DIGITAL REPOSITORIES – A TOOL FOR EFFECTIVE MANAGEMENT OF INSTITUTIONAL ASSETS

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ABSTRACT
Many activities and processes in universities are presented, accomplished, documented and archived using modern information technologies and tools. Digital repositories are a powerful tool for depositing and storing a digital production created in the educational institutions. The aim of the current work is to analyze the benefits of institutional repositories as a tool for effective management of digital assets in universities. The process of implementation of DSpace repository at Trakia University and issues related to its integration and use are discussed.

Key words: digital repositories, digital assets, DSpace

INTRODUCTION

Information technologies are an undivided part and an environment where different activities are organized by organizations, including universities. As a result, the available information, which is used, requires more efforts for its effective storage and management.

Digital repositories are becoming more and more popular because they facilitate the processes of deposit and storage of digital content. Via them educational institutions and lecturers can share their intellectual production in an environment that provides powerful tools for its management.

The aim of the current work is to analyze the benefits of institutional repositories as a tool for effective storage and management of digital assets in universities. The process of implementation of DSpace repository at Trakia University and issues related to its integration and use are discussed.

NATURE AND CHARACTERISTICS OF DIGITAL REPOSITORIES

Repositories are "collections of digital objects." They are characterized by (1, 2):

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• The architecture of the repository allows management of both content and metadata (data that describes content).

• Repositories provide a minimum set of functionalities: Upload data – digital content and metadata about content, Data Management – various actions within the repository, Storage, Access control, Search, Access to the stored materials to users.

All these features define digital repositories not only as a means of preserving digital materials, but they also provide opportunities and mechanisms for search and retrieval of stored content.

INSTITUTIONAL REPOSITORIES

An institutional repository can be seen as a digital archive of an intellectual production created by the members of the institution (academics, researchers, teachers, students). This intellectual production is a result of the activities organized and conducted by the institution (3).

On the other hand through institutional repositories the organization offers a variety of services for management and dissemination of digital materials to its members (4).

Therefore, the institutional repository is a means for storage, management and dissemination of digital output.

Institutional repositories can store different types of content: scientific articles, research and project results, audio/video content, multimedia presentations, dissertations, student theses and projects, learning materials, etc.

ADVANTAGES OF DIGITAL REPOSITORIES

Digital repositories can support different processes and activities in educational institutions – administrative, research, educational and others.

Users should recognize the profits that can be derived from digital repositories, in order to be motivated to use them and deposit quality materials. Both universities and their members, and users outside the universities can benefit from digital repositories. The advantages of institutional repositories can be summarized as follow (2, 3, 5, 6, 7):

• **Management of the intellectual production.** Repositories support and facilitate the activities of management of production that is created both by lecturers and learners. Management processes can be divided into two main groups:

▪ **storage and archiving of a digital content** – Teachers create intellectual production mainly in two directions – a content related to their research activities and learning materials used in the training process. Digital repositories create conditions all available production of a teacher to be stored in one place and constantly to be enriched. Students' projects, theses and dissertations also belong to the intellectual output of universities. In most cases this output is not visible to a wider audience. Institutional repositories can contribute to solving this problem and to facilitate the visibility and accessibility of students' works.

▪ **management of the deposited content** – software solutions for building digital repositories have powerful tools for management of the stored materials: Description of deposited content with appropriate metadata; Update stored materials; Search and retrieval of repository assets by different criteria; View stored content, Import/Export of deposited content, and more.

• **Visibility of the digital output.** Digital repositories provide new, alternative mechanisms for publication and dissemination of scientific production via Web and new access channels to published materials. This is a prerequisite for widespread distribution of deposited content – familiarization of the results of researchers' work to a large audience, better opportunities for citing and etc. Digital repositories ensure visibility and accessibility of the institutional assets in a regulated way.

▪ **publication of a scientific production** – Traditionally the scientific production is published in conference proceedings, journals, monographs. This model of publication usually requires the payment of fees. Institutional repositories allow the results of lecturers' research work in digital format to become more visible and popular than the paper publications.

▪ **access to a scientific publication** – Sometimes the access to a scientific production is difficult, even almost impossible because not every educational institution can afford subscriptions to many journals. Digital repositories centralize and collect digital content and provide fast, easy and remote access to the stored resources. The results is reducing of access restrictions and defining rules and conditions of access. The open access to a huge amount of information sources (results of research projects, ongoing studies and etc.) may help the rapid development of researches, sharing of experience and knowledge between scientists.

The advantages of digital repositories are not only for teachers and learners. The long term benefit is an improvement of the visibility of the educational institution. Digital repositories are a tool that provides opportunities for promotion of teachers among a wide audience of scientists and researchers, and this leads to raising the prestige and reputation of the educational institution.

CHOOSING A SOFTWARE SOLUTION FOR THE INSTITUTIONAL REPOSITORY

Our main goal is to create an institutional repository to store, manage, and disseminate research output of academic staff and production created by students – essays, projects, undergraduate and graduate thesis and dissertations.

There are various software platforms for creating such a repository. The available software packages for digital repositories are examined and compared in **Table 1** (8, 9, 10, 11, 12).

The main criteria are: Type of software; Supported types of content: documents, images, audio, video, learning objects (LO); Capabilities for management of collections of documents; Supported metadata formats, Multi-language support; Advanced search capability; Browse View Options (by Author, Title, Subject, Year Collection); Syndication; Web 2.0 options (Tagging; Comments; Ratings; Reviews; Bookmarks); Statistical data (Number of publications, Number of downloads of publications, Last deposited, Search Query statistics, Google Analytics support); Integration with e-learning systems.

Table 1. *Comparative analysis of software packages for digital repositories*

Criterion	DSpace	EPrints	Fedora	EQUELLA Repository	Greenstone	IR+
Type of software	Open source	Open source	Open source	Commercial	Open source	Open source
Supported types of content	Yes	LO*	Yes	Yes	Without LO	Without LO
Management of collections of documents	Yes	No	Yes		No	Yes
Supported metadata formats	Dublin Core; Qualified DC; METS; IPTC Exif; MODS; PREMIS	Dublin Core; METS; RDF; TEI CSV; MARC; TEF; ORE; BibTeX; DIDL; MODS; LOM; Refer; и др.	Dublin Core; Qualified DC METS; Any XML metadata format	Dublin Core; Qualified DC; METS; MARC SCORM; LOM	Dublin Core; METS; MARC; EAD	Dublin Core; MARC
Multi-language support	Yes	Yes	-	Yes	Yes	
Advanced search capability	Field-specific	Full-text search Metadata search Field-specific	Field-specific; RDF search (SPARQL) GSearch (fulltext)	Field-specific	Full-text search Metadata field search	Full-text searching Faceted searching and results narrowing
Browse View Options	Yes	Yes **	-	Yes **		Yes**
Syndication	Yes	Yes	-	Yes		Yes
Web 2.0 options	Yes	Yes *	-	Yes	No	Yes ***
Statistical data		Yes *		Yes		Yes
Integration with e-learning systems	Sakai, Drupal, Moodle****	Moodle****	Moodle****	Moodle		
* Additional add-ins, developed by other developers, are required; ** Not all fields are supported; *** Provide tools for Personal Private Workspaces, Portfolio Pages, Contributor Pages **** Working on it.						

The table shows that the software products provide rich opportunities for building a functional repository.

The main criterion we set is our repository to be built via open source software. The advantages of this type of software are incontestable not only because of the price, but they are related to the ability to customize and extend the repository according to the needs and preferences of consumers. Almost all products can be installed under LINUX, UNIX, Mac OS X and Windows, which is also important criterion.

After the comparison of the proposed solutions, our choice is DSpace. DSpace is developed by MIT Libraries and Hewlett-Packard. DSpace is an open source software package. It can be used to build an institutional repository that stores, indexes and distributes intellectual output of educational institutions in digital format with options for customization and expansion.

An additional reason for DSpace choice is the fact that in Bulgaria most universities have institutional repositories built on DSpace – Sofia University, Academy of Economics – Svishtov, Institute of Mathematics and Informatics – Bulgarian Academy of Sciences. There is a large DSpace community in Bulgaria, which helps for further development of the software and rapid solving of problems.

1. INSTALLATION AND CONFIGURATION

The following components are required in order to install and configure DSpace (11):
- Oracle Java JDK 6 or 7
- Apache Maven 2.2.x or higher
- Apache Ant 1.8 or later
- Relational Database: (PostgreSQL or Oracle)
- Servlet Engine (Apache Tomcat 5.5 or later)
- Perl

After installing the package Dspace 3.1 we made the necessary initial configurations, including Bulgarian localization **(Figure 1).** DSpace offers two user interfaces – the first one is based on JavaServer Pages (JSP) technology, and the second one – on the Apache Cocoon framework (XMLUI).

Figure 1. DSpace repository of Trakia University

2. CREATE COMMUNITIES AND COLLECTIONS

The main presentation and grouping of information in the repository reflects the structure of the organization itself. This is done in order to facilitate understanding of the structure of the repository and to improve the processes of navigation within it. **Communities** and sub-communities usually correspond to the administrative units in an educational organization – faculties, departments, colleges,

researcher centers, laboratories, service units, etc.

Communities contain **collections**. Collections can be regarded as a form of clustering content (content that is thematically organized). Collections can be shared among several communities. Each collection may contain sub-collections (11).

Collections contain items that represent the stored information. Items consist of bundles of bitstreams. Bitstreams are streams of bit – files. After installation and configuration of the digital repository of Trakia University, the major communities and collections were created. They can be edited and if it is necessary new ones can be added **(Figure 2)**.
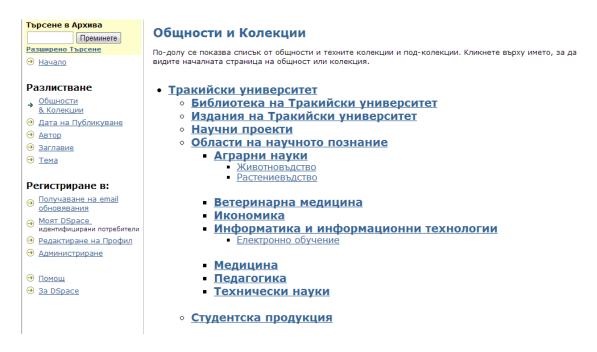

Figure 2. Communities and collections in Trakia University DSpace repository

For each community and collection can be set policy for: access (who can have an access to the community/collection) and actions (activities such as reading, writing, adding, removing items, which can be performed by users).

3. DEPOSITING CONTENT
The process of content submission follows several steps **(Figure 3)**:

• Description of depositing content – whether the content has been published or publicly distributed before, when and where, how to cite; if there is more than one title (whether it is translated in different languages); author, title, language, type of deposited content (animation, article, book or book chapter, dataset or learning object); keywords, abstract, etc.;

• Files upload – there is an option to check whether each file is successfully uploaded by calculating the checksum;

• Distribution license.

DSpace provides transfer of digital content between DSpace and other systems, i.e. import and export of content and metadata (metadata are stored in a XML file).

4. BROWSE AND SEARCH IN REPOSITORY
DSpace users can browse the deposited items by different criteria – Title, Author, Issue Date, Subject (Keywords) **(Figure 4).** Browsing may be limited within certain collections or communities.

DSpace allows adding tools for visualization of attachments, such as Google Docs viewer, FlexPaper Project, JW Player, pdf.js and others. Users are facilitated when they work with attachments, because it is not necessary to have installed a variety of applications for visualization.

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Figure 3. Content submission.

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2010	Webconferencing tools and Moodle	*Kiryakova, Gabriela; Yordanova, Lina*
2010	Using information technologies to carry out formative assessment	*Kiryakova, Gabriela*
2011	System for electronic professional records	*Angelova, Nadezhda; Kiryakova, Gabriela; Yordanova, Lina*
2011	ICT for co-woring with office documents in Economics students' education	*Yordanova, Lina; Angelova, Nadezhda; Kiryakova, Gabriela*
2011	Web 2.0 in business	*Kiryakova, Gabriela; Yordanova, Lina; Angelova, Nadezhda*

Figure 4. Browsing items by Issue Date

Searching in the repository is one of the most important and basic functions. The Search module provides indexing of the new content and search capabilities in collections, communities or in the whole repository. DSpace uses the free high-speed, full-featured text search engine library Lucene.

5. STATISTICAL DATA
DSpace repository can automatically generate statistical data for tracking attendance, in terms of: content (individual items), collections, communities, and the whole system. Statistical reports include: Total visits of the page (community home page, collection home page or item); File Downloads; Top Country Views; Top City Views; Number of performed searches; Most popular searches and more.

PROBLEMS AND ISSUES TO CONSIDER
The main problems and tasks after building an institutional repository are associated with the need to fill the repository with quality materials. Unfortunately, a part of academic staff is not motivated enough to deposit and share their digital production with the rest of the world.

Copyrights may also cause significant problems. It is necessary the educational institution to develop a strategy and policy on these issues.

It is very important to provide opportunities for interaction and integration of digital repositories with other administrative systems, web sites, repositories for learning objects in order to achieve effective management of the available information. Institutional repositories can and should be part of e-learning, which is implemented by the educational organization. Therefore, it is necessary to look for ways to integrate institutional repositories with learning management systems in order to combine the advantages of both types of systems and to improve the efficiency and quality of education.

CONCLUSION
Digital repositories are a means for effective conservation and management of institutional assets in educational institutions. They can serve various activities carried out in universities – administrative, research, educational and others. Institutional repositories can support and be a source of information in the processes of evaluating the academic staff, as well as the accreditation of universities. Digital repositories help scientific achievements of the teaching staff and learners to be disseminated to a wide audience through new channels with high degree of visibility and accessibility. The most measurable result of Trakia University DSpace repository will be improvement of citing of published scientific production in a regulated and modern way. Integration between institutional repositories and other information systems may be a part of the overall solution in terms of information strategy of universities.

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