Simplified Management of Complex Digital Archive and Web Presentation Projects

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ABSTRACT

The Allen Memorial Art Museum (AMAM) at Oberlin College is using digital technology to enhance its educational mission: digital archiving and web publishing are being used to vastly increase and enhance the availability of our educational resources. By pursuing the dual goals of presentation and preservation, we are creating a system that will allow unprecedented access to thousands of significant works of art while simultaneously vastly reducing the need for handling and exposure to light of valued, delicate objects. The AMAM, as an academic art museum, recognizes the increasing importance of digital technology for educational and teaching purposes. Demand for access to our collection is increasing, while at the same time staff resources and exhibition space are limited, and concern about collection care is growing; alternative methods are needed to provide access to the museum's collection. The AMAM is building on past accomplishments to explore and use new ideas and information technologies in the service of education and teaching.

KEYWORDS: project management, site design, evaluation, education, digital archives, system integration.

INTRODUCTION

At ICHIM 1997, the AMAM's Jenny Wilker presented a paper titled 'The Electronic Presentation of a Scholarly Collection Catalogue: An Oberlin Case Study.' That paper detailed our work on the creation of a multimedia CD containing many high-resolution images, in depth scholarly essays, audio, video 3D sculptures, as well as online databases of Japanese prints and ancient coins. As these projects evolve into presenting our collection on the world wide web and developing a comprehensive digital archive, many new aspects of project management are emerging that demand not only technical savvy but also careful purpose. As decisions are made that commit enormous human and financial resources to rapidly changing technologies, it is important to assess how our efforts to increase access to our collections are having a positive effect. Are more people viewing and learning more about great art? Are lives enriched because of remote access to the museum's collection? Can educators use our resources to enhance student learning? If so, how can we measure our impact?

This paper will organize the major issues that a museum must address when embarking on digital archiving

and web publishing projects. The AMAM has developed project sub-categories that simplify management of this complex work. Diagrams and concept maps illustrate distinctions and relationships between equipment needs, collection management software, interactive web site design, information architecture and useful evaluation tools. The accompanying web site provides updated material, links and a comprehensive bibliography that will enable attendees to gain further knowledge about each of the elements described in the following sections. (www.oberlin.edu/allenart/projects/ichim01.html)

ABOUT THE COLLECTION

Oberlin College combines a nationally ranked undergraduate college of arts and sciences with a renowned music conservatory. Oberlin's intense engagement with things of an artistic and aesthetic character led to the formation of The Allen Memorial Art Museum in 1917. The AMAM was founded as an academic art museum for the education and enrichment of the students and pedagogical support of the faculty of the college. In forming its collections, Oberlin has placed a strong emphasis on works of art that relate to humanistic education and consequently to the curriculum. The museum ensures proper collection care and management, issues publications about the collection or exhibitions, organizes exhibitions primarily using the permanent collection, organizes interpretative programs, and makes the collection available to scholars, students and faculty. The museum serves the entire college through educational outreach using the collection to enrich the content of courses in both the College of Arts and Sciences and the Conservatory of Music. In addition, the museum has a second educational mission to serve the general public. The AMAM develops exhibitions and programming for an academic audience, and interprets them for a public audience. Gallery tours, lectures, and other programs and activities for adults and children offer to the public the same quality learning experience as those available to Oberlin students. From its inception, the museum has been open and free to the public, which is now defined to include the global public that accesses the museum through the web.

The AMAM provides an unusually distinguished and varied teaching collection. The comprehensive permanent collection of approximately 75% Western and 25% non-Western ranges over the entire history of art, with particular strength in collections of old masters (17th century Dutch and Flemish painting, Old Master prints), western European modernism, modern and contemporary art, and Asian art (notably Japanese ukiyo-e prints). There are representative collections of paintings, sculpture and decorative arts from the 15th through the 20th centuries, ancient and medieval art, and a small number of high quality African and Pre-Columbian artworks. Major holdings include paintings and sculptures by Picasso, Matisse, Cézanne, Rouault, Miro, Sisley and Pissarro. The Old Master print collection includes distinguished works of Dürer, Rembrandt and Goltzius, among others. Particularly pertinent to our role of teaching young adults is the unusually large number of revealing works dating from early in the careers of artists who later developed their work

into significant monuments in the history of art; for example, the collection includes important early works by Domenichino, Cole, Monet, Mondrian, Picasso, Rothko, Warhol, Hesse, and Oldenburg.

As the omnipresent trend toward digitization has encompassed the AMAM, projects have been designed to make the collection available to the widest possible public, first through a multimedia CD titled *Masterworks for Learning* (Wilker), then online databases of Japanese prints and ancient coins, and recently through an interactive website and digital image archive.

GOING DIGITAL: IMPACTS AND CONSEQUENCES

During recent planning for a complete redesign of the AMAM web site a variety of issues were uncovered that broadened the project far beyond mere web site building. Initially, simple questions arose about what types of digital media the museum had that could be re-purposed for the web site. But when discussion turned to the possibilities of making the web site "dynamic and interactive" with "full access to the museum's 12,000 piece collection" it became clear that the scope of the project was growing quickly. If the site is to be dynamic, then how often will the content be updated, and by whom? If it is to be interactive, which museum personnel will do the interacting? If there is to be a digital version of thousands of works of art, how would those images be generated, and where would the hundreds of gigabytes of image data be stored, and on what medium? If the web site were to make this wealth of information available to the world, how would it be organized and managed? Would all the images, even the high-resolution files, be available to everyone, or would access be restricted? This sample of issues makes obvious the amount of change caused by attempts to harness the transformative potential of digital technologies.

It became clear that the web project would in some way involve the collaborative work of the entire museum staff of sixteen persons. In order to accomplish goals without the ability to dedicate an entire team to digital media, very careful project planning was required. To organize the project and integrate the activities of the diverse staff it has been useful to divide the work into discreet yet interrelated chunks. To simplify management, technical diagrams and "concept maps" were developed as visual organizers, and techniques were borrowed from corporate web-management and project-management processes.

For the AMAM's relatively small staff, it was important to commit our resources productively and efficiently. By learning from other institutions' experiences, the AMAM can avoid investing time and money into processes that would lead us to conclusions that others have already reached. So, to quickly increase our awareness and understanding of the issues we had uncovered, and to be sure our efforts produced online resources that would be of greatest value to the widest audience, we joined several related organizations and conducted a thorough review of current museum practices. In this way, we hope to avoid pitfalls already identified and quickly adopt the "best practices" of other successful implementations when appropriate for our own projects.

CATEGORIES OF WORK

Six loose categories have been established to facilitate the digital archive and web presentation work here at the AMAM. While these categories evolved from specific needs here at the AMAM, they are general enough to apply to any similar institution with limited resources and broad goals for web and digitization projects. The first category, project management, actually encompasses the other five categories and serves as an overall organizational process. The categories of work can be described as follows:

- *Project management*, including overall planning and implementation for all aspects of migrating, upgrading, or initiating new digital processes in the museum;
- *Design*, including the "look and feel" of the AMAM's online presence, ease of use, consistency of navigation, branding and functionality available on the web site;
- *Technical infrastructure*, including hardware and software needed to create and maintain an archive and web site, image capture techniques, data storage devices, database techniques, intranet / Internet connectivity, and any "back end" technologies that support the end users;
- *Content management*, including creation, development and organization of web-accessible, digital archive resources and educational materials, as well as metadata standards to increase accessibility of data to diverse end users' systems;
- *Rights and reproductions*, including artists' permissions for web-publication of modern work, user agreements, licensing, intellectual property and copyright issues, and barriers to unauthorized use;
- *Evaluation*, including usability engineering of the web site with behavioral observations; also data-oriented, outcome-based evaluation of educational outreach activities.

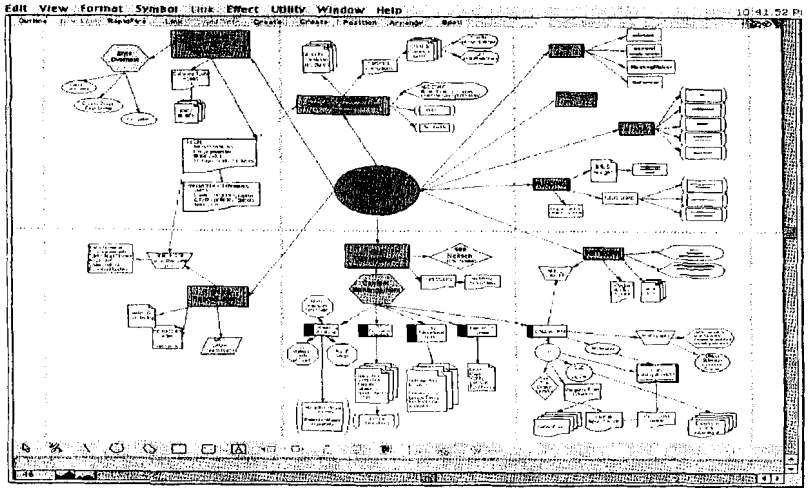

Figure 1: Project planning concept map created with Inspiration© software. Spanning six pages when printed, it provides an easily annotated overview of project scope, timelines, goals and responsibilities.

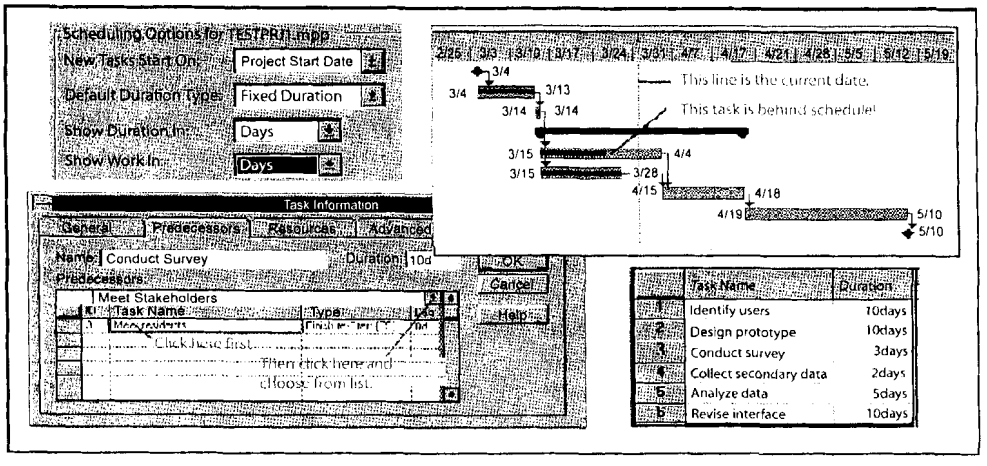

Figure 2: A set of four screen clippings showing the versatile interface of Microsoft Project. A variety of project planning software tools are available (see this paper's accompanying web site). Select this type of software based on your organization's approach, style, and way of working.

Obviously, each of these categories has application beyond museum web sites. Innumerable books on project management, web tutorials on site design, and courses on database development exist to elucidate the finer points of these topics. However, many resources have been developed that are

particularly useful or even specific to the museum and cultural heritage sector. To illustrate how each of these categories provide a structure for museum/web work, and to identify the specific resources for museums and cultural heritage institutions, it is useful to examine examples directly from the AMAM's current activities.

PROJECT MANAGEMENT

"Thou shalt create a picture of thy project schedule." So reads the sixth commandment from TechRepublic's list: *The Ten Commandments of Project Management* (Cavanaugh). For the AMAM this picture has been invaluable in keeping many aspects of complex projects in focus (see figure 1). For this particular "concept map" the AMAM has used inexpensive and easy-to-learn software called Inspiration©. As a diagram of primary project categories, sub-categories and connections between related items, this map is an adaptable way to organize a wide variety of tasks and goals. Project timelines and target dates are included in text boxes and detailed on a separate, single page timeline that omits the graphics of this diagram. Spanning six pages when printed, the concept map is useful to tape to a wall for discussion and markup. As changes are made, pages can be re-printed to replace outdated parts of the taped-up map. For larger, more complex projects, organizations may wish to investigate specialized software such as Microsoft® Project© that provides greater control and more options for managing tasks, costs, resources and interdependent deadlines (see figure 2). A small variety of software exists to meet these needs. Alternatives are Microsoft® Visio© or ConceptDraw© from Computer Systems Odessa®. Diagrams are particularly useful for explaining technical needs to non-technical staff, as well as for content organizers to collaborate on information architecture with web designers.

Prior to the creation of a comprehensive diagram, the AMAM began the planning by conducting structured interviews of the stakeholders. The museum director, curators, educators, the art librarian, preparators, and students were asked a series of questions about what they envisioned for the museum web site. Responses to questions about style, functionality and content were used to generate the initial site design. It quickly became clear that the primary strength of the AMAM web site would be the scholarly presentation of its collection, so this forced certain decisions about site design. Other institutions may find it more productive to focus on other characteristics. Strength may lie in educational strategy, large membership, excellent volunteer staff, or another particular forte. This core competence should be evident in an institution's mission statement, should emerge as a common perspective in preliminary design interviews, and should provide a niche in which to excel. Designing around this core competence will produce a site that communicates an organization's strengths. As the project moves through implementation, the interviews serve as a reminder of the initial goal as inevitable additional features and functions become part of the project. However, once the early phases are complete it is useful to specify a date for "feature freeze," after which only refinements or bug fixes occur. Any new functionality or major changes may

be put off until the next version. A feature freeze date prevents the problem of "scope creep" in which suggestions and new ideas expand a project far beyond its original size, timeline and budget (Doll).

DESIGN

Design is a topic that is likely to elicit more vocal opinions than most other aspects of going digital. Most people are confident about expressing their opinions on the "look and feel" of a web site, and most people have solid ideas about what makes a site easy to use, or not. See this paper's accompanying web site for extensive resources to aid in creation of web pages and navigation schemes. A good place to start is with a list of what *not* to do. Avoiding pitfalls from the beginning can save time and frustration caused by having to re-design a site after many hours of work have gone into a poor design. Jakob Nielsen is a widely respected design and usability expert on the web. Nielsen's *Top Ten Mistakes of Web Management* (Nielsen 1) can be a springboard for careful site design from the start of a project, or a useful lens for examining an existing site. Nielsen distills the major issues of management, interaction and content into straightforward, easy to implement techniques. Some of his minimalist design approaches may be too ascetic for museums with rich visual resources who wish to provide users the option of using bleeding-edge technologies to, say, allow a web visitor to manipulate an ancient Japanese scroll, complete with turning spools and the sounds of rustling rice paper, because that is part of *experiencing* that work of art; nevertheless his strict approach to functional design and quality presentation are excellent guides.

Aspects of site design that a museum or cultural heritage institution should consider include page structure, navigation & site consistency, branding or marketing, and functionality. Developing good **page structure** includes designing for a clear, easy to understand user interface (more on Usability Engineering below in the Evaluation section). Part of the user interface is based on how information is laid out on the page – here any skills in desktop publishing, or visual design in general, will transfer well. Additionally the web enables *hyperlinking* and *non-linear organization and access,* meaning of course that a link may be created allowing a site visitor to jump from anywhere to anywhere else. This ability to link related information should not be underestimated, or feared! In cases where the AMAM has need to compare an online work of art to a work on another organization's web-site, we will provide a link that allows visitors to leave the AMAM site for another. "The *Internet is a net.* Much of its power comes from dissolving the boundaries between hitherto isolated pockets of content. Many of the best hopes for improving the Web bring separately-sourced content together in integrated designs." (Nielsen 2) In other words, people who visit your site will find it most useful if it provides the best access to information related to your organization's primary subject matter, its core competence. Even if some of that information is found via hyperlinks to sites outside your own. This also makes sense in that it is more productive to create original content than to attempt recreation of content

that may already exist, published by another institution.

Clarity of internal **navigation** and some level of **site consistency** are critical if users are to efficiently find things on your site. The AMAM is incorporating site consistency by selective use of standardized page structures for presenting art in a digital catalogue. Use of the web technology cascading style sheets (CSS) will enable page templates to be used as the basis for generating web pages on-the-fly as users query the site. Consistent methods of navigation are used throughout the site, such as:

- anchor links from a navigation bar at the top and bottom of each page to specific sections of text within the page,
- limited use of popup windows for glossary terms, comparative images, or annotations,
- a "drill-down" navigation hierarchy that always shows the visitor their relative location in the site.

Generally, it is a good idea to follow established standards for navigation. Visitors are more able to find what they are looking for if they do not have to decipher some new navigation scheme that looks cool but that may seem arcane to newcomers.

Graphic consistency throughout the AMAM site is intended to enhance **branding** of the AMAM and Oberlin College image. Customized versions of standard logos and symbols appear throughout the site. For example, the OBERLIN logo and the AMAM's symbol of a half-Byzantine, half-Venturi capital are used regularly.

The ways visitors can interact with a site describe the **functionality** that can range from the limited presentation of text and images via HTML pages to incorporation of:

- simple HTML forms that allow visitors to ask questions or provide feedback
- "mail to" links that create an e-mail message to a designated contact person
- moveable 3D objects or animations (i.e. QTVR)
- specialized search interfaces for online databases of images, manuscripts or articles
- newsletters and mailing lists
- guest books and discussion forums
- online courses
- audio and video content
- real time interaction, from artist chats to virtual gallery tours complete with a graphic avatar representing "you" that moves under your control and allows you to chat with other visitors.

For a tremendous example of a single museum implementing several of these technologies see *Toward a Virtual Community* (Gaia) in which the Museo Nazionale della Scienza e Tecnologia of Milan, Italy, presents the results of using Internet communications tools and their significant influence on the museum's relationship with its physical and virtual visitors. Each of these technologies has an impact on design and should be evaluated based on a site's purpose, navigational requirements, possible browser plug-in needs, and the additional maintenance required for each level of functionality that is added to a site's design.

TECHNICAL ISSUES

The behind-the-scenes equipment and networks that support a digital museum can be the most daunting challenges. They require a level of technical sophistication and specific skills beyond the typical experience of the cultural heritage professional. At the AMAM we are fortunate that we can rely on the information technology department at Oberlin College to handle most of the infrastructure for web serving and Internet access. This is a large department, and if we were responsible for this internally, it would require personnel devoted to hardware procurement, support, maintenance and upgrading. Additionally, the production, storage and management of digital information require administrative resources that can easily overwhelm a small staff or modest budget. The AMAM has intensively researched available options and selected technology based on a balance of cost and functionality.

Web Hosting

The most serious option for publishing a web site is to run dedicated computers (web servers) and lease a high-speed connection to the Internet from a telephone company or ISP. Alternatively, a museum may focus on development and design, then contract an outside company to be the "web host" that handles the web server and high-speed Internet connectivity. This is a mid-range alternative that allows a museum to focus on the content while paying others to handle the infrastructure. It still requires the knowledge of how to select a web hosting service, how to design a site to take advantage of technical features offered by the host, and how to design and upload the site to the host, but avoids having to purchase and upgrade most of the equipment. Several guides to choosing a web host are available on this paper's accompanying web site.

While decisions about web hosting and Internet connectivity will depend on the unique conditions at each museum, there are other technical considerations for which international standards are emerging, particularly in the areas of imaging and data management.

Imaging Standards

File types. Determinations regarding data sharing are best made in the context of the widest possible compatibility. A digital collection is most valued when it is accessible to people to whom it is important, and these people may be in any country working on any type of computer. As the AMAM produces digital surrogates for the objects in our collection, we are saving image data in TIFF files (Tagged Image File Format, a bitmap graphics file format that was developed for storing scanned images. It can be used with black and white, gray scale, 8-bit color, and 24-bit color images, and transfers well between different platforms). TIFFs are "non-lossy" and do not degrade data quality over repeated saving (as do JPEG and other "lossy" file types) and can also be compressed and expanded without degradation. It is a common output option on scanners and digital cameras, and can easily be converted to other formats for print or web output. While not the only choice for digital archiving, TIFF is very widely used and viewable with common hardware and software. It is also "non-proprietary" and does not depend on the technical support of a single company.

Image Processing. As images are captured and prepared for saving as archival master files they are put through

a minimal but very significant adjustment procedure. The adjustments are kept minimal to avoid excessive data degradation, yet they are significant in that they vastly improve the quality of the digital image. First the images are cropped and rotated (if necessary) then adjusted for brightness and contrast using the Levels dialog in Adobe Photoshop. A clear description of image adjustment using intensity histograms and color curves in Adobe Photoshop, complete with an arts-oriented technical background, is available in the book *Adobe Photoshop Master Class* (Caponigro). The digital image is color corrected in an attempt to make the data accurately represent the original piece. However, because the color displayed on computers varies with each platform, monitor type, and viewing conditions, it is essential to perform color management *before* any corrections are made to the images. Color management involves many phases: setting the monitor to a specific color temperature and gamma compensation level, adjusting the white point, setting the image processing software to work in a particular color space, embedding a specific color profile to the image data, calibrating a camera or scanner so that what the camera "sees" as black, white, and colors are as close as possible to the way the computer and monitor interpret these values, and eventually viewing the original art under a specific (daylight equivalent) light source and comparing it to the digital image displayed on a carefully calibrated system. Calibration can take many hours, but it can ensure accurate data with only minor recalibration every few months. To learn more about color management refer to the paper "Practical Approach to Color Management" (Long) published in the Fall 2000 MCN Spectra. This entire issue of Spectra is devoted to digital imaging for cultural heritage and contains many valuable articles on this topic. Also refer to the extensive color management resources available from Timo Autiokari at his Accurate Image Manipulation web site and the excellent "Guides to Quality in Visual Resource Imaging" available from the Research Libraries Group (see accompanying web site).

Subsequent to color balancing, the master files are then processed through the relatively simple Unsharp Mask filter in Photoshop. This deceptively named filter actually increases the sharpness of the digital image. This completes the image processing for each file, which is then saved as the digital archive master, which brings us to the topic of data storage.

Data Storage

Our earliest digital photography (1997) with a Fuji DS-300 captured 1280x1000 pixels and produced files around 3MB in size. Our current camera, a Nikon Coolpix 990, captures at 2048x1536 pixels, producing 9MB files. Our next camera will probably capture 8000x10600 pixels in 24bit color to produce 244MB files. Assuming digitization of 8,000 works of art, many with detail shots and QTVR objects, hundreds of gigabytes (possibly terabytes) of data will be generated. Today's desktop hard drives average around 40GB. Certainly even a few hundred GB of data will require some sort of special storage device. While still evaluating equipment solutions, we have determined the relevant questions that will inform our decision. First, we must guess at how frequently the master files will be used, and what is an acceptable speed to access each image. A 244MB TIFF master image will require a computer with hundreds of MB of

memory and a fast processor and graphics card, and probably will be viewed only occasionally – during the initial preparation of derivative JPEG images for the web, during preparation for printing of special bulletins or posters, and by the researcher who wishes to study the highest quality representation of the art without traveling to Oberlin or transporting the art itself. It is probable that the majority of images will be viewed over the web as middle- or high-quality JPEGs. So, the TIFF archive does not necessarily have to be "online" but could be stored offline on CD or "near-line" in a DVD jukebox or tape drive. Second, we must judge the available media and determine which offers the greatest stability. Magnetic tapes are said to deteriorate more quickly than CD or DVD, but CD and DVD also have a limited lifetime. Another option is to use RAID storage (Redundant Array of Independent Disks). A RAID array stacks hard-drives in a computer, replicates data across the drives so that if one drive fails all data is not lost. It can be kept online or nearline, provides more rapid access than a tape drive or CD/DVD jukebox, and is composed of relatively cheap standard components. Speed, affordability, and proven reliability in corporate data warehouses all point to RAID as the current best option for the AMAM. No matter which storage option is chosen, considering the expected evolution of data storage technology, it is advisable that digital archivists plan to *refresh* or transfer image data to some new medium every 3 to 5 years. While some predictions optimistically estimate the lifetime of the standard CD-ROM at 200 years, archivist Howard Besser and historian Stewart Brand present extremely persuasive arguments for regular migration every few years until more stable or self-maintaining methods are developed (see accompanying web site).

CONTENT MANAGEMENT

Arising from the storage of large amounts of data is the issue of how to organize and access the data. Solutions for data management for collections have evolved considerably with developments in networking and interoperability, and the AMAM has decided to implement a comprehensive collections management system.

Collections Management

Early in the planning process it became clear that to operate efficiently the museum needed a centralized system for managing the image archive, the web site data, and the physical collection itself. The AMAM already had a collections management system (the text-based Argus "Classic" running on a UNIX server) but it offered limited access and no support for graphics. The decision to integrate the image archive and web database with an upgraded collections management system (CMS) is an attempt to avoid redundant systems. To keep the image archive separate from the web-sized images, or to keep web-ready data separate from collections management data, would require duplication of information, extra maintenance, and would complicate error- and version-control. Upgrading to an advanced CMS will centralize information and provide greater access to a wider client base. Criteria for selecting the CMS will include the standard capabilities of tracking inventory, acquisitions, loans, rights and reproductions, as well as robust cataloguing capability that allows extensive input of scholarly research, interpretive information, and multiple image versions.

Evaluating and selecting appropriate

collections management software is a process defined by unique institutional needs, but as with other aspects of going digital, tools exist to simplify the job. To access an online course and comprehensive evaluation tools for collections management system selection, subscribe to the Canadian Heritage Information Network (CHIN). The CHIN software review provides in-depth functionality descriptions for 21 different products and information on vendors, training, reliability, customer support and more. As a comparative analysis tool it provides a more thorough review of available products than the AMAM could possibly conduct with our limited resources. In addition, Elizabeth Agro at the Carnegie Museum of Art in Pittsburgh, Pennsylvania USA, developed a similar process. This includes strategies for assembling an evaluation team, interviewing vendors, and a good RFP (Request for Proposals from vendors).

Though the CMS is a central component, it is not expected that it will do everything on its own. The archive of digital images will reside on a different machine than the CMS, the web server will draw data from the CMS to fill in web pages with up-to-date information, and curators will add data to the CMS server with client software as they create new curatorial catalogue information. The CMS will act as an organizational hub to manage the physical collection, the digital surrogates, and the published web content.

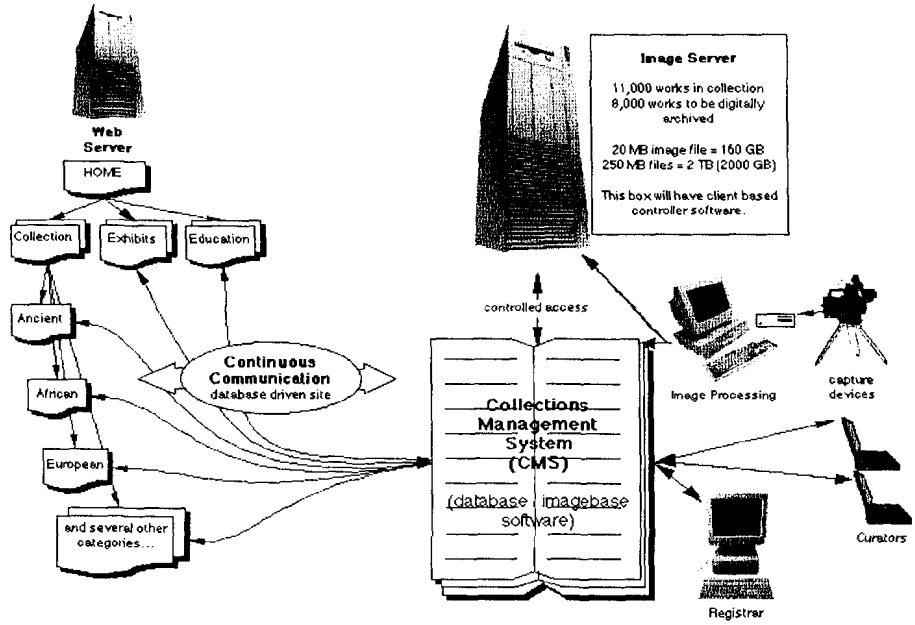

Figure 3: Communication between the web site, CMS, image server, and various museum personnel computers in a dynamic system where updates to the CMS are immediately reflected on the web site and image archives are protected from unauthorized access.

Metadata and Digital Resource Access

Management of digital resources requires data that describes the resources so that they may be searched and accessed effectively. *Metadata* can be defined as the "data about data" that describes the content within digital files, location information for the files, and the technical characteristics of the files themselves. In the interests of keeping data most accessible for the longest foreseeable time the AMAM is following existing and emerging metadata standards, essentially to label data consistently so it is accessible via common searching and indexing tools. The most obvious of these standards is the Dublin Core, which defines a simple set of fifteen descriptive elements, which are in turn described by ten standard attributes. Widely considered a good "basic set" of descriptive elements (title, creator, subject, description, etc) the Dublin Core Metadata Element Set (DCES) is typically built upon with additional detailed elements and data descriptors that fit the unique needs of each archive builder. An art museum, for example, may incorporate the Categories for the Description of Works of Art (CDWA) and Union List of Artist Names (ULAN), both maintained by the J. Paul Getty Trust, or the Core Categories for Visual Resources developed by the Visual Resources Association. What is important about including standardized metadata is that it labels archive contents with relatively consistent terminology. This facilitates finding information without necessarily requiring full knowledge of the information's existence or characteristics.

Additionally, promising developments are seen in the work of the Open Archives Initiative (OAI). A coalition of diverse constituents, OAI is working toward establishing interoperability standards that will further promote efficient dissemination of all types of content. John Perkins from the CIMI Consortium explains "the OAI technical framework describes how *repositories* of metadata about information resources are constructed... A repository makes available via a simple protocol *records* that contain metadata about its items (content). A repository may, optionally, organize its items into sets corresponding to its collections or other groups, thus allowing clients to harvest metadata records selectively. A *record* is an XML encoded byte-stream that serves as a packaging mechanism for harvested metadata. The OAI protocol mandates the use of unqualified Dublin Core as the common record for discovery. (Dublin Core 2001) It also allows community-specific metadata sets described by XML SCHEMAS for more detailed description based on the assertion that both simple metadata for interoperability and cross-domain discovery as well as a method for conveying richer community-specific descriptions are needed." (Perkins). The OAI framework integrates a previously accepted standard (Dublin Core), adds a container-style layer based on common technologies (XML, JAVA, CGI, etc.) and adapts to meet unique archive needs via "extension packages" of community-specific vocabularies. The OAI framework will likely develop into a versatile, customizable tool for publishing archives and online databases to make them vastly more accessible and cross-searchable on the Internet. Consistent use of such a standard for metadata construction will ensure the widest data availability for the longest possible time.

Content Generation

Though the staff at the AMAM is small, most of the staff will contribute to content generation for the web site and digital archive. The Assistant to the Director will prepare general information and news items. The Curators will prepare additional catalog information to elucidate the art content. The Curator of Education will develop age-appropriate versions of the curatorial catalog for two or three levels of primary and secondary school students, as well as lessons and activities for use by schoolteachers. The Curator of Academic Programs will develop links between the collection and specific curricula in other college departments. Images of art works will be captured by professional and student photographers, and prepared for the archive and web site by student image processing assistants. The Web Site Manager will prepare graphics, navigational elements, captions and general information. Content development will be an ongoing, collaborative process between the above mentioned museum staff and other partners from within and beyond Oberlin College.

RIGHTS AND REPRODUCTIONS

There has been tremendous controversy about copyright, intellectual property and fair use since the proliferation of digital technology and computer networks. Technologies to protect published digital media from unauthorized duplication are numerous and varied, some are public and some are proprietary, most are easily cracked. Laws about these issues are in constant flux and still open enough to interpretation so that court decisions frequently alter the landscape. Large corporations amass the rights to millions of works while collection digitization generates hundreds of thousands more. Some institutions are publishing everything for free while others strive to invent business models that generate profit from digital media distribution. As a not-for-profit organization the main priority for the AMAM is not revenue generation but content distribution. As of this writing, the AMAM is planning free access of medium quality JPEG images and the full curatorial catalog. Images of moderate resolution typical of web publication do not lend themselves to the types of reproduction that a pirate could easily profit from. That is, they cannot be used to produce large, high quality printed products. Knowing that no current technology will perfectly protect the content we wish to publish, we will use the following methods for the images to which we hold copyrights.

User agreements. To access high-resolution images a web site visitor will have to accept a "click-through" license or agreement of a type that precedent has shown to be legally binding. These are commonly seen in electronic download commerce and do not present a significant obstacle to access, but do provide some measure of accountability to use the images only in authorized ways.

Digital watermarking. All images will be encoded with an invisible "digital watermark" using technology from Digimarc. This technology embeds copyright and contact information into the pixels of the image. This information becomes available to potential users of our images and enables our images to be identified remotely by the Digimarc tracking service if they are reproduced on other websites. The watermark is invisible to the human eye and durable enough to withstand some level of image

processing, conversion and compression. However, an image pirate would not be significantly hindered from removing the watermark with a little persistence, so this is not considered a foolproof safeguard.

Download locking. To reduce the likelihood that images from our web site will be downloaded without permission, the AMAM may implement a JavaScript element that disables the "save to disk" function of most web browsers, but even this can be circumvented by disabling JavaScript in the browser or taking a screen shot with the browser window open. Technologies from Internet Expressions (SafeMedia) and Artistscope (Secure Image Pro) offer more protection, but may require a web site visitor to have an additional browser plug-in in order to view the images. Unfortunately, the extra step of downloading and installing this extra component will discourage a large percentage of web users from using a site any further.

EVALUATION

Evaluation should be conducted at numerous levels to analyze the technical developments of museum digitization and the effects of online educational material. The many aspects of going digital each require a specific kind of analysis or evaluation strategy. Evaluating the clarity of a web site's navigational scheme is far different than evaluating the usefulness of an online activity for student learning. The AMAM is utilizing a spectrum of evaluation tools and techniques to generate quantitative data and anecdotal evidence that will help to guide the development of our digital resources.

Usability Engineering

There are many guidelines for designing and testing web sites. Good design will ensure that people can use a site easily - a critical characteristic considering the impatience of web users and their tendency to just "go somewhere else" when a site is not immediately understandable. During design, a web site should be tested with a group of end users who are *not* involved with the design of the site. This "outsider perspective" can expose problems with the interface that can be corrected early. Solving design problems early in the process can save time and effort (and money) before they are invested in creation of an interface that seems perfectly clear to the "insiders" who already know the site purpose and content. That is, expertise and familiarity can blind you to the likely perceptions of an outsider. The biggest single advantage is that a usability study gives you feedback from the point of view of the user (Kirakowski). Also try heuristic evaluation as another cheap usability engineering method for quick and easy evaluation of a user interface design (Nielsen 3).

Traffic Analysis

Once a collection web site, online archive or educational web site is published, analyzing site traffic is key to understanding whom is visiting and what they want from your organization. Traffic analysis tools are available that perform a wide range of functions. In addition to the basic data on the number of "hits" to a home page, designers can collect information about what key words were entered in a search engine to bring users to the site, how much time visitors spend on a given page, where visitors com from, and where visitors went afterwards. Knowing this type of information helps to determine the best way to improve a site. The technology research group Gartner Research describes it well: "Being able to track

visitors and site usage allows organizations to attract new visitors, retain repeat visitors...and to provide users with the best possible experience while visiting the site." The Gartner document "Web Site Traffic Analysis: Perspective" is a solid introduction to methods and software available to perform this task (Shaw/Nutter).

Outcome Based Evaluation

For organizations that have a mission to provide quality educational content that has some positive effect on people's understanding or appreciation of art and culture, traffic analysis is probably not enough. Increasingly, funding providers are requiring a higher level of accountability to show measurable results and positive impact on the end users of technology upgrades. In the USA, many federal grants are awarded only with a commitment to perform outcome based evaluation (OBE). This complex process requires careful definition of what exactly are the expected outcomes of a technology-based initiative. It is no longer enough to say that there is more content online that is viewed by more people. Additionally, organizations are being asked to demonstrate how technology can improve student learning, or make some general improvement in the life condition of the end users. To this end, there are few proven tools or methods of measurement. Many institutions are developing web-based materials for teachers to integrate into their classroom activities, but unless the teacher reports the results, it is not clear what impact, if any, the materials are having on the quality of teaching and learning.

Pre- and post-visit evaluations. We are working with college faculty and regional teachers to develop educational materials that fit identified needs in a wide variety of curricula. Lessons and activities will be evaluated by a series of pre- and post-visit analyses. *Pre-visit materials* will provide an orientation to a particular aspect of the museum while collecting information about the users familiarity or knowledge. *Post-visit materials* will provide follow-up and a sense of "closure" to lessons and activities, and will be designed to collect information about how users familiarity or knowledge has improved as a result of the visit, lesson, or activity. It is important to distinguish between designing for educators to evaluate student knowledge, and designing for the museum to evaluate the quality of its educational materials. These are two entirely different approaches and must be clearly separated to ensure the right kind of data is collected.

Standardized testing. Educational materials developed for the public schools in our region will incorporate specific learning objectives that are part of the state's standardized proficiency tests. While these tests are controversial in their value, method of implementation, and assessment of student ability, they nevertheless provide a guide for identifying specific learning outcomes. These learning outcomes can be isolated and used as indicators of the value of some museum-developed educational material. Collaboration with regional educators who use the AMAM's educational material can provide quantitative data that shows the level of impact our technology-based outreach has on specific areas of student knowledge. Similar data can be collected at the college and university level, but will require the identification of learning outcomes that are not based on state standardized tests.

User surveys. To collect data from general users, the AMAM is developing questionnaires and feedback forms that query site visitors about the perceived value of our web site and online archive. In some cases the online surveys will be based on paper versions used to evaluate exhibitions and educational activities that are held at the physical museum. Usually it is the visitor that has either an exceptionally good or exceptionally bad experience that will voluntarily complete a survey style evaluation form, but we still hope to collect some useful information even from this type of data collection.

None of these evaluation techniques are perfect. They do not take into account varying levels of command of the language, varying amounts of exposure to the subject matter, varying age levels within student groups, or varying levels of teacher experience. Evaluators cannot control many of the variables that factor into student learning or visitor satisfaction. Nevertheless, data can help an organization to improve educational materials and to some extent test and document that improvement.

CONCLUSIONS

Among the numerous issues museums face when integrating digital technology, some have reached a point where standard practices can be followed. For web design and digital archiving, standards and best practices exist that should allow rapid progress in the planning and implementation of projects. Still, issues around intellectual property, copyright, data accessibility and outcome evaluation remain variable as the transition to digital media continues. Despite the rapidly changing landscape and constant technological development, it is possible for a small cultural heritage institution to embark on ambitious digitization and web presentation projects with considerable success. Much of the territory has been explored and many resources are available to guide a dedicated group in the preservation and presentation of collections at a level barely imagined just a few years ago. The AMAM will continue to aggregate the best tools developed by our peer institutions around the world, and we hope to pioneer new methods of educational outreach that can be proven to justify the technological investments we are making. As digital archiving and web presentation mature over the coming years, we will strive to make our research and activities available so that others can learn from our best practices. For each program, measurable outcomes will become the tools for reporting the kinds of differences museums make among our users, and will help to identify successes and communicate our value to a wide range of supporters. Look to the AMAM web site for further information that promotes ongoing funding, support and collaboration.

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