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OPTIMAL SELECTION OF DIGITAL ASSET MANAGEMENT SYSTEMS IN ACADEMIC LIBRARIES: LEVERAGING ON COVENANT UNIVERSITY MODEL

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ABSTRACT

The use of institutional repository (IR) has gained tremendous acceptance in several Higher Education Institution (HEI) in many countries. However, many HEIs report poor usage and enthusiasm. This paper develops a decision model to assist in characterization and selection of digital repository solutions in academic libraries. Five technologies, namely: Eprints, Dspace, Fedora Repository, Greenstone and SAP Document System explored. Using the model, these were evaluated with respect to installation process, functionality, performance, cost, security, usability, workflow, scalability and interoperability. The model was found to adequately address the critical transparency requirements for due diligence selection process in the establishment of Covenant University Institutional Repository. It is recommended that leveraging on this model would enhance adoption and usage of digital repositories in developing countries.

KEYWORDS

Digital Repository
Content Management
Characterization
Document Management
Emerging Economies

INTRODUCTION

The use of Institutional Repositories (IR) has gained tremendous acceptance in several Higher Education Institutions (HEI) in many countries. (Kyriaki-Manessi, 2013), and (Koulouris, 2013), reported the status in Greece HEI Libraries. These IRs usually contain Faculty's published and unpublished work, students' theses and institutional archival collections. However, many HEIs report poor usage and enthusiasm. Davis, P et.al, (2007), evaluated the reasons for non-use of Cornell University's IR. Some of the reasons for low patronage highlighted include mistrust, mainly deriving from its long periods of understaffing and poor services. Specifically factors such as functionality, performance, cost, security, usability, workflow, scalability and interoperability are mentioned. Several methodologies can be used to identify and categories the factors in selecting IR software to enhance patronage by libraries and users. Nevo, and Chan, (2007), empirically explored the roles and scope of knowledge management systems in organizations. Building on a knowledge-based view of the firm, we hypothesized and empirically tested our belief that more integration is needed between technologies intended to support knowledge and those supporting business operations. Holsapple, and Joshi (2002), identified and characterized a generic set of elemerial knowledge manipulation activities that can be arranged in a variety of patterns within KM episodes. For researchers, it suggests issues that deserve investigation and concepts that must be considered in explorations of KM episodes. For practitioners, the framework provides a perspective on activities that need to be considered in the design, measurement, control, coordination, and support of an organization KM episode.

Public domain IRs such as government creates the following types of documents (Kyriaki-Manessi 2013):

- Documents for the rule of law-legislative records, court records, police and prison records.
- Documents to demonstrate accountability to its citizen, - policy files budget papers, accounting records, procurement records, personnel records, tax records, customs records and electoral registers, property and fixed assets registers.
- Documents to protection entitlements – pension records, social security records, land registration records and birth/death records.
- Documents in providing services for its citizens – hospital records, school records, and environmental protection monitoring records.
- Documents for government's relationship with other countries – foreign relations and international obligations, treaties, correspondence with national and international bodies, loan agreements, etc.

Similarly, a typical public institution of higher learning creates Intellectual Properties (IP) such as students' theses, publications, patents, copyright, inventions, personnel records, physical planning drawings, accounting documents, etc. government documents often present special problems in managing citations. Many government documents, unlike IP in universities, may not have a personal author, or the publication date or title may not be clear. They7 differ widely in purpose, style, and content and the standard style manuals may not give examples for citing all these formats in a consistent fashion.

In emerging economies, these documents are usually shelved but over several years the handling of these will require dedicated staff to manage, with great challenges to the retrieval process. Several issues arise in the efficient management of these ever growing intellectual property and government business documents. For effective digital document management system Stajda (2009), suggested that the following questions must be addressed. They are:

- How do documents fit into the overall business process?
- How do users want to search for documents?

- The need to define lifecycle of documents.
- What is the change control process?
- Is there a formal approval process?
- What are the security requirements?
- What type of application files will be stored?
- How are versions and revisions used in the business?
- Do you need to support searching and maintenance in multiple languages?
- What is the volume and size of documents to be stored?
- Location of creators versus consumers.
- Are there document retention requirements?
- Do documents need to be converted to a neutral format for long term retention?

OBJECTIVES

All of the elements, for effective national development, depend upon an effective document management infrastructure (Kyriaki-Manessi, 2013). Without a document management infrastructure, governments and organizations are incapable of effectively managing current operations, and have no ability to use the experience of the past for guidance. Records are inextricably entwined with increased transparency, accountability and good governance. Lack of good document management system is directly linked to the persistence of corruption and fraud. Expert in financial management and control recognize that well managed record systems are vital to the success of most anti-corruption strategies. Records provide verifiable evidence of fraud and can lead investigators to the root of corruption. Well-managed records can act as a cost effective restraint. On the whole, prevention is much cheaper than prosecution.

In many developing countries, document management problem is a massive one. Existing record keeping systems – if they exist at all – are in adequate and unable to cope with the growing mass of unmanaged papers. Administrators find it ever more difficult to retrieve the information they need to formulate, implement, and monitor policy and to manage key personnel and financial resources.

The World Bank report (Kyriaki-Manessi, 2013) goes on to enumerate the symptoms of poor document management systems as follows:

- Low awareness of the role of records management in supporting organizational efficiency and accountability.
- Absence of legislation to enable modern records management practice.
- Absence of core competencies.
- Overcrowded and unsuitable storage of paper and electronic records.
- Absence of purpose built record centers such as Content and Cache Servers.
- Absence of a dedicated budget for records management.
- Poor security and confidentiality controls.
- Absence of vital records, disaster recovery and preparedness plans.
- Limited capacity to manage electronic records.

This paper develops a decision model to assist in the characterization and selection of digital repository solutions in public institutions. Five technologies, namely: Eprint, Dspace, Fedora repository, Greenstone and SAP DMS, used in the digital asset management are explored, under various conditions and operating environments. Comparison of the features, benefits and advantages of these technologies are evaluated with respect to installation, functionality, performance, cost, security, usability, workflow, scalability and interoperability in the management of public digital assets. There are several publications on developing and

implementing document management system. Stajda (2009) discussed effective document management system using SAP Netweaver technology. Bolu (2010) reported an ongoing implementation case study in a public sector university document digitization of over twelve million pages, highlighting the taxonomy, content management system and the knowledge management implementation using an enterprise content management system. The questions of accessibility implementation for adult and physically challenged citizens are great concern in developing countries. Standards for achieving accessibility through technical specifications and interface design have been established for the conventional Web, however, it remains to be seen how far systems are conforming to these standards for document archival and retrieval (Holsapple and Joshi, 2002).

Borchert, (2005) addressed some critical issues in digital repositories such as multipurpose against specialization, scalability, independence, integration, metadata schema support, bulk data importing, customizable interfaces, copyright management, workflows support, sharing and re-use, permissions, discovery and institutional policy. A World Bank Group (2010) underscored why records management are crucial in the public sector. David, P et.al (2007) evaluated usage of a university institutional use such as redundancy with other modes of disseminating information, the learning curve, confusion with copyright, fear of plagiarism and having one's work scooped, associating one's work with inconsistent quality, and concerns about whether posting a manuscript constitutes ''publishing''.

The benefits of effective document management system cannot be overemphasized. The problem remains how to characterize select cost-effective large scale digital asset management system in the public sector and meeting the transparency criteria in their due diligence selection processes.

METHODOLOGY

Four open source institutional repositories and one proprietary document management software were installed and configured to host and manage digital assets. They were:

- Dspace – A digital repository developed as a joint project of the Massachusetts Institute of Technology (MIT) Libraries and the Hewlett-Packard Company, USA.

- Eprints – The GNU Eprints self-archiving software that has been developed at the Electronics and Computer Science Department of the University of Southampton, Uk.

- Fedora – Fedora (or Flexible Extensible Digital Objective Repository Architecture) is a modular architecture built on the principle that interoperability and extensibility is best achieved by the integration of data, interfaces, and mechanisms (i.e., executable programs) as clearly defined modules.

- Greenstone is a suite of software for building and distributing digital library collections. It provides a new way of organizing information and publishing it on the Internet or on CD-ROM. Greenstone isproduced by the New Zealand Digital Library Project at the University of Waikato, and developed and distributed in cooperation with UNESCO and the Human Info NGO.

- SAP Netweaver – SAP Document Management System developed by SAP AG of Germany. It is proprietary digital asset management software included in the SAP Netweaver technology.

The following activities were carried out:

a. Setting up scanning facility. Training of digitization team on effective scanning skills, '*rasterizingor OCRing'*. Book-marking, creating taxonomy and classification.

b. Developing metrics for evaluation. Simulating infrastructure environment such as power outage, low bandwidth and human errors of poor workforce skills.

c. Creation of Content, Cache and Conversion Servers for the SAP DMS.

d. Uploading of digitized document unto the repository servers.

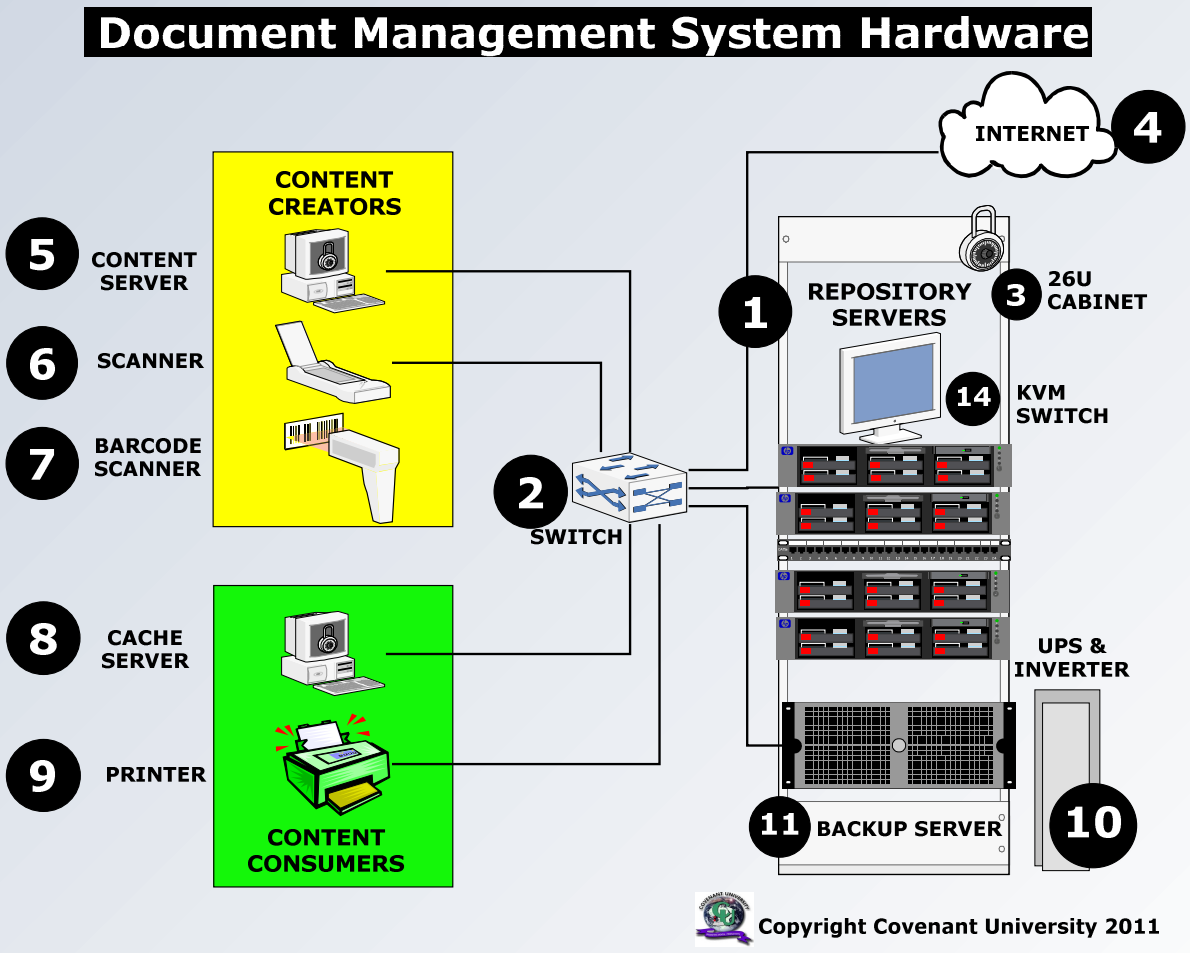
Installation of the following operating systems and institutional repository software are shown in table 1 and the research infrastructure schematics in figure 1.

Table 1: Servers and Operating Systems Installation

Servers	Operating Systems	Repository
Server 1	Ubuntu 10.0	Dspace 1.7.2
		Eprints 3.2.8
		Fedora repository 3.4.2
		Greenstone 2.8.4
Server 2	Fedora 14 (Server Edition)	Dspace 1.7.2
		Eprints 3.2.8
		Fedora repository 3.4.2
		Greenstone 2.8.4
Server 3	Windows Server	Dspace 1.7.2
		Eprints 3.2.8
		Fedora repository 3.4.2
		Greenstone 2.8.4
Server 4	Windows Server 2003, Enterprise Edition	SAP Document Management System
Server 5	SAP Content Server 6.30	
Server 6	SAP Cache server	

3.0 Implementation

3.1 Implementation Layout



Generally, the open source repositories compared favourably with the proprietary SAP DMS. However the best document management system against the requirement of the public sector under consideration is SAP DMS. This is largely due to the security consideration and workflow appropriate to content requirement against lock using the SAP Engineering change Control. Cost and initial cost of hardware and software is a major concern for SAP DMS especially in a developing economy where sustainable funding may not be guaranteed and skills are generally low. For Linux installation, Fedora Repository and Eprints are the easiest to install with SAP requires considerable Experience of the SAP Netweaver, the platform on which SAP Enterprise solutions runs. After SAP DMS, Dspace has the best functionality and performance for document management in the public sector.

Usability, scalability and customization through the application programming interface (API) are about the same for all the repositories other than SAP DMS which is a lot better than the rest. All allow scanning of the metadata field types in the database by simple or advanced search. In terms of interoperability, such as interoperability with e-learning installation such as Moodle, Fedora seems to be the best. All the repositories, except for SAP DMS, are freely distributable and subject to the GNU General Public License. All support the Open Access Initiative.

	The following metrics using the Delphi approach was developed for evaluation **Table 2: Metrics for Institutional repository evaluation for Public Sector Implementation**							
FACTORS		1	2	3	4	5		% Max
1. Installation		Degree	Degree	Degree	Degree	Degree	Weight	(Points)
a	Operatng Systems	160	200	240	280	320	40%	
b	No of Steps	240	300	360	420	480	60%	
	SubTotal	400	500	600	800	800	100%	4%
2. Functions								
a	Core	600	750	900	1,050	1200	60%	
b	Important & Useful	400	500	600	700	800	40%	
	Sub Total	1,000	1,250	1,500	1,750	2,000	100%	10%
3.Performance								
a	Search	500	635	750	875	1000	50%	
b	Discovery	500	625	750	875	1000	50%	
	Sub Total	1,000	1,250	1,500	1,750	2,00	100%	10%
4. Cost								
a	Hardware	600	750	900	1,050	1200	60%	
b	Software	400	500	600	700	800	40%	
	Sub Total	1,000	1,250	1,500	1,750	2,000	100%	10%
5. Security								
a	Permissions	1,050	1,313	1,575	1,838	2,100	70%	
b	Versioning	450	563	675	788	900	30%	
	Sub Total	1,500	1,875	2,250	2,625	3,000	100%	15%
6. Usability / Accessibility								
a	Sharing, Re-Usage	200	250	300	350	400	20%	
b	Metadata	300	375	450	535	600	30%	
c	Content Server	300	375	450	535	600	30%	
d	Cache Server	100	125	150	175	200	10%	
e	Multi-language	100	125	150	175	200	10%	
	Sub Total	1,000	1.25	1,500	1,750	2,000	100%	10%
7. Workflow								
a.	Approval	900	1,125	1	1,575	1,800	60%	
b.	Change Contro;	600	750	900	1,050	1,200	40%	
	Sub Total	1,500	1,875	2,250	2,625	3,000	100%	15%
8. Scalability								
a.	Versatility	500	625	750	875	1,000	50%	
b	Bulk Imports	500	625	750	875	1,000	50%	
	Sub Total	1,000	1,250	1,500	1,750	2,000	100%	10%
9. Application Programming Interface								
a.	Program Language	300	375	450	525	600	50%	

b.	Documentation		300	375	450	525	600	50%	
	Sub Total		600	750	900	1,050	1,200	100%	6%
10. Interoperability									
a.	Integration		700	875	1,050	1,225	1,400	70%	
b.	File Types		300	375	450	525	600	30%	
	Sub Total		1,000	1,250	1,500	1,750	2,000	100%	10%
Total			10,000	12,500	15,000	17,500	20,000		100%

	Results and Discussions The evaluation results are shown in Table 3 for the repositories studied**.**											
	Table 3: Repository evaluation for public Sector use Case.											
FACTORS			Dspace		Eprints		Fedora		Greenstone		SAP DMS	
1. Installation			Rate	Pts.	Rate	Pts.	Rate	Pts.	Rate	Pts.	Rate	Pts.
a	Operating Systems		5	320	5	320	5	320	5	320	4	280
b	No of Steps		3	360	4	420	4	420	5	480	1	240
	SubTotal			**680**		**740**		**740**		**800**		**520**
2. Functions												
a	Core		4	1,050	4	1,050	4	1,050	4	1,050	5	1,200
b	Important & Useful		4	700	3	600	3	600	2	500	5	800
	Sub Total			**1,750**		**1,650**		**1,650**		**1,550**		**2,000**
3.Performance												
a	Search		4	875	3	750	3	750	3	750	5	1,000
b	Discovery		4	875	3	750	3	750	3	750	5	1,000
	Sub Total			**1,750**		**1,500**		**1,500**		**1,500**		**2,000**
4. Cost												
a	Hardware		5	1,200	5	1,200	5	1,200	5	1,200	1	600
b	Software		5	800	5	800	5	800	5	800	1	400
	Sub Total			**2,000**		**2,000**		**2,000**		**2,000**		**1,000**
5. Security												
a	Permissions		3	1,575	3	1,575	3	1,575	3	1,575	5	2,100
b	Versioning		3	675	3	675	3	675	3	675	5	900
	Sub Total			**2,250**		**2,250**		**2,250**		**2,250**		**3,000**
6. Usability / Accessibility												
a	Sharing, Re-Usage		3	300	3	300	3	300	3	300	4	350
b	Metadata		4	525	4	525	4	525	4	525	5	600
c	Content Server		1	300	1	300	1	300	1	300	4	525
d	Cache Server		1	100	1	100	1	100	1	100	4	175
e	Multi-language		3	150	3	150	3	150	3	150	5	200
	Sub Total			**1,375**		**1,375**		**1,375**		**1,375**		**1,850**
7. Workflow												
a.	Approval		2	1,125	2	1,125	2	1,125	2	1,125	5	1,800
b.	Change Contro;		3	900	3	900	3	900	3	900	5	1,200
	Sub Total			**2,025**		**2,025**		**2,025**		**2,025**		**3,000**
8. Scalability												
a.	Versatility		3	750	3	750	3	750	2	500	4	875
b	Bulk Imports		3	750	3	750	3	750	2	500	5	1,000
	Sub Total			**1,500**		**1,500**		**1,500**		**1,000**		**1.875**
9. Application Programming Interface												
a.	Program Language		3	450	3	450	3	450	3	450	2	375

b.	Documentation		3	450	3	450	3	450	3	450	4	525
	Sub Total			**900**		**900**		**900**		**900**		**900**
10. Interoperability												
a.	Integration		4	1,225	3	1050	5	1,400	2	875	1	700
b.	File Types		2	375	4	525	5	600	2	375	5	600
	Sub Total			1,600		1575		2,000		1250		1,300
Total				15,830		15515		15,940		14650		17,445

CONCLUSIONS AND RECOMMENDATIONS

Proper document management requires trained staff, adequate and continuous funding, appropriate environmental conditions and physical security. Appropriate document management structures and governmental legislation and/or regulation are needed. A document management system should have realistic targets and project design. This can be achieved by a scalable, secure DMS implementation.

Computerized systems must be adopted appropriately, with regard for local capacity, with concern for legal requirements for evidence. They must fit the business requirements with adequate disaster recovery plans as well as systems support and upgrades. Sustainable infrastructure capacities such reliable power supply through renewable power sources with adequate technical support is critical for emerging economies. The model discussed above could be useful in the characterization and optimal selection of public sector institutional repository for document management in emerging economies.

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