institutions and IRs; national universities becoming self-reliant; new participation by other public universities

The number of institutions commissioned for Area 1 projects has continued to grow year by year since the start. In Phase 2, after leveling off at 68 institutions in the 2008 academic year, the number rose to 74 in 2009 and is now growing steadily.

The annual trends in number of Area 1 commissioned institutions are shown in Table II-1 below. Looking at the 2009 academic year, of the 74 commissioned institutions, 54 were national universities, 5 were other public universities, 13 were private schools, and 2 were inter-university research institutes. Compared with the 2007 academic year, the last year of Phase 1 projects, the number of national universities had declined by 3 while there were 5 more other public schools plus the 2 new inter-university research institutes. The decline among national universities is because the IRs started up by these projects are being taken over by the universities with their own budgets and personnel. At the same time, as shown by the increase in other public schools and the new participants as inter-university research institutes, IRs are making further inroads among university libraries and other institutions underlying the academic information infrastructure.

Moreover, as the results of these commissioned projects continue to emerge, recognition of IRs in university library circles is growing, along with awareness of their need. The actual number of IRs is rising steadily, reaching 124 as of March 2010, and is expected to continuing increasing (Figure II-1). The creation of regional shared repositories is also progressing, with participation by many universities and other institutions (e.g., two-year colleges and research institutes). When these organizations are included the number of those establishing repositories reached 175 by the end of the 2009 academic year (Figure II-2).

The spread of IRs in Japanese university libraries overall, not only among commissioned institutions, is as shown in Table II-2. As of the 2009 academic year, of 773 universities in Japan, 18.6 percent operate IRs, with the rate of diffusion being especially high for national universities compared to other public and private universities. By focusing coming commissioned projects on encouraging the establishment of IRs by other public and private university libraries, it should be possible to increase the diffusion rate further.

Table II-1 Trends in commissioned institutions

	Commissioned institutions	Types of institutions			
		National	Other public	Private	Inter-university research institute
2005 academic year	19	17	-	2	-
2006 academic year	57	47	-	10	-
2007 academic year	70	57	-	13	-
2008 academic year	68	54	2	12	-
2009 academic year	74	54	5	13	2

Table II-2 Spread of institutional repositories

	Total	Types of institutions		
		National	Other public	Private
Institutional repositories	144	73	14	57
Universities	773	86	92	595
Percent of institutions operating IRs	18.6%	84.9%	15.2%	9.6%

(Numbers of universities are from the MEXT Report on School Basic Survey for 2009.)

1.2 System types: DSpace maintains large share among signs of diversification

One of the major factors to consider when establishing an IR is what system (software) to use. As seen in Table II-3 on the status of software use by institutions commissioned in the 2009 academic year, DSpace continues to enjoy by far the greatest number of users, even if the share has slipped somewhat since Phase 1 and slight signs of diversification are starting to appear.

Table II-3 Software introduced by commissioned institutions

	Software product	University users	Main universities
1	DSpace	47	Hokkaido University, The University of Tokyo, Nagoya University, Kyoto University, Kyushu University, etc.
2	NALIS-R	8	Yamagata University, Tokyo Gakugei University, Gifu University, Nagoya Institute of Technology, University of the Ryukyus, etc.
3	eRepository	5	Chiba University, University of Yamanashi, Osaka University, Hiroshima University, Shimane University
4	XooNIps	5	Asahikawa Medical College, Saitama University, Keio University, Aomori University of Health and Welfare, Seigakuin University
5	InfoLib-DBR	3	Kobe University, Yamaguchi University
6	iLisSurf e-Lib	3	Kanto Gakuin University, Doshisha University
7	ePrints	2	Okayama University, Chugoku Gakuen University
8	T2R2 System	1	Tokyo Institute of Technology
9	Digital Commons	1	Okayama University
	Total	75	(The total of 75 is because Okayama University uses two different packages.)

1.3 Lead time: Continues to decrease

The time required from commissioning to test release was 276 days in the 2005 academic year, thereafter gradually decreasing to 255 days in 2006, 247 days in 2007, and 174 days in 2008. Likely reasons for this improvement in lead time are the establishment of standard practices for system development and the sharing of accumulated expertise of the early universities with those that followed.

The time to release to the public likewise has decreased in recent years, from 379 days in the 2005 academic year and 410 days in 2006 to 258 days in 2007 and 227 days in 2008. The reason for the relatively long time in 2006 is that commissioned projects were originally designed to extend across two fiscal years, meaning that institutions could afford to hold an extended trial release before opening their systems to the public.

Note that institutions starting commissioned projects in the 2009 academic year are not included in these figures, since their number is small and the majority of them had already released their systems prior to the start of the projects.

Table II-4 Lead time to release

	Days to trial release	Days to general release
2005 academic year	276	379
2006 academic year	255	410
2007 academic year	247	258
2008 academic year	174	227
2009 academic year	255	349

2. System Operation

To see the changes in system operation from Phase 1 and Phase 2, the data for the 2007 and 2008 academic years will be compared.

2.1 Establishment of standard practices: Steady progress

For effective operation of an IR, standard practices need to be established including documentation of policies and rules concerning approvals within the institution (university) and various administrative operations. A general survey of internal executive-level authorization processes and the development of written IR policies and operational rules in institutions commissioned under this program reveals major progress in the 2006 academic year, around one year after the program began. Thereafter, steady progress was made in establishing practices as successive institutions began operation. Overall, the know-how for introducing an IR seems to have become well established.

2.2 Organization: A variety of administrative organizations per institution; stable operation with small staff on average

A variety of organizational approaches are taken to IR operation, reflecting the different situations of each university. IR operational functions can be divided broadly into content development, system operation, and publicity and promotion. In some universities a single organizational unit is responsible for all these functions concurrently; in others the entire library organization is involved, while others have established dedicated working groups. This situation has remained unchanged since the start of the program.

The number of persons involved in operation (full-time equivalent: FTE) was 1.49 persons in the 2007 academic year but grew to 2.25 persons in 2008. This can be seen as reflecting the rise in importance of IRs in the services of university libraries.

Table II-5 Personnel engagement in IRs (FTE)

	2007 academic year				
	Content	System	Promotion	Other	Total
Average	0.70	0.31	0.16	0.32	1.49
Median	0.5	0.2	0	0.2	1.1
Max.	3.2	2	1.8	2	6
Min.	0	0	0	0	0
Standard deviation	0.73	0.41	0.33	0.41	1.26

	2008 academic year				
	Content	System	Promotion	Other	Total
Average	1.18	0.40	0.47	0.20	2.25
Median	1	0.3	0.3	0	1.8
Max.	7	2	5	1.8	14
Min.	0	0	0	0	0.05
Standard deviation	1.04	0.42	0.70	0.36	1.99

2.3 Cost: Drop in content production cost, rise in personnel costs

The average overall cost of producing IR content was 1,461,000 yen, a drop from 2,209,000 yen in the 2007 academic year. Other personnel costs, however, rose to 527,000 yen from 392,000 the previous year.

Despite the drop in the average cost of content production, the median cost did not change significantly, suggesting that rather than a major change in the cost of the actual work required, the weight of content production in CSI costs was smaller, causing the decline shown. The rise in average personnel costs can likely be explained by an increase in human resources invested in IRs as their importance grows among the services of university libraries, as noted above.

In addition to the above, please see the presentation by Prof. Yoshinori Sato of Tohoku Gakuin University analyzing current IR costs and related issues. The slides at the URL below were also the source of the data given in this section.

http://www.nii.ac.jp/irp/event/2009/debrief/pdf/4-5_CostStudy2008.pdf

3. Content

To see the trends in content production not only for commissioned institutions but for IRs in Japan as a whole, reference was made to data from the IRDB content analysis system.

3.1 Content production status: Stable growth

Based on data from the IRDB content analysis system, the number of materials produced increased by 327,390 in the 2008 academic year and by 268,686 in the 2009 academic year, for a cumulative total of 874,587 materials, surpassing the 850,000 level. While the growth rate has slowed somewhat, the number of materials can be seen as growing steadily with the increase in the number of IRs.

Table II-6 Breakdown of expenses

	Content production costs (CSI portion only; 1,000s of yen)		Other personnel costs (1,000s of yen)	
	2007 academic year	2008 academic year	2007 academic year	2008 academic year
Average	2,209	1,461	392	527
Median	1,235	1,414	0	0
Max.	18,749	3,300	5,209	9,247
Min.	0	0	0	0
Standard deviation	2,900	956	843	1,514

*Personnel costs in this table include those for non-regular staff and part-time employees.

Looking ahead, the rate of increase in production of new content is likely to drop further as the pace of new IR establishment slows over time. The reason for this assumption is that the large amount of content registration that takes place when repositories are newly launched tends to taper off and give way to everyday, routine content registration, inevitably leading to a decline in the number of new materials.

Table II-7 Content production

	Increase	Cumulative
2007 academic year	-	278,511
2008 academic year	327,390	605,901
2009 academic year	268,686	874,587

3.2 Content targets: Increase in research bulletin papers, slight drop in general periodical articles, other changes

Looking at the status of content production by resource type, research bulletin papers are steadily increasing, accounting for more than half of the total at 343,543 materials out of the total of 629,399 full-text materials, or 54.6%. While academic journal papers and dissertations have also increased, they make up only 14.0% and 5.2%, respectively, of the total. Based on these trends, it will be necessary to consider where to focus in future content production. Taking into account the specific program being carried out by universities, the National Diet Library, and NII for archiving and registering dissertations, it will be important for each institution to draw up strategies for content enhancement.

Table II-8 Materials by type (as of the end of March 2010)

	Full text	Metadata
Academic journal articles	87,748	209,833
Dissertations	32,588	44,252
University research bulletin papers	343,543	384,449
Conference papers	9,888	54,232
Conference presentation materials	2,265	2,270
Books	7,809	17,228
Technical reports	4,266	4,414
Research reports	12,188	14,296
Articles in general periodicals	29,296	35,780
Pre-prints	279	309
Learning materials	1,791	4,261
Data/databases	3,239	3,378
Software	2	8
Other	94,497	99,877
Total	629,399	874,587

4. Prospects for the Future

4.1 Statistics and evaluation: significance of IRDB system and assessment system rollout

In Phase 2, of note first of all is the major progress made in establishing an environment for statistical analysis and assessment of IR development and operation. In the statistics area, the IRDB (Institutional Repositories Database) content analysis system developed and operated by the NII (http://irdb.nii.ac.jp/) provides analytical data on academic IRs in Japan including their number and growth in achieved content. For assessment, a project aimed at building an IR assessment infrastructure is progressing as an Area 2 commissioned project under this program and is in the process of establishing a means for analyzing the current state of IRs and future directions.

4.2 Progress of jointly operated repositories: launch of regional shared repositories

Of special note also is the launching of shared repositories and start of operation. From the 2007 to 2008 academic years, eight regional shared repositories were launched nationwide with the number of participating institutions reaching 60. Besides national, other public, and private universities they include two-year colleges, specialized vocational schools, and also public libraries and archives, showing how IRs have been making broad inroads in Japan.

Building on these efforts, it will be necessary to create the means for wider participation by institutions in the form of cloud-based shared repositories.
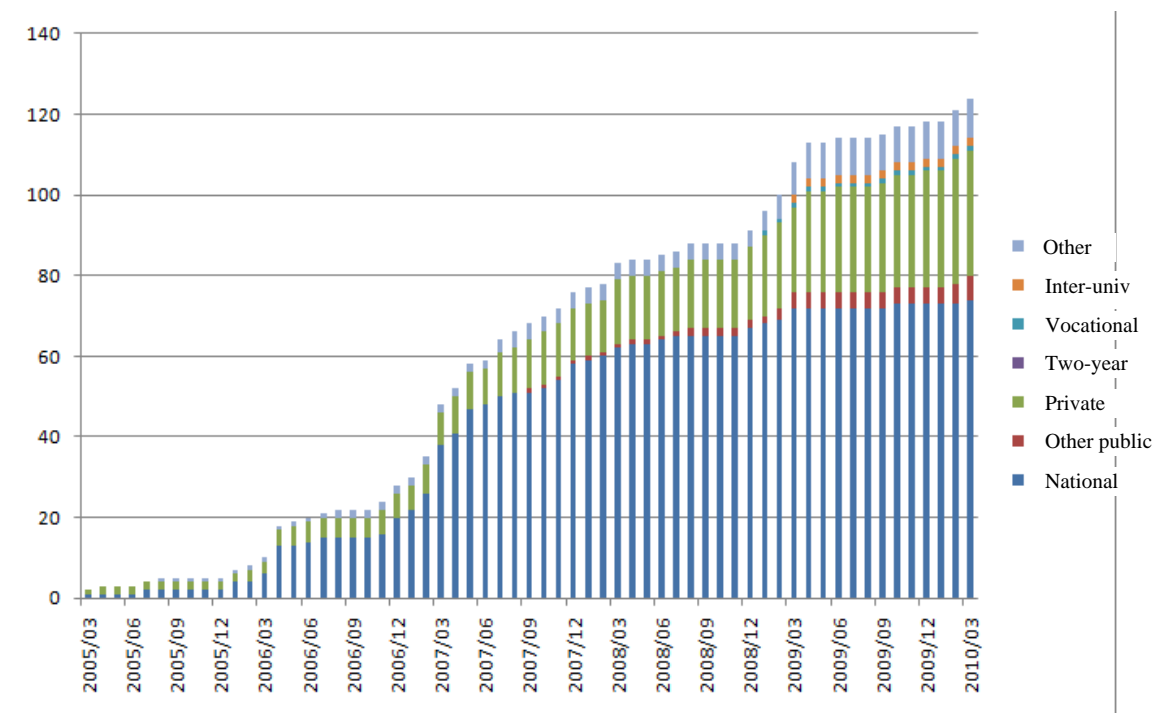
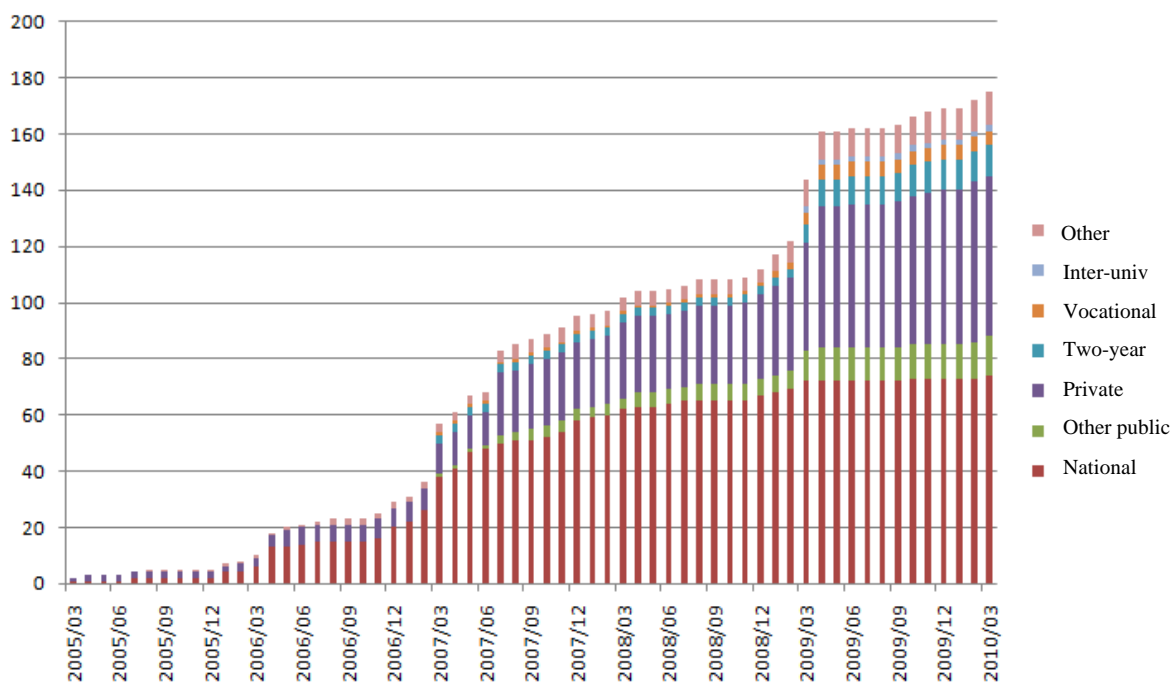**Figure II-1 Institutional repositories: 124 (end of March 2010)**

Figure II-2 Institutions having repositories: 175 (end of March 2010)

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III. Area 2: Research and development on building new services through collaboration among IRs and improving IR convenience for boosting research and education

1. Overview

In the 2008 academic year the NII Institutional Repositories Program entered Phase 2. For Area 2, a total of 22 projects by 37 universities were adopted for commissioning during Phase 1. With the exception of a few projects on topics that were judged as suitable for Area 1, most of these achieved their initial goals and the Phase 1 program was ended.

In Phase 2, most of these projects based on the Phase 1 results were carried over as continuing projects in expanded form. The Phase 2 Area 2 projects are listed in Table III-1.

Table III-1 Phase 2 CSI Projects (Area 2)

No.	Theme	New/ cont.	Project name	Lead, contributing, participating universities
1	Added value (systems)	Cont.	Access path to Institutional Resources (AIRway) (research and development for improving resource discovery and accessibility in IRs)	Hokkaido, Kyushu, Tsukuba, Chiba, Nagoya, Kanazawa, Kyoto, Osaka
2		Cont.	MaiIdentity Program (on interoperability with researcher information systems)	Kanazawa, Waseda, Kyushu, Shinshu, Chiba, Nagasaki, Obihiro Ag., Shizuoka, Hokkaido, Osaka
3		Cont.	Input/output activation for research communities to be involved with Institutional Repositories	Kyushu, Saga, Chiba
4		Cont.	Developing Intersystem Tools for Institutional Repositories (ITIR)	Nagoya, Gifu
5		New	Structuralization of Tsukuba Science Repository (TSR) for value enhancement	Univ. of Tsukuba, Tsukuba Univ. of Technology
6	IR assessment indicators	Cont.	Standardization of usage statistics for IR evaluation (ROAT)	Chiba, Tohoku, Kanazawa, Hokkaido, Osaka
7		New	Research visibility analysis system project	Shinshu, Saitama, Keio
8		New	The effect of the development of institutional repositories on scientific communication	Hokkaido, Kyoto
9	Licensing database	Cont.	Copyright policy management on open access and self-archiving (SCPJ)	Tsukuba, Hokkaido, Chiba, Tokyo Institute of Technology, Kanazawa, Osaka, Kobe
10	Community formation	Cont.	Digital Repository Federation (DRF) (for the vitalization of the institutional repository community)	Hokkaido, Chiba, Kanazawa, Osaka, Tsukuba, Waseda, Hiroshima, Otaru Univ. of Commerce
11		New	Framework for sustainable upgrading of repositories by creation of a user community	Chiba, Osaka, Hiroshima, Shimane, Kagawa
12			Human Resource Development for Sustainable Institutional Repositories	Kyushu, Saga, Nagasaki, Kumamoto, Beppu, Miyazaki
13	Open source	Cont.	Initiative for XooNIps-based new repository system	Keio, Beppu, Kinki, Sapporo Medical Univ.
14	E-publishing support	Cont.	Development of a Journal Editing and Publishing System (ePubs)	Waseda, Kyoto, Hiroshima, Nagasaki, Saga
15		New	Developing an Electronic Publishing System based on the platform of Institutional Repositories (EPSIR)	Nagoya, Kyushu
16	Subject-based repositories	New	Development of Education Subject Repository	Tokyo Gakugei Univ.
17		New	Repository of Archaeological Reports (RAR): wide-area collaboration from five Chugoku prefectures	Shimane, Tottori, Okayama, Hiroshima, Yamaguchi
18		New	The development of an open access and bi-directional repository for medical science	Sapporo Medical Univ.

No.	Theme	New/cont.	Project name	Lead, contributing, participating universities
19	IR promotional strategy	New	IRcuresILL (Developing faculty-library collaboration scheme enabling IR to serve as alternative to ILL/DD for sharing academic information resources)	Otaru Univ. of Commerce, Hokkaido, Chiba, Kanazawa, Osaka
20	Regional shared repositories	Cont.	Shared Repositories Project (ShaRe): Model development and dissemination	Hiroshima, Okayama, Hiroshima Institute of Technology, Yamagata, Saitama, Nagasaki International, Hokkaido, Chiba, Kanazawa, Osaka
21	e-Science	New	In vivo experiment of data curation for repository-based e-Science	Chiba, Kanazawa, Kyushu, Hokkaido, Osaka

Of the Phase 2 projects, nearly half (10) are carried over from Phase 1 while the rest (11) are new projects. Moreover, Phase 1 (2007 academic year) had 14 projects and in Phase 2 there are 21, a gain of 7 projects.

Looking at the project themes, three are about subject-based repositories, five about adding value (enhancing repository functions through system development), two cover e-publishing (including overlay journals), three are on community formation (including human resource development), one is about regional shared repositories, three cover repository assessment indicators, and one project each is devoted to the themes of licensing databases, open source, human resource development, repository promotion strategy, and e-Science.

Three overall trends are to be seen, namely,

  (1) The establishment of representative themes by carry-over projects;

  (2) The deepening of those themes in new projects; and

  (3) The diversification of themes (increase in number of themes).

Examples of (1) include Hokkaido University's AIRway, Keio's XooNIps, Tsukuba's SCPJ, Chiba's ROAT, and Hiroshima University's ShaRe (shared repositories). As core Area 2 projects, these are becoming indispensable for IR promotion by the CSI program.

An example of (2) is first of all the increase from one to three ROAT projects as attempts at IR assessment. As seen also in the large number of materials being made available through JAIRO, it has become possible to define the significance of and analyze IRs based on usage state; and as one indicator of the maturity of repository projects, the diversity and maturity of assessment programs and assessment indicators themselves are desirable. On the theme of e-publishing support, it is of no small interest that Nagoya University is carrying out a project linking OJS to repositories (overlay journals), an advanced undertaking that would not have been possible in Phase 1.

An example of (3) is the project by Otaru University of Commerce. Comparing document duplication and IRs as two academic information communication means, the project perceives document delivery by IRs as an alternative to ILL and carries out innovative publicity activities towards faculty and ILL staff. Regardless of the technologies involved, the top priority regarding IRs is gaining the understanding of researchers who produce papers so that the archived content can be increased. Efforts to publicize IRs as means of distribution and establish (create models of) promotion methods are extremely important.

The average number of institutions involved in each continuing project increased from 2 in Phase 1 to 4.5 in Phase 2. The Digital Repository Foundation (DRF) operated by Hokkaido University and others is taking part in eight of these projects, which is evidence of progress since Phase 1 in making community formation a core concept of the projects.

Table III-2 shows the number of CSI projects in which each university is taking part as lead, participant, or contributor.

The listing of a university as participant or contributor, while not necessarily indicating the extent of that school's overall activeness, at least gives an idea of the collaboration being carried out. In that sense, schools participating in and contributing to a large number of projects deserve praise for their leading role in community formation and cooperation with Area 2 projects in the CSI program.

As a future direction for the CSI program, it would be desirable to have institutions engaged only in Area 1 to join also in this participation/contribution framework, boosting the activities through community formation and cooperation in projects of general applicability. With many universities lacking the resources to carry out research and development projects on their own, the area 2 projects will be more effective if the projects of individual schools can be boosted by joint participation.

2. Prospects for the Future

The Area 2 projects of Phase 2 can be divided broadly into those based on themes that have somewhat matured, which need to be continued as core projects, and those based on new concepts with expectations for future development.

Looking at the status of repository-related workshops and NII portal training sessions, participation is of two kinds, that for reinforcing personnel at schools already providing IRs and that for starting up new IR services, making clear the need for schemes for continuation and expansion purposes.

Of the Area 2 projects, there are many that play an essential role in forming the foundations for a variety of human and system networks by means of repositories, as well as many projects requiring active support in follow-up CSI programs covering each theme. There are also a number of themes that need to be addressed for the establishment of IR infrastructure but were not proposed as a project theme for Area 2. It is therefore to be hoped that budget incentives will be provided for supporting new themes in addition to the budget allotment for existing projects.

As for themes needing further expansion and refinement, development of value-added services boosts support for researchers. What is needed is not technology for the sake of technology but development for increasing content and for creating technologies and services that support researchers (both users and content creators). These value-added services may encompass a variety of projects and small themes. Development of repositories into something like digital libraries and their application to subject-based repositories can also be classified broadly in these valued-added services.

Table III-2 University engagement in Phase 2 CSI program (Area 2)

Lead, participation, or contribution	Universities
9	Hokkaido, Chiba
8	Osaka
7	Kanazawa
5	Tsukuba, Hiroshima, Kyushu
3	Kyoto, Okayama, Nagoya, Waseda, Saga, Nagasaki
2	Shinshu, Saitama, Keio, Shimane, Sapporo Medical Univ., Otaru Univ. of Commerce, Beppu
1	Nagasaki International, Kagawa, Kinki, Kobe, Tokyo Institute of Technology, Shizuoka, Obihiro Univ. of Agriculture, Gifu, Tsukuba Univ. of Technology, Tohoku, Tokyo Gakugei Univ., Tottori, Yamagata, Hiroshima Institute of Technology, Miyazaki, Kumamoto

As noted in the section on the DRF, important new issues are (1) creating an international framework for IR through global cooperation and (2) participating in this way in the international IR community. We hope these will be realized through cooperation and collaboration among the NII, repository community, and university libraries.

V. Outlook for Phase 3 and Beyond

The report *New Horizons in Academic and Scholarly Communication* on Phase 1 of the NII Institutional Repositories Program included the following outlook on Phase 2 and after: "When our successors look back on the history of IRs in Japan, they will undoubtedly see this first phase as one in which the seeds for subsequent IR growth were sown. Following this line of thinking, it is inevitable that Phase 2 be characterized as a period of cultivation, and Phase 3 as the harvest stage."

Can it in fact be said that Phase 2 was a cultivation period, and will Phase 3 be a time of harvest? In light of the various discussions taking place in the CSI program, this chapter considers the prospects for Phase 3 and beyond. It looks at future trends in Japan based on overseas trends, examines the funding outlook, and covers also system interoperability across IRs, global collaboration, human resources development, and the relation to SPARC Japan.

1. Benefits and Significance of Project Commissioning in the CSI Program

The IR projects carried out under the CSI program have had major direct and indirect effects on university libraries in Japan. Regarding the direct objective of the CSI program to improve distribution of academic and scientific information by supporting dissemination projects, it must of course be emphasized that the number of repositories is now more than 170 storing more than 800,000 full-text materials. Japan is the only country other than the United States with that many IRs and materials. As of the end of January 2011, the total number of views from JAIRO exceeded 4,660,000 and the number of direct downloads from individual repositories far surpassed accesses to JAIRO. This means that not only are these materials being disseminated, they are actually being used; and the services are contributing greatly to making academic information available to society, the researcher community included.

Regarding these materials, the download statistics of multiple universities are being analyzed based on the log standardization procedures of the ROAT (Repository Output Assessment Tool) project. The results are individually verifying the large difference in access trends for different languages and content types.

According to the analysis, there are many accesses from overseas to English-language content, while accesses to Japanese-language content and to research bulletins containing papers, many of them written in Japanese, are mainly from inside Japan. In the case of papers included in research bulletins but written in English, there is a clear tendency for accesses to originate outside Japan. Analyzing the accessing domains, in addition to academic institutions there are many commercial ISP domains and government domains. This suggests that in addition to improved availability thanks to open access to peer-reviewed papers, the service has led directly to large-scale society-benefitting usage of the papers, research presentations, research records and other materials produced by universities as the results of their educational and research efforts.

Access from overseas to English-language content (mostly peer-reviewed papers) is evidence of how international contributions are being made as a result of open access. Considering the estimated output of academic papers in Japan (ranking 4th worldwide according to Thomson Reuters (2010)),[1] this shows the global impact of the IRs in this country.

Reviewing Japan's measures for dissemination of academic and scientific information,[2] the Science Council of the Ministry of Education, Science, and Culture issued a proposal in 1994 on enhancing the digital library functions of university libraries. In accord with the proposal, digital library promotion funds were established first for the Nara Institute of Science and Technology in 1995, followed in 1997 and after for the University of Tsukuba, Tokyo Institute of Technology, Kyoto University, the University of Library and Information Science (now part of the University of Tsukuba), and Kobe University. The Nara Institute of Science and Technology digital library was intended only for internal use and was not made publicly available. Then starting in 2002, funding for development of digital library functions was provided for in the supplementary budgets to Tohoku University, Chiba University, The University of Tokyo, Tokyo Gakugei University, Hitotsubashi University, Osaka University, Hiroshima University, Kyushu University, Saga University, and Kagoshima University.

These schools archived content in line with their own characteristics and made it available on the Internet. Some universities also bolstered their information services for on-campus use. Characteristic content was selected by each school for dissemination, from earthquake disaster-related collections to dissertation abstracts and full texts, high-resolution images of rare works, and syllabi. At this point, however, there were still questions regarding the most important point, whether these efforts were leading to effective use of the materials, since the materials that were housed in individual university libraries and made available by these projects seldom matched the everyday research and educational needs of researchers.

In general, for improving distribution of academic and scientific information, rather than scattered dissemination of rare archived materials, a certain level of homogeneous access is essential, premised on a critical mass of homogeneous content necessary for education and research. The way the budgetary appropriations process works in Japan, however, is aimed at individual institutions or sporadic projects, and thereby ineffective in raising the standards of a given area of the academic environment all at once, where the real need is for collaboration among multiple institutions. Moreover, because academic information distribution is not a direct target of science and technology promotion, but rather the peripheral infrastructure for science, it is difficult to attract direct financial support. After Japanese universities became corporate entities, enhancement and promotion of academic information distribution came to depend on the individual efforts of each school and the existence of policy measures on the national level has become difficult.

The CSI program offered a way past these sorts of bottlenecks that had occurred especially since incorporation, in the limited context of providing the infrastructure for disseminating a diversity of content by means of IRs. While the digital library projects of university libraries had demonstrated a number of advances in the area of digital archiving, in terms of usage no major benefits had been shown. By contrast the CSI program, in which more than 700,000 materials were made available, gaining more than 4,660,000 views and even more downloads, achieved a significance going beyond support for repository projects by individual institutions and provides suggestions on how to offer financial support for improving academic information distribution on a national scale.

For the sake of comparison it is useful to look at financial support in Europe focusing on IRs.[3]

In the UK, projects that had been carried out since 2002 with financial assistance from multiple support programs of the Joint Information Systems Committee (JISC)[4] include Focus on Access to Institutional Repositories (FAIR, 2002-05), the Digital Repositories

Programme (2005-07, 2007-09), and the JISC Repositories and Preservation Programme (2006-09), among others. As the world's first assistance scheme for IRs, FAIR led to the birth of SHERPA, RoMEO and other projects supporting repository efforts around the world and continues to this day. Following the successes of FAIR, a variety of other assistance programs are being carried out under policies specifically aimed at achieving open access. Collaboration between JISC and university libraries in the UK has also been conspicuous. The cooperative relationship between an assistance system with a clearly national objective and university librarians, a group of professionals, can be seen as having created the kind of circulatory system in which academic information distribution policies can function effectively.[5]

In the Netherlands, the well-known DARE (Digital Academic Repositories) network was implemented as a collaboration between the ICT provisioning organization SURF and university libraries.[6] SURF carried out an assistance program for introducing IRs in all the nation's universities, with each university providing matching funds. In a very short time, the program managed to establish an IR network with the explicit policy objectives of fulfilling the Berlin Declaration on Open Access.

As a program intended for Europe as a whole, the DRIVER (Digital Repository Infrastructure Vision for European Research) project, modeled on the DARE network, was implemented with EU funding. DRIVER has been carried out in two phases. Among the major fruits of the project are the DRIVER Guidelines (metadata standards) and DRIVER Portal (harvester).

DRIVER was an EU institutional repositories assistance project under the 6th Framework Program. An open access pilot project[7] planned under the 7th Framework program was implemented, and OpenAIRE (Open Access Infrastructure for Research in Europe)[8] was launched in 2010 as a successor project to provide backing for it. The open access pilot project is one of the EU science and technology infrastructure provision programs designed to achieve open access of research results (post-prints) in seven areas that receive assistance under the 7th Framework program. In the process, the above DRIVER Guidelines were carried over as OpenAIRE Guidelines. Both DRIVER and OpenAIRE are assistance projects promoting academic information distribution for all of Europe as part of the EU science and technology promotion policies. As in the UK, they are being carried out against the backdrop of close collaboration between personnel administering the assistance and university libraries including professional librarians.

In this way Europe was able to implement its policy measures for academic information distribution through collaboration between government and professional layers, which would seem to be an essential part of science and technology promotion.

In Japan, meanwhile, advanced initiatives were attempted as policy measures of the Ministry of Education, Culture, Sports, Science and Technology (former Education Ministry) based on policy council responses and proposals and making use of the budgetary appropriations request process noted earlier. These, however, were carried out as sporadic projects and were of limited effectiveness. There were shortcomings also in achieving shared awareness of the objectives and collaboration between the government and the university libraries and library personnel carrying out the projects.

The CSI program overcame these weaknesses to a certain extent by focusing on the issue of establishing a dissemination infrastructure by means of IRs. Thanks to that focus, as opposed to assistance for individual projects having in common only the keyword "digital

libraries" as happened in the 1990s, provision of assistance for the common theme of IRs along with the critical mass of homogeneous content realized thereby proved to be a powerful force. At least when it came to providing an environment for distributing academic information, this approach turned out to be particularly effective and demonstrated a certain superiority to the budgetary appropriations request approach.

The CSI program, in terms of both collaboration among university libraries and that between the NII and university library circles, has produced benefits that are secondary but diverse and essential. In projects like the DRF (Digital Repository Federation), a collaboration by librarians on their own initiative and going beyond the national/public/private distinctions, a variety of successes are to be seen, including the innovation and promotion of library activities as seen in poster sessions and public-participation international conferences, as well as English-language presentations in overseas journals and international conferences. That these kinds of professional activities, taken for granted in the West, took place as one output of the CSI program is highly important; and it is also worthy of note that voluntary initiatives like these with essentially the same professional quality as in the West are gradually being realized.

The results achieved by the CSI program through commissioned projects were able to be achieved thanks to this new approach to financial assistance; moreover, the effects on collaboration between the NII as a shared institution of universities and university libraries have been direct and positive. Collaboration between the two was indispensable in the first place for improving distribution of academic information, and the collaborative relationship in the form of project commissioning has been shown to be a considerably effective "framework."[9] This is the financial policy implication of the CSI program successes made clear over the course of Phase 1 and Phase 2.

2. Digital Repository Interoperability

2.1 Introduction

One advantage of digital repository use is the relative ease of achieving interoperability across systems. This chapter introduces the system interoperation possible using features that are standard in most repository software. Besides institutional repositories it looks also at subject repositories.

2.1.1 OAI-PMH

Repository software programs such as DSpace and EPrints on which digital repositories depend have incorporated system interoperability functionality from the start, in the form of the metadata exchange function Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). The general way of utilizing OAI-PMH up to now has been limited to cross-search sites such as OAister (www.oiaster.org) making use of bulk metadata harvesting (ListRecords). OAI-PMH also has a GetRecord function for output of individual metadata entries in the specified metadata format. What can be done using this function?

For example, by issuing a GetRecord request for an entry in a repository (if a handle is attached the URI does not change), metadata for that content can be obtained and can be processed for embedding in a website.

Since the website only uses the metadata, the website content and repository metadata can be fully synchronized. When a researcher creates a list of academic accomplishments on a website, it is extremely useful to be able to synchronize the content with a repository (which

can be done, moreover, simply by specifying the identifier). This feature is applicable also to blogging tools and the like.

Let us look at some other examples. Using the free document management software JabRef, document bibliographic information registered in the subject repository arXiv.org can be designated by its arXiv.org document ID (which is practically identical to the OAI-PMH identifier), and then automatically fetched by issuing a GetRecord request. This is likewise a highly useful function for users.

Though often overlooked, the OAI-PMH metadata federation mechanism has the potential for even wider application. Also not to be overlooked is that third parties unrelated to the repository operator can offer these features as service providers.

2.1.2 SWORD

The federation provided in OAI-PMH applies to metadata only and can be considered a client-pull approach. On the repository end there is no involvement in the metadata specifications. SWORD (Simple Web Service Offering Repository Deposit), on the other hand, is a server-push type interoperability protocol that has become popular in the last few years and is already implemented in EPrints and DSpace.

A SWORD client uses Atom Publishing Protocol for transfer to a server. Resources are ZIP archived along with METS XML metadata and uploaded to the server. The user information stored in DSpace and EPrints is used for user authentication, and the collection is processed according to the user information. The server receiving the files converts the metadata and content to an internal format for storing. As a result, in the ideal situation content registration is completed with execution of one round of commands (or of an internally adjusted program).

The ideal situation is when the metadata configurations and so on are matched between the two sides. So long as the metadata configurations conform (just as oia_dc is mandatory in OAI-PMH), bulk registration of all the papers in a research bulletin, for example, in another repository can be done mechanically. Naturally the same kind of thing can be accomplished by exporting metadata in CSV format, but for deploying a digital repository the potential can best be expanded by providing infrastructure as protocol.

In Phase 2 of the CSI program, Nagoya University implemented federation between research bulletins and IRs using SWORD.

2.2 Subject repositories and the future of institutional repositories

2.2.1 RePEc

Discussion papers in economics play a role similar to that of research bulletins. RePEc (repec.org) is a global portal for such papers. Use of ftp or http is recommended for uploading materials to the RePEc database. If metadata and content files are stored in the specified directory tree in ReDIF format, RePEc will automatically crawl the directories. Several IRs in Japan link to RePEc.

The technology used for system interoperability with RePEc was outmoded. With arXiv.org, SWORD can be used to submit materials (http://arxiv.org/help/submit_sword). Using this function, interoperability with the following kinds of IRs should be possible. Suppose that discussion papers are offered as a DSpace collection. (They could also be

mathematics and physics pre-prints, or technical reports in engineering.) When new arrivals are registered, at the same time the full text and metadata are output in SWORD format and automatically submitted to clients. In this way the data submitted to IRs is automatically shared with arXiv.org. Various means can be adopted for generating the metadata to be submitted. One possibility would be to use the GetRecord request of OAI-PMH.

2.3 Outlook

If researcher IDs function properly, it is quite possible that in the future the content submitted to arXiv.org by researchers will be collected automatically and comprehensively in IRs. On the institutional repository end, compiling appropriate collections will enable the IRs to function effectively as subject repository gateways. The same mechanism can also work between IRs, such as for sharing content when faculty members move to different universities.

The people behind arXiv.org have also, without going into the details, talked about opening the platform for system interoperability through such means as Facebook application linking or researcher ID field trials. Linking with subject repositories like arXiv.org should be highly useful as a means for making effective use of IRs.

The original purpose of digital repositories can perhaps be summarized as encouraging content sharing in some form or other, in that way giving added value to the content as well as enabling the repository operator to play a leading role in academic information communication. Clearly the operators of IRs are university libraries. It would seem that the themes to be addressed are endless and that the future is ripe with possibilities.

3. International Collaboration

The main objective of IRs is to achieve open access by making available peer-reviewed papers (post-prints). Distribution of academic information is by nature borderless. Ways must be found to distribute academic knowledge effectively at low cost and to enable its sharing by more stakeholders. Open access is a concept intended to enhance this essence of academic information distribution through IR establishment.

From the concept of open access it naturally follows that the IR movement has to be made a global one. Accordingly, the IR organizations in each country are working to strengthen international collaboration, to standardize the various technologies and metadata that can be called the infrastructure of repository operation, and to share operational know-how. There is much more that must be done in numerous areas in this regard, from exchanging ideas on global information sharing to creating technical standards and joint frameworks. With CSI financial backing, the DRF is telling the world about the status of repositories and open access in Japan through presentations overseas, international conferences, and English-language reports. CSI commitment to international engagement is seen also in DRF participation in COAR (Confederation of Open Access Repositories) as a founding member.

The results obtained from international collaboration in Phase 2 of the CSI program, mainly through DRF initiatives, are summarized below. These are benefits that were not seen from conventional university library activities and show how the CSI program has had a large positive impact on library globalization and collaboration not limited to repository deployment.

(1) Acceptance of overseas information

(i) Translations by DRF

Six volumes including University of Rochester survey reports and technical documents were translated and shared in Japanese,[10] with major benefits for technology development and establishment of IR operations in Japan.

(ii) Creation of information sharing activities hosted by Japan

The Digital Repository Federation International Conference (DRFIC 2009) was held in December 2009, hosted by the DRF and NII/SPARC Japan. With the participation of 174 persons from eight countries, the conference featured discussions and information sharing on international cooperation, on open access in the Asia-Pacific region, and on pioneering case studies in various countries.[11]

(2) Dissemination of information from Japan

(i) Presentations at international conferences, etc.

At three international conferences there were eight presentations including those given at poster sessions and short and oral presentations, reporting to the world about trends in Japan, DRF community activities, and specific efforts such as the junii2 repository metadata schema and the Society Copyright Policies in Japan (SCPJ) project.

(ii) Exchange of views and meetings with other institutions

There are many different projects by various institutions in each country aiming to solve the same issues as in Japan. For the sake of international collaboration with these efforts, the DRF is exchanging views and working for a consensus on information dissemination by Japanese projects.

(3) Synchronizing with global trends

(i) MoU between DRIVER and DRF (Nov. 25, 2008)[12]

On the occasion of a visit to Japan by Dr. Norbert Lossau of the DRIVER project on October 1, 2008, a memorandum of understanding was signed. This gave Japan a chance to participate in the worldwide growth of European IRs and open access projects.

(ii) Cooperation with and participation in COAR establishment (Oct. 21, 2009)[13]

COAR was established with the cooperation of 28 institutions in 17 countries of Europe, Asia, and North America. Both the DRF and NII participated from Japan, and Shigeki Sugita from the DRF (at that time affiliated with Hokkaido University) was appointed as Deputy Chairperson. As a result, a new channel was obtained for raising international awareness of Japan's IR and open access activities.

In July 2009 an international collaboration working group was set up in the DRF, which followed up on movements leading to COAR establishment and at times put forth proposals and information from Japan.

(iii) Participation in Open Access Week (OAW)(Oct. 19-23, 2009)[14)]

Taking advantage of the international event week OAW hosted by the US SPARC, individual university libraries in conjunction with ILL services informed researchers about open access and carried out promotional activities, centering around the IRcuresILL project.

A report on DRF Phase 1 activities, which had been carried out as a Phase 1 CSI-commissioned project, was translated into English and published on the DRF website. This was made known via the JISC mailing list and drew many comments from various countries. The content collection methods developed by Japan are by no means inferior to those of other countries. There is also plenty of latent interest in them. Without efforts to get the message out to the world, however, there is much in the Japanese situation that is not visible to other countries.

To solve this major problem, first of all more must be done to disseminate the CSI program results through presentations of papers, participation in related conferences and other means. To this end strong support should be given to international announcements of results in the commissioned projects.

Second, as noted earlier, in fast-moving fields it is necessary to stay on top of international trends and technical standards at all times. Important measures in this regard include regularly inviting leading figures to Japan, strengthening channels between international and domestic communities (including financial support for international conference activities and participation in international organizations) and translating overseas technical documents into Japanese in a timely and agile manner. The commissioned projects should support such moves by universities.
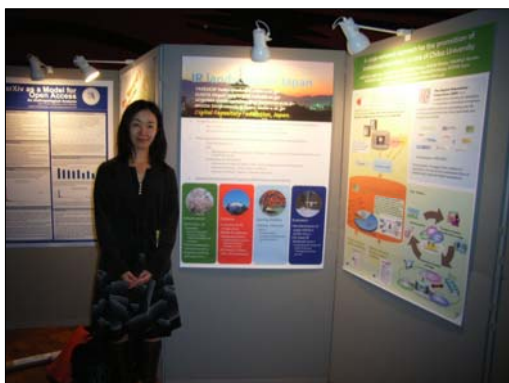
Venue of Berlin 6 poster sessions (Nov. 11-13, 2008)

MoU exchange on DRIVER/DRF cooperation
(at Nov. 2008 SPARC DR Meeting)

DRFIC 2009 (Dec. 3, 2009) presenters and chairperson

COAR launch ceremony (Oct. 21, 2009)

4. Human Resources Development

Human resource development (training) projects in Phase 2

	Date	Name	Venue/host	Objectives	Description	Participants
2010 academic year	July 23-25 Aug. 28-30	Training of academic portal staff	Nagoya University Library National Center of Sciences Host: NII (with cooperation of DRF)	IR establishment: Teach the necessary administrative skills to staff involved in planning, proposing, and operating IRs in university or other libraries.	IR role in academic information distribution/ research impact/implementation strategies/ content forming/IR support strategy of NII/ system introduction/case studies/copyright seminar/scholarly research process/IR deployment/group study and presentations	30 each
	Oct. 29-30	DRF/ShaRe regional workshop (Hiroshima) DRF ShaRe-Hiroshima	Hiroshima University Library Host: DRF ShaRe	Acquire knowledge in IR development and administration. Plus information exchange on shared repository	IR introduction/project strategy and content building/copyright and processing practice/ approach to researchers/related trends and technologies, etc.	67
	Dec. 11-12	DRF/ShaRe regional workshop (Yamagata) DRF ShaRe-Yamagata	Yamagata University SCITA Center Host: DRF ShaRe	Acquire knowledge in IR development and administration. Plus information exchange on shared repository	IR introduction/project strategy and content building/copyright and processing practice/ approach to researchers/related trends and technologies, etc.	68
	Feb. 9-10	DRF regional workshop (Kanto region) DRF-Okayama	Tokyo Institute of Technology Host: DRF	Acquire knowledge in IR development and administration. Plus information exchange	IR introduction/issues when starting up IR/ copyright/system and metadata introduction, etc.	81
2011 academic year	Aug. 5-7 Sept. 9-11	Training of academic portal staff	Nagoya University Library National Center of Sciences Host: NII (with cooperation of DRF)	IR establishment: Teach the necessary administrative skills to staff involved in planning, proposing, and operating IRs in university or other libraries.	1. Recognize IR significance anew and start developing 2. Establish IR and submit content 3. Release IR and develop further	30 each
	Sept. 18	DRF regional workshop (Kinki region) DRF-Mt. Machikane	Osaka University Library Host: DRF	Acquire mainly technical knowledge. Plus information exchange	Copyright handling/data backup class/digital resource archiving/access log analysis/ introduction to repository metadata, etc.	29
	Dec. 17	DRF/ShaRe regional workshop (Hyogo) DRF/ShaRe-Hyogo	Kwansei Gakuin University Library Host: DRF ShaRe Association of University Libraries in Hyogo Prefecture	Acquire knowledge in IR development and administration. Plus information exchange on shared repository	Introduction/content collection/metadata, copyright/case study reports/introduction to shared repositories/report on shared repository case, etc.	83
	Jan. 7-8	DRF regional workshop (Tohoku region) DRF-Sendai	Tohoku University Library Host: DRF	Acquire knowledge in IR development and administration. Plus case study reports plus state of IRs	Introduction/project strategy/content collection and copyright/approach to researchers, simulated presentation	53

Reaction of trainees (based on questionnaire)

(From academic portal staff training)
- I expected professors to be more resistant to publishing their papers in an open access journal. It was encouraging to know they wanted their papers read by more people. Getting to know researchers better seemed to be the fastest approach to assembling repository materials.
- I thought there was a bit too much introductory discussion and theory. I would have liked more hands-on practice and participation other than group discussions, such as practice investigating copyrights and actually registering content.
- The general flow chart and explanation of the basic process of introducing an institutional repository in a university was easy to understand. The inclusion of individual case studies was also helpful, enabling me to get a clearer image of the process.
- A little too much material was crammed into the time available. It would be good to have preliminary and follow-up courses for IR training.
- Since the lecture content would seem to be largely affected by differences in trainee levels and the type of system, I would prefer separate training occasions divided by level, etc.

(From DRF/ShaRe-Hiroshima)
- Because of the broad theme I wasn't expecting it to be of immediate usefulness, but as it turned out much of the discussion was related to everyday questions and issues, so I found it helpful. I should have asked my colleagues to participate together with me, even if they're not directly in charge.
- Listening to all the presentations taught me a lot about the art of presentation.

(From DRF-Sendai)
- Each year there is new and updated material, which is useful for getting new information and clearing up past issues.
- I realized that working to achieve better communication is essential given that there is still an enthusiasm gap between IR operators and researchers.

Prospects for the Future

The July 2009 report, "Further development of university libraries and distribution of academic information (summary of deliberations)" in the section on issues for improving IRs notes the need to raise the level of professionalism of library personnel and says human resources development is essential to establishing and maintaining IRs. The skills required are many and varied, both at the development stage and the operation stage. They include planning ability, presentation skills, communication skills, cooperation, and knowledge and technology regarding systems and copyrights; moreover, personnel must keep informed about the latest trends and information in the field and be able to reflect these effectively in the services.

Human resources development in Phase 2 was concentrated on academic portal staff training, had to be fit into short regional workshops, and in each case was intended for institutions about to start up an IR or having started one only recently. Clearly this training and information exchange have led to an increase in IRs in Japan. Another fruit of this training project has been the formation of regional shared repositories and other kinds of IR communities, which are key to further IR expansion.

Toward the enhancement of this training in Phase 3, various kinds of training geared to each district and to different levels from beginner to mid-level and advanced, and in forms such as group training and OJT, should be carried out under one system.

As indicated on the previous page, the structure for training human resources in IR provisioning is being established. To advance the cause of open access further based on IRs, human resources will be needed who can communicate effectively with researchers and academic societies.

The financial belt-tightening and decline in human resources faced by universities as a whole have created a difficult situation for the CSI program, which is a non-regular effort. It is necessary to broaden the outlook for university library services while maintaining balance with conventional services, and to motivate personnel to pursue their work with enthusiasm.

By cooperating effectively with the programs being carried out by related organizations, we need to contribute to the development of the next generation. These include the academic portal staff training program, university library staff short-term training and long-term training programs, the DRF training of newly appointed staff and training sessions for mid-level staff being carried out as commissioned projects, and the SPARC Japan workshops, among others.

5. Relation to SPARC Japan

5.1 Background to the start of the SPARC Japan project

The SPARC Japan International Scholarly Communication Initiative[15] is a project begun in 2003 by the NII for supporting and strengthening e-journals published by Japan's academic societies and other organizations, aimed at putting back into the hands of Japan's researchers the outstanding research results that they had been publishing overseas and boosting the dissemination of research results from Japan to the international community.

The phrase "serials crisis" refers to the rise in costs of academic journals publishing academic papers and the resulting decline in titles purchased by university libraries, starting from the 1980s in North America and from the 1990s in Japan. To counter this trend, university library groups in Europe and elsewhere called for initiatives to create a competitive market that would solve the rising costs, through support for publication of academic journals by researchers, and bring about more effective distribution of scientific and academic information. Notable examples are the SPARC program in the United States and SPARC Europe. As a means of realizing open access so as to change how academic information is communicated, powerful support is being provided in recent years for library initiatives regarding IRs and on-campus publication, led by SPARC in the United States.

In Japan, in addition to the problem of rising costs, the English-language publications by Japanese academic societies and other organizations are not sufficiently competitive globally; moreover, Japan was slow to join the worldwide movement toward electronic publication of academic journals, which started in the 1990s. This situation threatened to prevent a fair evaluation of the research results from scientific and other academic activities in Japan. SPARC Japan is a project being carried out in response to this situation. In cooperation with university libraries and others, it is encouraging the distribution of English-language journals by Japan's academic societies and other organizations in electronic form, so as to contribute actively to improving the global infrastructure for academic information distribution and promote wider dissemination of Japanese research results.

5.2 Initiatives and results of the SPARC Japan project

Phase 1 of SPARC Japan was carried out for three years from 2003 to 2005, followed by

Phase 2 lasting three years from 2006 to 2008. Among the accomplishments of Phase 1 were assistance for the digitalization of journals and for introduction of an electronic article peer review system, the birth of the e-journal package UniBio Press, and participation in related projects overseas such as Project Euclid. Determining that e-journal publication needed further backing by this project, it was decided to continue with Phase 2 for another three years or so with the aim of solving issues remaining from Phase 1, while providing comprehensive assistance across academic societies in order to provide an environment that will encourage them to publish journals on their own. Upon the conclusion of Phase 2, consideration was given to continuing the project. It was decided to make the 2009 academic year an interval period for project evaluation. It was further decided to end financial support for individual academic journals with the conclusion of Phase 2, based on the assessment that the academic societies publishing partner journals had successfully established a model for sustainable publishing of academic journals.

5.3 Basic aims of SPARC Japan Phase 3

The three-year period from the 2010 to 2012 academic years was declared as Phase 3 of the project. At the 2nd SPARC Japan Steering Committee meeting for the 2008 academic year, it was decided that the direction for Phase 3 would be, "building on the results up to now, moving to actions designed to improve academic information distribution for all stakeholders including academic community members, university libraries, researchers, and academic societies" (March 10, 2009).

Phase 3 of the project was to be focused on comprehensive advancement of academic communication as a whole, in close collaboration with the NII Institutional Repositories Program. From an administrative standpoint, the working group under SPARC Japan cooperates with the Library Liaison Working Committee working group on institutional repositories and advancement in the dissemination of scientific information.

5.4 Areas of collaboration with SPARC Japan and future outlook

In the 2009 academic year, SPARC Japan people met with WG3 members and a SPARC Japan Seminar 2010 joint planning committee meeting was held (February 19, 2010) with the purpose of furthering mutual understanding between academic societies and libraries, the two main protagonists in academic information communication.

Academic societies and libraries, as the issuers and purchasers of academic journals, respectively, in one sense have conflicting interests. At the same time, they are also partners in the provision of researcher services. In the above meetings, as a first step toward the start of actual collaboration between academic societies and libraries, the two sides gave the following presentations.

- Academic society presentation, "Toward the future of library-academic society collaboration" (Yuko Nagai, Secretary-General, the Zoological Society of Japan)
- Library presentation, "Aims of the SCPJ Project" (Mika Saito, University of Tsukuba Library)

In addition the following two items were confirmed as part of the agenda for the 2010 academic year.

- A seminar event dubbed the "getting to know you series" in the SPARC Japan Seminar
- Further enhancement of SCPJ as a joint endeavor by libraries and academic societies

These efforts are significant as a first step toward close cooperation between the two sides in promoting open access backed by a Japanese business model. Toward further development in the future, they also agreed it would be necessary somehow to involve researchers, central to academic communication, in addition to academic societies and libraries.

References

1) Thomson Reuters, Global Research Report Japan (2010). http://ip-science.thomsonreuters.jp/press/release/2010/GRR-Japan/ [in Japanese]

2) National Institute of Informatics, *New Horizons in Academic and Scholarly Communication, NII Institutional Repositories Program Phase 1 Report*, p. 1.

3) The following paper gives details of European IR assistance projects in general. Note that rather than per-country assistance, the Knowledge Exchange alliance of support organizations provides backing applicable to pan-European issues.
Hideki Uchijima, "International status of institutional repositories centering on Europe and America," *University Library Research*, No. 90, March 2011. [in Japanese]
Knowledge Exchange: http://www.knowledge-exchange.info/

4) The following report looks back at assistance programs by JISC for academic information dissemination.
"Open Access for UK Research: JISC's Contribution"
http://www.jisc.ac.uk/media/documents/publications/programme/2012/jiscoamainbrochure.pdf

5) The following report covers one of the repository assistance projects carried out from 2006 to 2009, detailing the role of JISC. Dalton, Pete; Conyers, Angela. "JISC Repositories and Preservation Programme Final Evaluation Report." http://ie-repository.jisc.ac.uk/435/

6) DARE plays an important role as a model for Europe's repository network. The following two papers give details on the process of connecting SURF and universities in DARE.
(1) Waaijers, Leo. "The Dare Chronicle: Open Access to Research Results and Teaching Material in the Netherlands." Ariadne. 2007, Issue 53, October.
http://www.ariadne.ac.uk/issue53/waaijers/
(2) VanderKuil, Annemiek; Feijen, Martin. "The Dawning of the Dutch Network of Digital Academic Repositories (DARE): A Shared Experience." Ariadne. 2004, Issue 41, October.
http://www.ariadne.ac.uk/issue41/vanderkuil/

7) See the following on the open access pilot project carried out under the EU (EC) 7th Framework Program. Europe's repository projects receive financial aid for supporting this project, which is given a clearly defined status in official policy. The model for the repository network is DARE covered in reference 6 above.
http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1300&lang=1

8) OpenAIRE is a community of repository operators in European countries formed for directly assisting self-archiving of EU-funded research. The vice-president of the EC (European Commission) attended and gave a speech at the launching ceremony held in December 2010. See the official OpenAIRE website below for details.
http://www.openaire.eu/

9) In devising and implementing policy measures for academic information distribution, it is important to maintain and further develop various "frameworks" concerning matters of budget, human assistance, collaboration and the like whose effectiveness have been demonstrated by the CSI program.

10) DRF-wiki (Japanese translations of English documents available through this site)
http://drf.lib.hokudai.ac.jp/drf/index.php?Foreign%20Documents [in Japanese]

11) DRFIC 2009 website (http://drf.lib.hokudai.ac.jp/drfic2009/index_en.htm)
Report (Special article No. 1) by Hideki Uchijima on Digital Repository Federation International Conference 2009, SPARC Japan Newsletter No. 4 pp. 1-5. [in Japanese]

http://www.nii.ac.jp/sparc/publications/newsletter/PDF/sj-NewsLetter-4.pdf

12) DRF-wiki on cooperation between the DRF and the DRIVER project.
http://drf.lib.hokudai.ac.jp/drf/index.php?Cooperative relationship between DRIVER and DRF [in Japanese]

13) E992, COAR launched as organization for international collaboration on open access, Current Awareness-E, No. 1612009.11.18 (http://current.ndl.go.jp/e992) [in Japanese]

14) IRcuresILL, Open Access Week (http://drf.lib.hokudai.ac.jp/oaweek/) [in Japanese]

15) International Scholarly Communication Initiative SPARC Japan (http://www.nii.ac.jp/sparc/en/)

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