Organizing Institutional Information with Digital Asset Management System Software

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With digital information increasing exponentially within institutions of all types and sizes, organizing the digital files within many organizations is becoming an increasing problem. Digital Asset Management Systems (DAMS) software can assist institutions with this organizational problem. DAMS have developed and evolved over the past two decades with organizations in a variety of fields implementing numerous DAMS. These DAMS often contain many functions tailored to specific fields. DAMS assist in the input, management and output of digital files for an organization's users, tracking the files and storing metadata about those files, thus turning them into organizational assets. DAMS incorporate a variety of tools for organizing information utilizing metadata schemas, taxonomies and thesauri to assist in the storage and retrieval of the assets. DAMS come in a variety of classes and cost brackets suitable for any organization needing to implement one. Some very basic steps should be taken to select a DAMS appropriate for a given institution. DAMS are an extraordinary asset to any organization with large numbers of digital files, which is increasingly becoming the case with all institutions.

Introduction

The arrival of the information age has brought with it an enormous proliferation in digital files. Numerous institutions, in both the public and private sectors, find themselves with an overwhelming amount of digital data including documents, images, video, illustrations and multimedia presentations. Often these important files reside in a variety of places - in obscure folders on networks and intranets, on archived compact discs and digital video/versatile discs, and on employees local hard drives. As the number and type of digital files proliferates, the task of locating specific files and resources becomes increasingly difficult. The problem becomes even more acute when dealing with non-textual resources, such as images, audio, and video resources, where text-based searches offer few answers. Within a given institution, this organizational chaos decreases effectiveness and employee productivity, as members of the institution constantly search for files and documents utilizing personal face-to-face networks and/or recreate data or media that may already exist within the institution but cannot be located.

In order to handle this problem, numerous institutions in both private industries, such as advertising and broadcasting, as well as in public institutions, such as universities, museums, and libraries, have incorporated Digital Asset Management software systems into their production workflow. Digital Asset Management Systems (DAMS) are software

tools aimed to assist in the "archival, retrieval, tracking, manipulation, re-purposing, interaction with, and transaction of all types of digital media – text documents, illustrations, images, audio, and video files" (Sawarkar, 2001, p.3). The nature and scope of DAMS varies widely, from desktop software built to organize local content, to modularly designed, enterprise-level solutions that utilize relational databases and offer a vast array of industry-specific features. The systems generally incorporate several software options to assist users in organizing information, including tools to keyword search textual resources, to create and populate metadata fields, and to design and populate taxonomies and thesauri, all of which make digital files into searchable and browsable assets for the system's users.

History of DAMS

Digital asset management systems were first developed in the early part of the 1990s by large companies as a way to address their in-house needs to archive, organize and retrieve their growing digital information collections. By the middle of that decade, burgeoning demand for asset management brought enterprise level solutions onto the market, sold and serviced by companies such as IBM and Content Management Systems, aimed largely at handling large numbers of documents. By 2001, there were 98 packages of this variety on the market (Boss, 2009). Since then, both the number and scope of the DAMS available for commercial use has continued to grow.

Digital asset management systems for library use came several years later. In 2002, the OCLC (Online Computer Library Center), in conjunction with several vendors of library software packages, began development of digital asset management systems for libraries. Within the next several years, a handful of packages for libraries entered the market, including ENCompass (made by Endeavor), DigiTool (made by ExLibris) and CONTENTdm (made by the OCLC). Open source tools for library use began appearing around this time as well. DSpace, one of the most popular open source DAMS for digital library use, was developed over two years as a collaborative project by Hewlett-Packard Labs and the Massachusetts Institute of Technology Libraries and was released in November of 2002 (Smith, 2003).

Systems designed for the management of media assets developed concurrently with those for document archiving purposes. One of the first media asset managers was developed in 1993 by a company called Luna Imaging, intended for use in museums to manage collections of pictures, audio, and video (Boss, 2009). One of the more notable DAMS was developed by CNN in 1999, which enabled every department in the company to share the archived content in the system (Song & Wang, 2010).

New DAMS continue to emerge today, while existing packages develop and acquire new features as software companies continue to strive to meet the evolving needs of organizations that rely on digital assets as the foundation of their business practices. In some cases, such as that of DSpace(TM), the development process has taken an interesting turn. The software's release under the BSD open source license has led to a scenario in which development of new features and even of overall architecture decisions is no longer solely driven by its creators at HP and MIT, but has become a collaborative development process involving many of the institutions who have adopted the technology contributing features to the DSpace DAMS as well (Smith, 2003). Given the success of DSpace, one would expect more of these participatory design projects in the DAMS industry, particularly OpenSource DAMS, in the future.

Constituent components of DAMS

Digital Asset Management Systems are a collection of pieces of constituent software that operate together. Each component can be classified into three main categories — Input, Management, and Output (Claman, 2007; Lu & Xiao-shan, 2010; Sawarkar, 2001).

Input software refers to all the tools used in the processes of acquisition of digital assets. These tools vary widely depending on the nature of the DAMS and the industry it is serving. If the assets are not born digital — digital files that have been created digitally as opposed to scanned or digitized from physical sources — these tools can include scanning and optical character recognition packages, tools for audio or video conversion to supported media data types, and tools for metadata entry. For born digital content, input tools exist for the creation and harvesting of metadata — or data about the file as opposed to contained within it — which becomes crucial for classifying and retrieving the content (Lu & Xiao-shan, 2010).

The management category of DAMS functions includes tools for storing, controlling access, and directing the workflow of digital assets. DAMS are typically built on top of some relational database that handles the information about the actual file stored on a networked hard drive usually in the form of a BLOb (Binary Large Object) (Sawarkar, 2001). Many DAMS do not include storage as a feature of their DAMS, but rather the software comprises all the functions for access, including collation, indexing, controlled lists, and search tools. In many cases, tools exist for creating copies of the primary digital assets, such as thumbnails or lower-fidelity video, audio or image files, that can be used for searching, viewing and providing lower quality copies for specific purposes such as in a website. Many systems, like DSpace(TM), include tools for preservation as well, both “bit preservation,” in which efforts are made to keep files exactly as they were when received, and “functional preservation" where efforts are made to keep files in usable formats as paradigms evolve (Smith, 2003).

Tools for securing user log-in, file access control, and rights management also fall under the umbrella of management tools. These features allow DAMS users to have access to only the information they are privileged to, thus allowing greater institutional control over information. Additionally, DAMS packages include tools for collaborative editing of photos, videos or documents and integration with industry standard editing tools for their content types. Most DAMS include tools to track and store versions of a particular digital asset as well. Many DAMS packages also contain workflow management features or have a built-in capacity to integrate with existing workflow management software. Museum Victoria, for instance, utilizes lookat.me(TM) from Media Equation Pty Ltd. as their DAMS, but integrates the system with Serena Business Mashups workflow management software, and the two packages in conjunction give them many novel options for automation (Broomfield, 2009). For example, given a specific preservation and digitization process to be carried out, the workflow management software allows the assignment of personnel, techniques, and equipment to be employed, and the DAMS package automatically incorporates this information into the technical metadata for the newly created object once the process is complete. This flexibility allows institutions to track the progress of their digital assets through specialized members of their organization while seamlessly allowing appropriate

personnel to make key edits and decisions on the assets.

The third and final category of DAMS functionality is output, which typically includes tools integrated into a unified platform for providing delivery of digital assets to the end user. The DAMS output tools generally revolve around a robust web or web-like interface, integrated with a range of tools for viewing digital assets, including document and image viewers, tools for downloading and printing documents, streaming media viewers, and file size and format converters (Lu & Xiao-shan, 2010). Many DAMS packages provide customization tools to the end user depending on the nature of the institutional need, such as web publishing and e-commerce functionality as well. DAMS output functionality varies widely as packages cater to or are developed for different needs.

None of these functionalities, however, work without the adequate descriptions of the files within the DAMS. To adequately utilize a DAMS and turn files into assets, an organization must take the time to exhaustively describe each of their files with metadata to enhance their organizational systems.

The Role of Metadata

Metadata, is regularly defined as "data about data" (Sugimoto et. al., 2002). But for DAMS, metadata is much more than that. It is widely acknowledged to be foundational to their function; that is, without metadata, digital asset management cannot occur. As Tom Bachmann of EAS Planning puts it: "you can digitize your analog content and you can load that into a content management system, but simply *collecting content into one place does not make it into assets.* The value of assets begins with the ability to locate and re-use, to exchange assets and to leverage that content for myriad purposes. And metadata is accomplishing that. So, strong metadata solutions correlate to a more successful and relevant DAM for an organization and from a user perspective." (Moon, 2009, p. 287). In other words, metadata is, in some regard, the element that turns content into assets by allowing the files to be effectively categorized and retrieved to make them useful assets.

Metadata serves a myriad of functions in a DAMS package. Its primary purpose might be considered as providing a means for the location and retrieval of an asset. It also serves to distinguish assets from other, similar ones, for example, through versioning information. And, in many cases, it serves to automate the delivery of an asset to other systems where it is needed, for example to a web content management system (Moon, 2009). In her interview with the *Journal of Digital Asset Management* (2009), Madi Solomon of Pearson PLC discusses what she sees as the maturity model of metadata, specifically as it relates to DAMS. She sees metadata as having grown through five stages:

Level 0 (no metadata) - This stage represents just files with no associated metadata.

Level 1 (attribute metadata) - At this first stage, metadata gives cursory attribute-specific information, such as file size, creation date, and cursory remarks on content.

Level 2 (basic metadata) - This level includes, in addition to level 1 metadata, information on who created a resource, what it is, and how it is used. The descriptive aspects of the metadata reach a level of specificity so that data becomes searchable. Solomon compares this level of maturity to that provided by Google(TM), and states that this level of metadata is a prerequisite for a DAMS to be useful.

Level 3 (IP-profiled metadata) - Metadata at this stage is concerned with describing the

intellectual property rights of an associated object. This metadata is used by rights management software and financial systems.

Level 4 (tranformational metadata) - Solomon characterizes this level of metadata maturity as "metadata and other kinds of rules that facilitate the on-demand transformation of assets and content into more fungible or sellable forms" (2009, p.31). This level of metadata is no longer simply about describing a resource for findability purposes, but is acting as a kind of portal for the data to be accessed and manipulated in novel ways. A good example is Google Earth metadata that can be utilized in conjunction with other data sets in order to achieve geographic-based visualizations of their data.

Level 5 (networked assets metadata) - Solomon describes this final level of metadata as the direction she envisions DAMS metadata heading towards, but not yet having reached. In some sense, this level can be understood as the result of an entire metadata infrastructure becoming transformational — all resources are fluid and can be combined with other resources in order to achieve novel products (2009). Level 5 could otherwise be characterized as the "semantic layer" of digital asset management.

As the higher levels of metadata schemas become implemented in DAMS, the assets become increasingly more useful for institutions as the assets become not only more findable, but also more customized for individual users and integratable with other assets.

As metadata continues to mature, DAMS will continue to add new feature sets to take advantage of the additional varieties of interoperability that the richer metadata makes available. In many respects, metadata use in DAMS is nothing more than a microcosm of metadata use on the Internet as a whole. Although many companies still design and build their own metadata schemas, industries are realizing the benefits of adopting standardized metadata schemata in order to facilitate information sharing between internal organizational departments and other outside organizations. Standardized metadata schemes are particularly useful in non-enterprise settings, such as libraries and archives in public or academic settings, where information sharing is a more common practice (Moon, 2009). In the fields that require bibliographic description, Dublin Core, developed and maintained by the OCLC (Online Computer Library Center), has gained wide acceptance because of its design simplicity and expandability (Sugimoto et. al., 2002). MODS (Metadata Object Description Schema), which is maintained by the Library of Congress and is based on the MARC 21 schema, has however emerged as a competing standard. For describing art and architecture object, the museum and archives community uses the CDWA (Categories for the Description of Works of Art) schema, designed and maintained by the Getty Research Institute. In the audio/visual fields, a combination of MPEG-7 and MPEG-21 has become something of a common standard (Hunter, 2007; Lux et. al., 2004). Although integrating these different schema can be difficult at times, flexible DAMS or DAMS with prepopulated metadata fields based on these schemas can assist institutions in conforming and converting to multiple metadata standards.

Metadata is the key to an effective Digital Asset Management System and DAMS assist users and institutions in conforming to various metadata schemes and standards. As these standards evolve, DAMS will play a crucial role in effectively managing the assets of any organization allowing those assets to be searchable and retrievable for a variety of users.

Search and Retrieval in DAMS

Search and retrieval is an integral part of most DAMS and the tools adopted by many DAMS tend to have much of the same functionality as search tools for the Web. However, many DAMS incorporate slight alterations in their search algorithms in order to meet the needs of their associated asset collections. For example, in enterprise settings, search tools tend to be calibrated to achieve higher precision at the expense of recall, because oftentimes users are looking for a specific asset rather than a cluster of assets around a given search term (Moon, 2009).

Many DAMS typically have feature-rich search systems, in order to tackle different kinds of assets. Institutions with large collections of oral histories and interviews use DAMS systems that contain tools for speech indexing and retrieval. As speech recognition software has improved dramatically within recent years, search algorithms can sometimes successfully extract and index spoken word in noisy environments and without being trained beforehand for specific speakers (Moon, 2009).

Search and retrieval of images is a difficult technical problem. DAMS need descriptive metadata for images and this metadata typically needs to be human-generated, which is a time-consuming and expensive process. However, novel approaches are constantly being developed for making the process easier. For example, tools such as Caliph and Emir take advantage of the MPEG-7 standards to facilitate the generation of semantic metadata about images by presenting a graphical environment in which to represent object-action relations, and then make those objects and actions searchable (Lux et. al., 2004). Additionally, content-based image retrieval algorithms are making progress. IBM's QBIC (Query By Image Content) uses an interface in which a user specifies colors and shapes to find similar images (Hunter, 2003). Across more specific sets of pictures, such as pictures of faces, content-based image retrieval can perform quite well. Some DAMS packages utilize facial recognition software to generate searchable metadata about who is in certain images (Claman, 2007).

Some of the most advanced search systems exist in DAMS targeted toward specific industries, where many of the tools mentioned above are used in conjunction to make assets ever more searchable. Enterprise DAMS packages for video can now detect scene cuts, recognize faces, transcribe and index speech, and even extract information in order to make educated guesses about the time and location of the filming (Claman, 2007; Hunter, 2003). And another emerging trend in DAMS search is federated search, or the ability to search across networks of digital libraries with heterogeneous collections of resources (Hunter, 2003). One package that includes this feature is Metalib, by ExLibris (ExLibris Ltd., 2010).

Searching an organization's digital assets is a critical task for any DAMS. Although browsing can be helpful for less directed information inquiries, search is utilized in more targeted queries. As DAMS search capabilities improve, thanks in part to adequately provided metadata by humans, assets become more accessible. The use of yet another organizational tool in many DAMS can also assist in making an organizations assets ever more retrievable and useful.

Taxonomies and Thesauri

Taxonomies and thesauri are often incorporated into many DAMS, and yet the terms can be widely misused according to many authors (Moon, 2009; Slawsky, 2007). Many DAMS claim to integrate taxonomies

and thesauri but the terms are often misapplied to any system that is used to organize assets. In the library and information sciences, the terms are used much less ambiguously. Most DAMS utilize controlled vocabularies and the range of controlled vocabularies goes from synonym rings, to taxonomies, to thesauri, with each one increasing in specificity over its predecessor. Controlled vocabularies provide a way to organize content for later retrieval and a synonym ring is a group of data elements considered semantically equivalent for information retrieval. A taxonomy is a controlled vocabulary arranged into some kind of hierarchical structure. A thesaurus is a variety of taxonomy that contains additional information on the relationships between its terms, for example, relations of synonymy or associativity (Moon, 2009).

Taxonomies are used by all varieties of DAMS as a method of making digital assets browsable for their end users. In many cases these taxonomies are standardized, as is the case for collections of biological data or books. But for many enterprise systems, the taxonomies take proprietary form. Online retailers, for example, use taxonomies in order to facilitate a potential customer's browsing of their inventory.

Many experts in the field consider an intelligently designed and well-maintained thesaurus to be the most important aspect of a DAMS system. Thesauri provide an interpretive layer between user search terms and the controlled vocabulary used in the metadata, making a system capable of finding results that extend beyond keyword matches to associated terms and data. Thesauri also help the system account for common spelling errors or spelling variants. Especially for DAMS dealing in largely non-textual assets, thesauri make the search process more efficient for the user because a search can be designed to return all results falling under a specific domain. For example, a search for images of "dogs" can include images tagged with specific breeds of dogs even if the word "dog" does not show up explicitly anywhere in the associated metadata (Moon, 2009; Slawsky, 2007).

Additional features of current generation DAMS use taxonomies and thesauri for features beyond simple search and hierarchical browsing. Web 2.0 technologies such as Google's "did you mean" spell correction or Amazon's "other customers who bought this also bought" suggestion box rely on thesauri to aggregate their results (Moon, 2009).

Many DAMS packages, especially those built to deal with image-rich collections such as Artesia DAM and Quark DMS, include thesaurus maintenance functionality allowing DAMS administrators to modify and enhance the system's thesaurus. Separate thesaurus packages also exist that can be integrated into DAMS, such as Multities (http://www.multites.com/) or TermTree (http://www.termtree.com.au/) (Slawsky, 2007).

As taxonomies and thesauri further integrate and incorporate with many DAMS, enhancing search functionalities and extending metadata schemas for better asset management, speculation about the future of digital asset management needs addressing.

Current Research and Future Trends

In the past DAMS packages have largely been designed to function like the Internet in general — institutions provided static content to be viewed by some end user. But as Web 2.0 technologies have emerged on the web, they have trickled into digital asset management practices. Many DAMS now aim to provide environments for collaborative practices between publishers and audiences (Moon, 2009). Developments in DAMS have recently trended towards

systems capable of handling enormous amounts of assets in largely self-managing ways (Swisher, 2007). New systems generate content on the fly using metrics mined from their users in real time. Also, folksonomies are replacing traditionally maintained taxonomies. For example, the BBC implemented a social tagging folksonomy on their website to inform their professionally created taxonomy of new terms to utilize and incorporate (Moon, 2009).

Topic maps and ontologies are also making their way into DAMS packages as semantic metadata becomes more commonplace on the Web, and they are being used in novel ways. One example is the implementation of faceted search, by which large search results are broken down into smaller categories for easier browsing. Another is multimodal search, in which data collected about the searcher is used to make conjectures about the types of information and forms of media likely to satisfy his or her needs (Moon, 2009).

The future development of DAMS will likely continue in new ways as metadata schemes, search, taxonomies and thesauri become more advanced. The growth of digital files and information will also continue unabated and DAMS will become an integral part of organizing any institutions information, while also integrating into other parts of the world's overall networked infrastructure. As the advantages of implementing a DAMS in any organization with digital files should now be clear, it is necessary to discuss the types of DAMS currently on the market and how to select one for any given organization.

Types of DAMS

There are numerous DAMS and even types of DAMS available and one of the first factors an institution might consider in selecting DAMS to test is cost. Fortunately, DAMS come in a variety of cost categories and varied functionality to tailor their use to just about any institution — from sophisticated enterprise level software to more functional open source solutions with a plethora of packages in between.

Enterprise level DAMS generally incorporate massive storage and retrieval capabilities with state-of-the-art functionalities. Enterprise level DAMS range in cost from one hundred-thousand to half a million dollars to start with and are therefore generally found in large corporations with significant resources to implement such systems. Examples of Enterprise level solutions include Open Text's Artesia DAM, Interwoven's MediaBin, EMC's Documentum Digital Asset Manager, ClearStory's Systems' ActiveMedia, North Plains' TeleScope, and IBM's FileNet/Ancept Media Server. Each of these DAMS function within larger enterprise level content management (ECM) frameworks that allow an institution with significant resources and needs manage large amounts of data for intranets, Web, broadcast, and other areas in a modular environment (Regli, 2009).

For institutions and departments with slightly more modest needs and means, Mid-Level DAMS offer excellent functionality for a fraction of the Enterprise level DAMS cost. Mid-Level DAMS start at five thousand dollars and are therefore often found in media and marketing departments within larger institutions or in design agencies. Examples of Mid-Level DAMS include WAVE Corporation's MediaBank, ADAM Software's ADAM, Canto Inc's Cumulus, Widen's Media Collective, MediaBeacon's R3volution Enterprise DAM Suite, and Chuckwalla's Chuckwalla 5.8. Like the Enterprise level DAMS, these Mid-Level DAMS feature many integrations with the graphics products utilized in creative industries, such as the Adobe Suite, but do

not perform as well with assets over two-hundred fifty thousand, as the Enterprise level DAMS do (Regli, 2009).

For institutions whose DAM needs do not include large numbers of video and multimedia files, Lightweight DAMS may assist in asset organization. Lightweight DAMS include Microsoft's Office SharePoint Server, Oracle's Universal Content Management 10gR3, and Day Software's Communique DAM. These DAMS cost much less than those described above but do not possess robust capabilities for heavy use of video and multimedia or integrated functionality with creative products such as the Adobe Suite. They also are not designed to manage large numbers of assets. However, they may be a cost effective alternative for document management or asset management in small companies and possibly in conjunction with some web content management products (Regli, 2009).

Alternatives to traditional pay for product DAMS also exist if an institution has limited resources but great need for a DAMS solution. Open Source DAMS have proliferated in recent years and the variety of Open Source DAMS solutions give non-profit institutions of all kinds a DAMS that can adequately address their organizational asset management needs. Open Source DAMS have a wide variety of functionalities to suit different institutional needs and are also based on a variety of programming language technologies including Java, Python, PHP and ASP.Net. Some of the more popular DAMS written in the Java language include D-Space, Nuxeo and Fedora, while ResourceSpace, FocusOpen and Notre DAM often fill the PHP, ASP.Net and Python markets respectively (Sarwan, 2010). An institution interested in selecting an Open Source DAMS will want to look at both the functionality of the Open Source DAMS as well as the technology the DAMS is based on for integrations with their current information systems.

As institutional budgets will often constrain what level of DAMS an organization can afford, DAMS come in a variety of cost categories that will inevitably narrow the selection pool. A number of other factors will then come into play in an organization's DAMS selection process.

Choosing and Implementing a DAMS

Understanding what the institution needs in a DAMS system is critical in the DAMS selection. An institution with more than a quarter million digital assets would likely look at an Enterprise level DAMS while an institution with serious video needs would have to look at a DAMS with robust video capabilities (Fisher, 1997), both of which would require a larger budget. If the video institution utilizes Avid Editing Systems, then an Avid integrated DAMS will likely be the most comprehensive solution for DAMS needs (Claman, 2007). If the institution is a publishing agency with numerous Quark Xpress and Adobe InDesign documents with a budget too tight for an Enterprise DAMS, a Mid-Level DAM with the integration of these technologies is likely the best solution (Xiaxia et. al, 2008). And likewise, a non-profit institution with a very tight budget should take a serious look at an Open Source DAMS (Kaplan, 2009).

With so many DAMS available, choosing a DAM can be a daunting task for any institution. Once cost has been accounted for within institutional budget constraints, and a class of DAMS has been identified for testing, selecting a DAMS requires a number of steps.

1. The Assessment of Needs vs. Wants - Distinguishing needs and wants in a DAMS is the first step in determining the best solution for an institution. Although Adobe Suite Integration and robust video capabilities might be a nice to have feature,

if the institution's primary function is the cataloging of written texts then the system should focus on the core business (Kaplan, 2009). The main functions of the institution will likely be a determining factor in narrowing the DAMS selection pool.

2. Finding out what similar institutions use - Inquiring of colleagues at institutions of similar size and scope can be vital in selecting a DAMS. Institutions that have already implemented a particular DAMS know its strengths and weaknesses in a given area and can help an institution in a similar field in narrowing the selection pool. Of vital importance in this phase of the process is the identification of similar institutions — a document archive would not want to inquire of a video production house what DAMS they are using for example, nor would a rural public library inquire of the Library of Congress what DAMS they use. Once similar institutions are identified, asking the users of that system can be extraordinarily helpful in the selection process (Kaplan, 2009).

3. Purchasing reports - Reports on various DAMS can be purchased from various groups. These groups often study numerous DAMS implementations extensively and rate the systems in various categories. The reports from at least one organization cost around two thousand dollars, but could be useful in assessing various DAMS, particularly if an institution is looking at expensive Enterprise level systems (Regli, 2009).

4. Knowing the institutional users - The end users of the DAMS should be thought of first and foremost when selecting a DAMS. If the end use of the DAMS is preservation, the majority of end users will be archivists, just as the end users of a DAMS implemented for video production will likely be video editors. These end users must adopt the DAMS and use it comfortably for successful implementation (Kaplan, 2009).

5. The role of user studies - In order to find the best system for any given institution, a user study with end users should be performed on a demonstration version of the DAMS to assess the feasibility of the system in the institutions workflow. These studies will prove invaluable as the end users can give a variety of useful feedback on the system, while also participating in the selection process giving them a sense of influence over the decision. This is important as the end users are, ultimately, the client of the system implementation and must adopt the system for an effective implementation (Kaplan, 2009).

6. Special features - Institutions often have special needs for their DAMS, such as complicated internal workflows or Digital Rights Management (DRM) issues. The feasibility of the DAMS for these features must also be assessed. For example, the Museum Victoria needed to implement complex workflow procedures and this limited their pool of DAMS in the selection process (Broomfield, 2009). Likewise, the Greek Archdiocese needed robust DRM in their DAMS and this limited their selection process as well (Nicolakis et. al., 2003). If the DAMS will be integrated with a Web Content Management System (WCMS), this requirement will also limit the pool of DAMS in the selection process (Swisher, 2007). Further, although most DAMS support popular metadata schemes such as Dublin Core, other DAMS do not have comprehensive standards based metadata integration, and the institution must consider their own metadata needs when selecting a DAMS (Goh et. al., 2006). Some DAMS also offer more extensive offerings for thesauri, ontologies and other tools as well (Moon, 2009). Thus the specific requirements of the DAMS must be developed prior to the selection process.

7. DAMS for specific industries - As well as having special features in certain areas, many DAMS are targeted toward specific industries. In addition to Avid's DAMS (Claman, 2007), Cinebase was an early entry into the video broadcast DAMS market (Fisher, 1997). In the Open Source DAMS market, specific industries often gravitate toward particular DAMS. Museums and archives such as the Tufts University Archive have implemented the Fedora DAMS (Chavez et. al., 2007), while others such as the Museum Victoria have used the look@me DAMS (Broomfield, 2009). Many universities utilize the DSpace DAMS, such as Brandeis University (Kaplan, 2009) and Cambridge University (Tansley et. al., 2005). DSpace has also been utilized in an archive of the Indian Virtual Herbarium (Singh & Sharma, 2009). Governmental entities meanwhile, have been drawn to the flexibility and scalability of the Nuxeo DAMS and its accompanying suite of Content Management tools (Moon, 2010).

8. Don't Underestimate a DAMS Implementation - Selecting a DAMS for an institution is a large undertaking that will require people from a variety of departments and areas of expertise within the organization. Beyond end users, an organization needs to involve the information technology department in the decision. Implementing a DAMS, whether OpenSource or pay for product, is a time intensive and highly technical endeavor that will require the time and expertise of technical leads within an organization (Kaplan, 2009). If no technical lead exists in an organization, many companies exist to set up Open Source and pay for product DAMS. Such implementation services can be rather expensive, and although some DAMS do provide hosted solutions, such as OpenText's Artesia, these solutions will often cost as much as a dedicated salaried employee or an Open Source DAMS implementation service.

If the above steps are considered prior to the purchase and implementation of a DAMS, the DAMS' usefulness in turning an organizations digital files into assets will eventually offset the costs involved in implementation. Users will enjoy quicker access to the assets generated by their colleagues and the organization's information will become far more useful for both employees and customers.

Conclusion

DAMS can assist any organization with their digital organizational needs by helping them turn their files into assets. DAMS manage multiple types of assets, from their input, through their use and to their ultimate output to an end user. The asset can be tracked based on who is editing it, and it can be versioned as changes are made. The asset can also be manipulated and transformed into different states while maintaining the integrity of the original file for preservation. With these capabilities and more, institutions in a plethora of industries — including libraries, museums, archives, media production houses, marketing and publishing agencies, and corporations both large and small — are realizing the usefulness of integrating a DAMS into their organizations.

Although somewhat difficult and costly to implement, DAMS are becoming an essential tool for many institutions in their struggle to organize their digital files and turn them into organizational assets. DAMS come in a variety of cost categories and feature-sets, capable of assisting any organization with their institutional digital organization needs, from a Fortune 500 corporation to a small non-profit. With the incorporation of advanced metadata schemes, new interfaces and automated

capabilities, DAMS are rapidly becoming ever more powerful. DAMS are also developing more advanced search capabilities, Web 2.0 integrations, taxonomies and thesauri, as well as further file editing capabilities and integrations with existing software packages.

With all these features it's easy to see why many organizations are implementing and utilizing DAMS. Undoubtedly, many useful features are sure to come in the following decade, along with rapid price drops in pay for product DAMS due to the increasing use and functionalities contained in Open Source DAMS solutions. Open Source DAMS will also continue to evolve, perhaps even more rapidly as many institutions adopt and contribute to their functionalities. Whichever DAMS an organization chooses and uses to organize its institutional information, whether Enterprise, Open Source or in between, the DAMS are sure to be an integral part of the future organizational structure in many industries. As the world converts its workflow to an all digital environment, the usefulness of DAMS will be realized not only by information organizations, but in virtually all organizations. Thus, it is crucial for individuals in most fields to become familiar with Digital Asset Management Systems.

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