

## Comparative Analysis of Open Source Digital Library Softwares: A Case Study

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### ABSTRACT

The exponential growth in data generation and subsequent transformation into knowledge has created huge repositories of knowledge in the libraries. This has revolutionised the methods and techniques to retrieve the relevant and useful information for the users. The growth of Information and communication technology (ICT) has facilitated into achieving this. In this paper, a study of three open-source digital library management software has been presented which collects and disseminates information for library-users. This analysis involves the study and comparison of related software documents and respective technical manuals. Based on the results of the comparison, the implementation of Digital Library Management Software at DESIDOC has also been dealt in details.

**Keywords:** Open source; Digital library; Digital library software; DSpace; GSDL; Greenstone; EPrints

### 1. INTRODUCTION

A place, where collection of information resources is stored in print and other forms in an organised and accessible manner for print or study is referred to as Library. As defined by International Organisation for Standardisation a library is “irrespective of the title, any organised collection of printed books and periodicals or of any other graphic or audio-visual materials, and the services of a staff to provide and facilitate the use of such materials as are required to meet the informational, research, educational or recreational needs of its users”<sup>1</sup>. Digital Library is a type of information retrieval system where the information is stored in digital format which can be accessed within network of computer users<sup>2</sup>. It uses online repositories which can store the textual information systematically and can be accessed by users 24X7. There are various such digital repositories available, which may be open source or proprietary. Open source describes the method of software development, which uses the power of review and transparency of distributed peer-to-peer progression. Here the codes of software are available in open domain which can be customised by the respective users. This technique helps in providing high quality software through high reliability, low cost, flexibility and end of traditional seller lock-in. Since, these open source software come under “Open Source free license”, it allows the developers / users to change, improve and distribute software many times.

DESIDOC is the central information centre of DRDO which contains various types of information repositories to disseminate S&T information digitally to the DRDO users. To create and manage these information repositories, a suitable digital library software, DLS (sometimes also called digital

library management software) was required. Due to this, it was necessary to analyse the best-suited DLS for DESIDOC use. This resulted in the comparison of the three most popular DLS available today i.e. DSpace, GSDL and Eprints. Based on the comparison, DSpace was found to be the most suitable LMS in DESIDOC scenario and hence was used to develop the Institutional Repositories. The repositories which were earlier running on different Library Management software were also migrated into DSpace platform to create a common unified Institutional Repository for DESIDOC.

### 2. METHODOLOGY

To compare the three digital library softwares (DLS), various review papers on related subject were analysed. Also the technical details and complete specifications were also considered through the technical manuals available on the official websites of the three DLS. To compare the practical aspects, the frontend and backend of DSpace, GSDL and EPrints were also analysed to find their suitability with specific requirements of an information repository. The frontend and backend of DSpace are JSP and PostgreSQL where as for GSDL it is Perl/ Java and GSDL’s own database. For EPrint the frontend and backend are Perl and My SQL/PostgreSQL/ Oracle respectively. So DSpace becomes a default choice for organisations familiar with JSP and PostgreSQL. Furthermore, there are many more advantages in DSpace which make it a suitable choice for implementation of IR in an organisation.

### 3. DIGITAL LIBRARY MANAGEMENT SYSTEMS

The Open Source Digital Library software are the software applications that help in creating and presenting information repositories. The repositories built with the help of

these Digital library management systems can be searched and browsed based on Metadata as these features are inbuilt in such applications. Apart from this, they can be easily maintained, enhanced and re-created. Presently many open source software (OSS) applications are available for library and information management, for example DSpace, GSDL, Fedora, Eprints etc. Therefore, organisations can choose the one which is the most suitable for their requirement and implement them to create digital repositories. Focused mainly on three of the most popular Open source Digital Library software- DSpace, GSDL and EPrints.

#### 4. LITERATURE REVIEW

The Digital Library Management softwares (DLMS) provide a user-friendly and customisable architecture to create online digital libraries with much ease. With help of these applications, institutions/organisations can publish their research work, technical papers, manuscripts which will not only be available globally but also preserved as digital items. The softwares discussed above (Dspace, GSDL & EPrints) possess different services and architectures. However, it is not easy to propose one specific DLMS system as the most suitable for all cases. The study can help an organisation to select a proper DLMS for showcasing their digital repositories based on their own criteria. These criteria can consist of the type/format of the content to be uploaded, how the material is to be distributed, what is the backend and frontend of the software and the time frame available to setup this digital collection.<sup>3</sup>

Das compared the three software (Dspace, GSDL & EPrints) and observed that current open source digital library software still lacks certain functionalities apparent to be significant, as gathered from the literature. However, considering the three Dspace, GSDL & EPrints, Dspace and Greenstone have been found to be most suitable as they have well-built support to provide the desired functionalities to the end-users. EPrints is not far behind and it has potential to get better as it is going to add usage monitoring and reporting element in its upcoming version. The shortcomings of E-Prints as pointed out by the paper were lack of strong support in certain areas, especially in its search-module. However, this paper also agrees that each software package has its own strengths and weaknesses that caters to the need of various organisations with different set of needs<sup>16</sup>.

Seshaiah and Veeraanjaneyulu<sup>5</sup> presented some remarkable features of GSDL, and found that GSDL suits both Windows and Unix (Linux SunOS) and any of these systems can be used as a web server. It also has inbuilt administration function that enables the items to authorise new users to build collection, protect documents so that they can only be accessed by registered users. The collection created by GSDL possess effective full-text searching as well as metadata-based browsing facilities. Large volume (upto several gigabytes) can be built. Despite large data-volume, full-text searching is fast because of techniques like compression of the indexes to reduce data size etc. There is provision of Plug-Ins to accommodate new document types. The collection can accept multiple type of data like pictures, music, audio, video etc. It also supports documents from a variety of languages. Collection can be

updated in real time.

Another study by Sahu and Kadaria also discussed about the selection criteria for Open source digital library software. It states that evaluation of open source software is different from proprietary programs. The major variation in evaluation comes from the fact the information available for open source programs is generally different than that for proprietary programs. This information can be like availability of source code, program design opens for analysis by others, interaction between users and developers through open platform regarding the performance issues and many others. The authors are of view that selection criteria can be Open source licenses, Functional modules, Stable releases, Developers and user community, User interface and Documentation<sup>6</sup>.

The paper titled "Institutional repository software comparison: DSpace, EPrints, Digital Commons, Islandora and Hydra" supports DSpace as it has proven to be a strong and reliable repository platform since it was launched in 2002. With its latest releases, DSpace still maintains its position among the plethora of new DLMS available by providing more robust support for research data and more extensible back-ends. Whereas about EPrints, it points out that the main attraction of EPrints seem to be its user-friendly interface and ease-of implementation. However, the migration from another system into Eprints is not that easy The paper also mentions that Eprint can be an ideal repository solution for implementation in an institute where resources (financial or technical expertise) are limited<sup>7</sup>.

Rao<sup>8</sup> explored some of the reasons for using open source library management software. The major points that he mentioned are like free of cost availability since it can be freely downloaded from internet and ease of customisation to meet the organisation's specific needs. There are no copyright issues with this software and they use open standards which allows easy interoperability with other software. This software are regularly updated and there are online manuals available for technical support and help. Online help through developers' community is also available.

Madalli<sup>9</sup> advocated that DSpace is a fairly powerful software. Its main strength is that it allows submission of digital documents by its members but presently, it does not follow METS (Metadata Encoding and Transmission Standard). If it follows that, it can become much more powerful. The paper expects that the upcoming versions of DSpace will include METS also<sup>13</sup>.

Patil & Kanamadi<sup>10</sup> compared GSDL and EPrints as two widely used open source repository-software which mainly aimed at providing open access to article pre-prints and post-prints, including digital theses. These support a variety of file types like video, audio, images and zip files i.e all these types of files can be uploaded in these repositories. The authors concluded that EPrints is a useful Digital Library system which also has a large user community. But on the flip side whenever, there is a need for technical support and training in using the software, DSpace was found more convenient.

#### 5. DSPACE

DSpace is an open source digital library software which

allows us to capture and store digital data like text, video, audio etc into created repositories. It also provides facility to index, preserve and disseminate the digital material. Thus digital libraries use DSpace to manage the digital materials and publications in professionally maintained repositories.

If we see the world-wide scenario, there are more than 1000 digital repositories which are developed using the DSpace application for storing, distributing and preserving their digital data. DSpace is more common as a platform to build an institutional repository which is a digital collection of research documentation, intellectual publications, library collections etc. In Indian scenario Dspace is being used in many reputed organisations and projects like National Digital Library Programme of GoI, IIT Kharagpur Central Library, DIAT, DU (Deemed University) Pune, KUVEMPU University other IITs, IIMs and many other research and academic organisations. DSpace performs three major tasks to build a repository:

- It captures and ingests the digital content along with metadata
- It lists the content systematically and helps in searching based on keywords and metadata
- It supports preservation of the digital data for a long period of time

Therefore, DSpace can easily be customised to manage and preserve the digital content and provide accessibility of this data to the users. Since it is an open source software, an active community of developers, researchers and users across the world are collaborating to provide their expertise to enhance this application.

DSpace is capable of storing a wide range of digital data, which includes documents like articles, technical reports, conference papers, books, theses, multimedia publications, Administrative records, images, audio-video files, web pages etc. It also provides multiple features like visualisation, simulation of the stored data etc.

### 5.1 Latest Features of Dspace

As DSpace is a continuously growing platform, it keeps on releasing upgraded versions from time to time. 6.x is the latest update to the DSpace platform<sup>11</sup>. It consists of an upgraded configuration system, upgraded file storage plugins, and better quality control / health-check reporting features (through REST API and also through email). Furthermore, DSpace 6 has a Java API refactor that adds support for both UUIDs and Hibernate in the database layer. This feature makes it compatible for future challenges.

As reported by DSpace official website, the new Features and improvements in 6.x version includes.

- Java API refactor, featuring Hibernate and UUIDs
- Enhanced (reloadable) configuration system, featuring a new local.cfg configuration file
- Enhanced file storage plugins, featuring support for Amazon S3
- Configurable site healthchecks via email
- XMLUI framework for metadata import from external sources, featuring support for PubMed imports
- XMLUI export of search results to CSV (for batch editing)

- XMLUI extensible administrative control panel
- REST API Quality Control Reports, along with sample HTML clients and CSV export (for batch editing)
- REST API support for additional authentication methods (e.g. LDAP, etc)
- All searches default to Boolean AND.
- Enhanced indexing for searches (Excel is now searchable, as well as right-to-left text in PDFs)
- OAI-PMH adds compliance for Open AIRE 3.0 guidelines for literature repositories<sup>12</sup>

### 5.2 Limitation of Dspace

During implementation some limitations have been observed such as Flat File and Metadata structure, poor user interface, lack of scalability and extensibility, Limited API, Limited Metadata Features, Limited Reporting Capabilities and lack of support for linked data.

## 6. GREENSTONE DIGITAL LIBRARY

Greenstone Digital Library (GSDL) is an open source, multilingual software, which has been released under the terms of the GNU General Public License and is used widely for creating repositories and making them accessible online<sup>13</sup>. The development and distribution of GSDL is an outcome of the joint efforts by the New Zealand Digital Library Project at the University of Waikato, UNESCO and the Human Info hyperlink “<http://humaninfo.org/>” NGO. The aim of Greenstone software is to enable the users in building their own digital libraries. It provides a way to organise this information and publish it on the web or any other digital storage media like DVD and USB flash drives. In the later case, it will run on a non-networked environment. The digital libraries built by GSDL are fully-searchable and metadata-driven digital resource<sup>14</sup>.

Infact, this software encourages the effective deployment of digital libraries to share information and put it in the public domain. Therefore, it is in itself not a digital library, rather it provides a platform to build the digital library.

In 2004 its developers of GSDL were awarded by IFIP Namur award for “contributions to the awareness of social implications of information technology, and the need for a holistic approach in the use of information technology that takes account of social implications<sup>14</sup>”.

### 6.1 GreenStone Digital Library Versions

There are two main versions of GSDL namely GSDL2 and GSDL3. GSDL2 was the earlier version and still under wide-use where as GSDL3 is the latest version under active development. The best thing is that GSDL3 has backward compatibility and contains almost all the features of GSDL2. If a programmer is already working on GSDL2, he can either work with the latest release of GSDL2 or consider upgrading to GSDL3. The Greenstone Librarian Interface (GLI) provides a feature to import ‘Greenstone2 collection’ which helps in migrating to the new software for existing users of GSDL2.

Greenstone3 has been developed in JAVA and uses various latest web technologies—like XML Transforms (XSLT), and the Java Authentication and Authorisation Service (JASS). In

the same context if we see Greenstone2, then it was written in C++ and was based on many self-developed techniques by the developers as many latest web technologies were not available at the time. This made the users totally dependent upon the documentation by the development team. All these limitations have been overcome in the latest GSDL version.

## 6.2 Limitation of Green Stone Digital Library

Some limitations of GSDL have also been observed like Interactive content updation and management are not possible, no provisions for identifying duplicacy, metadata handling seems to be a bit difficult, during the collection building processing of some documents it hangs. Also, Linux Version looks robust than Windows.

## 7. EPRINTS

Eprints has been one of the popular Digital library software which has been in use for almost last two decades. It has been created at the University of Southampton and the currently version EPrints 3.3.16 Beta 1 is being used.

Being an open source software, it is convenient for use by any organisation with limited resources also. Initially Eprints required software-platform like Linux, Apache, MySQL, and Perl; now it can also run on Windows platform which has made it even easier for users.

Just like the other two Digital library software, Eprints is also a good choice to create an Institutional Repository and make it running. Documents along with the necessary metadata for the records can be uploaded by the users by filling information into a web form.

This software links to the SHERPA/RoMEO database which helps the authors to verify their rights regarding their submissions in the repository. In this way any unauthorised submission by the content-publisher is well taken care of.

### 7.1 Features of Eprints

Eprints is easy to use for both the end-users and the administrators; this is the biggest quality of Eprints. Users can submit the documents on Eprint in a straight-forward manner where users can proceed through the submission-process one step at a time. The metadata information can be provided with the e-copy of the document. The metadata information is quite simple like document type, document-title, author's name, date of submission etc. and can be submitted using a simple form. This doesn't require any knowledge of HTML or XML. For the administrator, the fields in the metadata are customizable. Therefore, the administrator can allow only those fields which are relevant for a particular repository and the end-user needs to fill only those particular fields. Users have an added advantage to manage their submissions as editing, updating, and removal of documents is possible even after submission. However, the administrator has the rights to restrict these functionalities.

Another facility that Eprints provide is that the administrator can specify a period only after which the document is transferred automatically to the archive-section.

Eprints also provide very effective search as well as browsing features. Search can be performed based on multiple options whereas the browsing feature is customizable and

robust. This helps in finding the documents effectively in the archives ("Repositories Support Project"). The Metadata Field entered, help in browsing the collection. For example, a particular document can be browsed Year-wise, department-wise, volume-wise etc. Browsing can be done based on any of the metadata fields within a collection, and multiple browsing criteria can be used. The browsing category can be customised by the administrator. Since Eprints is OAI-compliant, Google indexes the documents which are uploaded on an Eprints-archive. This helps in enhancing the visibility of Eprint-documents in cyber-space.

As per the feedback provided by users and other technical reviews, it has been widely accepted that the installation and configuration of Eprints is simple and fast. 'Eprints Services' is a company formed by the developers of Eprints which helps organisations to install, configure and use Eprint based repositories. Due to its multiple advantages today Eprints is being used in approximately 300 reputed organisation, the largest being the repository developed at the University of Twente in the Netherlands. This repository contains over 60,000 record. This in itself demonstrates the capability of Eprints in handling large collections.

### 7.2 Limitations of EPrints

No doubt there are multiple advantages of using Eprints to create digital repositories in libraries; still we may count certain limitations like the lack of the bulk upload feature. Uploading of files and creating records is definitely easy, but if someone has to upload an existing archive, then there are no options available to upload multiple records at one time. Multiple files can be uploaded in one go, but only when belong to the same record.

To elaborate further, migrating of records from an existing digital library software to Eprints is not at all a problem but if the existing collections are not contained within a database, then the records can't be uploaded in bulk in Eprints. This means each record has to be created individually. Also, in Eprints one can't create common records for multiple documents rather individual records for each document should be created one by one.

Another limitation of Eprints is the limited features in its search functionality. Boolean search is not available and also sometimes the search gives no output at all, which is not acceptable in today's time. At least suggestions for alternate search should be provided. User-created tagging feature is also missing in Eprints.

## 8. COMPARISON OF DSPACE, GSDL AND EPRINTS

Based on above discussion Features Comparison for DSpace, GSDL and EPrints are given in Table 1.

## 9. PRACTICAL IMPLEMENTATION OF DSPACE AT DESIDOC

Defence Scientific information and Documentation Centre (DESIDOC) of DRDO which provides information to various DRDO laboratories through its information and knowledge

**Table 1. Comparative account of GSDL, DSpace and EPrints**

<b>Features of Open source Software</b>	<b>GSDL</b>	<b>DSpace</b>	<b>EPrints</b>
Product Type	Software	Software	Software
Year of creation	1997	2002	2000
License cost/Update Cost	Free	Free	Free
License	GNU	GNU	BSD
Services	Training	Service via 3rd part service provider	Training, Consultancy, Site Visits.
Plug-in extends	Yes	Yes	
Resource Identifier	No/OAI Identifier	CNRI Handles	No
OAI-PMH	Yes	Yes	Yes
Z39.50 Support	Yes	No	No
Supported File formats <sup>7</sup>	doc, pdf, html, ppt, postscript, jpeg, gif, video, mp3, etc	doc, pdf, html, ppt, jpeg, gif, audio, video, etc.	Pdf, html, jpeg, tiff, MP3 and AVI
Supported Item Types(Storage and rendition)	Can store and manage all types of content	Can store and manage all types of content	Can store and manage all types of content
Thumbnail Preview	Images, Audio, Video	Images	Images, Audio, Video
Multilingual Support <sup>5</sup>	Greenstone provides ready-to use multilingual interfaces that are already translated in many languages.	Unicode character encoding, so different languages can be supported	Unicode is used
Machine-to Machine Interoperability.	Z39.50, OAIMHP	OAIMHP, OAIOR, SWORD, SWAP	OAIMHP, OAIOR, SWORD, SWAP, RDF
Syndication	---	RSS, ATOM	RSS, ATOM
User Authentication	User Groups	LDAP Authentication, Shibboleth Authentication	LDAP Authentication
Searching Capabilities <sup>4</sup>	Field Specific, Boolean Logic	Field Specific, Boolean Logic, Sorting options	Field Specific, Sorting options
Browsing Options	Browsing can be done using any field	By Author, Title, Subject and collection	Browsing can be done using any field
Metadata formats <sup>3</sup>	Dublin Core, Qualified DC, METS, RFC1807' NZGLS (New Zealand Government Locator Service), AGLS (Australian Government Locator Service)	Dublin Core, Qualified DC, METS	Dublin Core, METS
Associated Software <sup>3</sup>	Apache Web server, Java 1.4.0 or above, Image Magick Software Ghost scripts and Web Browser	Java JDK5 or later Apache Ant 1.6.2 or later, Apache Maven 2.0.8 or later Java 1.4 or later, PostgreSQL 7.3 or later, Apache Tomcat 4.x/5.x and Web Browser	Linux or Unix, Apache, Perl
Software Platforms <sup>3</sup>	Windows95/98/Me/NT/2000/XP/10 Unix/Linux, and MAC OS-X	Windows(NT/2000/XP/10) and AllPOSIX (Linux/BSD/UNIX-like OSs), OSX	Linux, Unix, Windows, OSX
Statistical reporting	Yes(Count of Full records)	Yes(Count of Full records)	Yes(Count of Full records)

Features of Open source Software	GSDL	DSpace	EPrints
Databases	Its Own	Oracle, PostgreSQL	MySQL, Oracle, PostgreSQL, Cloud.
Programming Language	C++, Perl, Java	Java and JSP	Perl
Web Server	Apache/ IIS	Apache and Tomcat	Apache
URL for free downloads <sup>10</sup>	http://www.greenstone.org/download	http://www.dspace.org/	http://files.eprints.org/



Figure 1. Single window services.

based e-services. More than 30 services are being provided to all the DRDO units country-wide through DRDO Intranet (Fig. 1) depicts the webpage on DESIDOC library-portal which contains the list of all these 33 services.

### 9.1 Requirement of DLS at DESIDOC

The web-services used to provide the information to the users were developed at different platforms in due course of time caused varied user experiences and difficulty in maintaining and hosting these 33 services. Therefore, for uniform user experience, enhanced search features and for effective maintenance of these service, it was decided to build these information repositories by using a uniform DLS platform.

### 9.2 DSpace at DESIDOC

Based on the analysis carried out to compare the most suitable DLS platform to build DESIDOC repositories, it was decided to opt for DSpace for creating these digital repositories. Few reasons to go for it was that it used JSP

and PostgreSQL as frontend and backend to build the applications. Both of these are available in open domain and easy to work with. Also, postgresQL is capable of storing and handling large amount to data which was the requirement of DESIDOC. Furthermore, DSpace provides various features for the users like full text search, metadata based search, federated search etc.

Furthermore, we can add or change any field to customise the default dubling core Metadata of DSpace. Dspace application is capable of accepting & managing large no of file formats like word, pdf, jpg, tiff, jpeg and even unrecognised formats can be registered in Dspace for future identification. Dspace has also been designed with flexible storage & retrieval architecture which can support variety of data formats & research disciplines.

At the same time many more features can be incorporated in these DSpace digital repositories like usage pattern analysis, implementation of business-intelligence tools etc, to make the services much more effective and user-friendly. All these features and qualities made DSpace as the default choice for IR at DESIDOC.

The features provided currently by DSpace can be summarised as follows.

- Uniform user-interface (UI) for all the services
- Specific search for individual services, available on the home page of each service
- Searches from meta data and full text for the service.
- Federated search facility: One common text box which search full text and meta data in all the 18 services migrated into DSpace.

Figure 2 shows these features in one of the repositories created using DSpace platform.

Figure 3 and Figure 4 depict the search features of repositories built on DSpace platform.

In this way DESIDOC has successfully implemented DSpace platform for 18 of its services like DRDO E-Journals, DRDO Knowledge Repository, DRDO Science Spectrum, DRDO Technology Spectrum, Newspaper Clipping Service, Institutional repositories of DRDO, Archiving of Newspaper

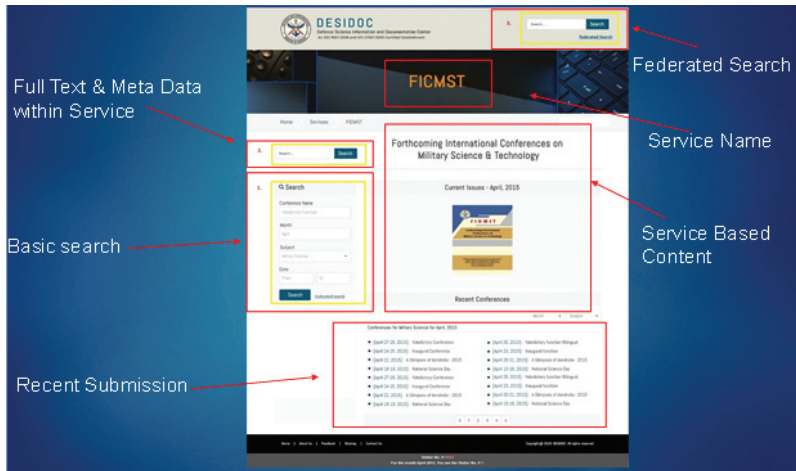


Figure 2. Uniform UI & search facility.

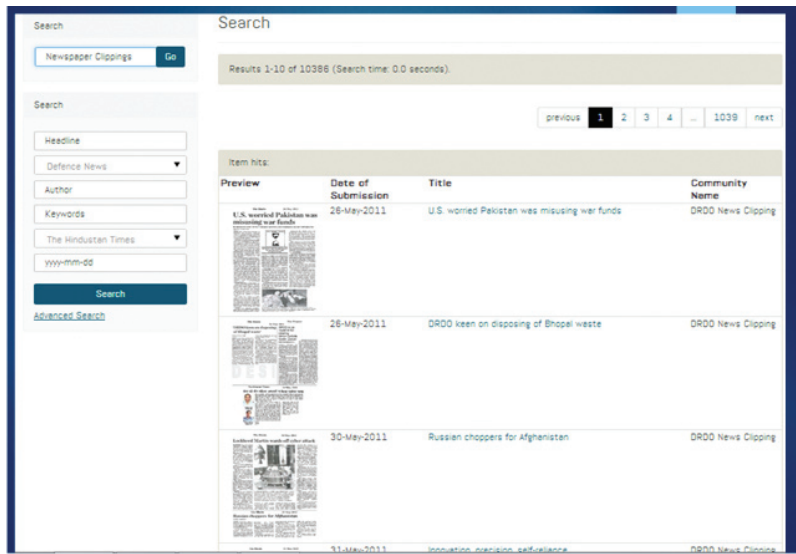


Figure 3. Individual service search results.

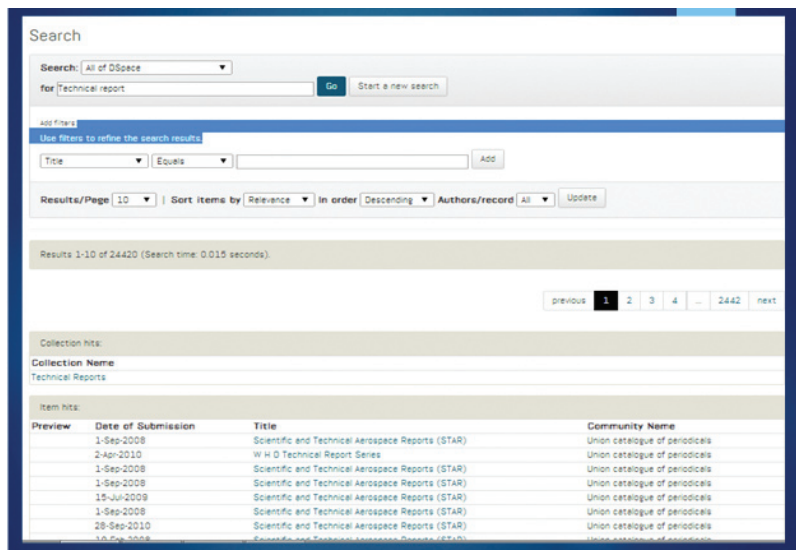


Figure 4. Federated search result.

Clipping, Union catalogue of periodicals, Archiving of E- journals etc.

What is worth-mentioning here is that all these repositories are actually, different communities of the same DSpace DLS where as for the users, they appear as different services provided by the Digital library of DESIDOC. This integration of various information-web-services into a common Dspace platform, has helped the IT-administrators at DESIDOC a lot, because now, instead of maintaining and managing multiple backends and frontends of various repositories they have now to deal with only one DLS i.e DSpace.

### 9.3 Proposed Enhancement in the DLS at DESIDOC

As the current repositories built using Dspace have performed quite well in meeting the user's requirements, DESIDOC is in the process to migrate the remaining repositories also on the Dspace platform. This will help DESIDOC, as an information centre, to have all its repositories in the common DLS i.e. DSpace. After this is done, there will be an advantage to search all the repositories through a single search i.e. federated search. Ease of maintenance and uniform user experience will be another benefits.

Also, it is proposed to analyse the usage pattern of these repositories through the features provided in the Dspace DLS. This will help the librarians at DESIDOC to understand the user's needs and further enhance the type and quality of content delivered through the DESIDOC repositories.

## 10. CONCLUSIONS

Therefore, Digital Library software (DLS) provides a platform to the digital library-service providers to create an easy to use, customizable architecture for its users. With help of these, the institutional repositories, research documents, manuscripts, audio-video data of organisations can be stored, preserved and also disseminated to the targeted users. The three software discussed above, though differ in their architecture and presentation, still meet all the broad requirements of digital libraries. As a result, it is difficult to prefer one specific DLS over the other system. Instead of generalizing the suitability, we should emphasise on specific needs of a particular digital library. As explained above, DESIDOC based on its specific requirements, has opted for Dspace as it DLS but Dspace has its own set of advantages and disadvantages. So, some other Information centre may prefer GSDLor EPrints for similar purpose. Therefore, depending upon the specific needs one DLS may be preferred over the other. The selection of the software is normally based upon on the format of data to be uploaded, the way it is to be disseminated, the choice of backend and frontend of the application and time duration for establishing a Digital Library etc.

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