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Knowledge Management Systems in Museums: the Next Generation for Assimilating Museum Information Resources in an Electronic Environment

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The Next Generation for Assimilating Museum Information Resources In an Electronic Environment

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Abstract

This thesis focuses on knowledge management practices, tools, and systems and how it can play a vital role for managing collections in museums. The purpose of knowledge management would be to control information across disparate collections and departments within museums. The process of gathering, collecting and storing various data will help institutions achieve cost-effective solutions for a successful information management system.

Implementing the concept and applications of knowledge management would create a culture that would encourage knowledge sharing among curators, registrars, directors of development and exhibition designers, to name a few. Further, it would establish museum-wide shared resources that would be available in one relational database for all to access, navigate, and contribute. However, facilitating this new museological concept presents many challenges and barriers. Advancements are being made through the development of knowledge tools, standards and other forms of technology. Overall, knowledge management would be beneficial in supporting the integration of museum informational resources (i.e. exhibition catalogs, press releases, memberships) in an electronic environment.

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Section1: Introduction

The International Council of Museums (ICOM) defines a museum as a "non-profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment."[1] These days, museums have to adapt to the ever-changing technological environments that surround them, especially in times of global knowledge and information. The creation of digital objects and archives, the advancements of computer software and hardware, and the presence of the World Wide Web and virtual visitors all contribute to changing expectations of museums. Museums, in essence, have now become knowledge systems, where vast amounts of information are stored. The knowledge contained within and between the various departments of a museum must be captured into the institution's memory, if it is to be managed and shared for the prosperity of the museum.[2]

Now, imagine visitors or employees of a museum putting their fingers on all of the information about a specific object or topic regardless of whether it was drawn from the collections department, the exhibition catalog, the archival collection, or another database in a curatorial department. Or picture a museum constructing an integrated information system where all of its resources are available from one single source instead of different informational databases. The goal of knowledge and information

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[1] International Council of Museums (ICOM), "Code of Ethics for Museums," 2001.

[2] Beastall, Graham. "Records management meets knowledge gathering." Records Management Journal, v. 9, no. 2, August 1998, p. 89.

management within a museum is just that—"to focus on creating a bridge from guided Web exhibits to unguided knowledge discovery through the construction of information systems that hold cultural heritage content."[3] Museums do not simply hold and display objects but they also maintain collections of objects that have complex interrelationships among each other and associations with people, places, movements, and events. Knowledge management would play a critical role in documenting and maintaining those relationships, as well as in indicating the authenticity, the structural and procedural integrity, and the degree of completeness of information objects.

Some museums are in the process of standardizing and constructing information systems, while other museums have launched strategies to realize the goal of knowledge management within their institutions. This thesis will examine the growing recognition of knowledge management and its importance for managing collections in museums. The paper will also discuss the need for instituting an integrated system to control information across disparate collections and departments within museums and cultural institutions. Building upon information architecture, the practice of designing and organizing the infrastructure of navigation systems, the knowledge management process will help museums find and manage information more successfully and achieve cost-effective, scalable solutions. Drawing upon case studies and research reports, findings presented suggest that the success of such practices will depend on the extent of technology applications, workflow management, budgets, and knowledge sharing and communication.

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[3] "Building Integrated Museum Information Retrieval System," *Museums and the Web 97: Selected Papers*. Pittsburgh, PA: Archives& Museum Informatics, p. 207.

Author's note: Because knowledge management is a fairly new practice in museums, most research findings, approaches, practical examples, and conclusions for my thesis paper were taken from large, for-profit corporations where the idea and practice of knowledge management is most commonly used and implemented. Therefore, my research lacks current practical survey data and other statistical evidence. Based on my research, very few museums have actually approached this new museological method.

The Value of Knowledge Management in Museums

Marc Pachter, of the National Portrait Gallery, stated the following, "...the origins of the museum as we know it to be based on two basic premises: one is the increasing notion of democracy and collections and the second is the whole question itself of information and knowledge and how museums deliver, or have that responsibility, and sometimes deliver it."[4] In other words, what Mr. Pachter is saying is that museums provide access to its collections for the public to view. The purpose of museums is to engage the public to see all the benefits and resources that they can offer. Museums offer a wealth of information and knowledge to society. Mr. Pachter continued to say, "These days if we speak of information of any sort we don't speak principally of museums as sources for it. They are necessary extensions of the urge for information but it is the electronic world that has given us vast amounts of information beyond our wildest dreams, occasionally information transferred into its next stage of knowledge but at least available to us in so many ways."[5]

Museums need to be more and more conscious of their functions and purposes to the public, not only of their objects and how they are placed, but also in the presentation of those objects and the physical spaces in which they exist. Like the guiding principles of the 16th and 17th century kunst and wunderkammers (wonder cabinets), modern museums strive to create a "sumptuous display of the heterogeneous and wide range of

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[4] Pachter, Mark. "Why Museums Matter." Common Threads MDA Conference 2002.

[5] Ibid.

contents," rather than merely create a conglomeration of objects.[6] That is why the knowledge domain has become increasingly valuable for museums.

The contemporary museum has evolved into a dynamic cross-disciplinary organization that pools its resources, developments, and services between individual users, museums, and other organizations. Museums have entered the networked environment, but at times act as stand alone entities reflecting their status as centers of exclusivity. With this mentality, museums risk excluding themselves from contributing to the networked environment that supports the establishment of multiple institutions working together and sharing knowledge. Integrating informational resources essentially benefits the museum community, the public and researchers as seen in Figure 1.

Figure 1: Knowledge environment in a museum[7]

This new museological concept of knowledge management supports the integration of museum information resources in an electronic environment. It seeks to use the museum information base as the full complex of data supporting institutional activities ranging from the pragmatics of acquisition to the abstraction of interpretive

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[6] Kenderline, Sarah. "Inside the Meta-Center: A Cabinet of Wonder." Pittsburgh, PA: Archives & Museum Informatics, Museums and the Web, 1999.

[7] Huber, Leonard. "Application Areas of Knowledge Management Instruments in Museums." http://www.digiart.at/huber/museum-km.pdf

display.[8] The idea is to de-centralize collections, records and other information in a museum and establish a series of relationships among multiple informational resources. As described by Neimanis and Geber,

> This would involve managing the process of communication or relationships among the components and constantly re-building the network of communications. It is ultimately linked to a group of resources, in close and continuous communication, and it classifies the similarities and differences among them. Thus...it has the potential to build up a more complete knowledge of the information environment.[9]

Although there are still many challenges facing the facilitation of knowledge management in museums, advancements are being made through the development of standards, software applications and knowledge tools, such as the *Art & Architecture Thesaurus*. Created by the Getty Institute, *The Art & Architecture Thesaurus*, which will be further explored in Section IV, is a structured vocabulary thesaurus mainly used for data standards in cataloging and other documents. It is important that museums work together to ensure that these developments lead to a common resource-sharing tool. Museums can collectively promote and enhance interpretations of collections by facilitating cross-disciplines and cross-references that will generate the success of knowledge management in their institutions.

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[8]Ibid, p. 3.

[9]Neimanis K., and Geber, E. "Seek and You Shall Find." Pittsburgh, PA: Archives & Museum Informatics, Museums & the Web Proceedings, 1998.

Case Study: The Dallas Art Museum

The Dallas Art Museum is an example of a large museum that is dedicated in implementing a knowledge management system and/or solution in its organization. In October 2003, the museum hired eForce and Stellent, Inc., two companies that are providers of knowledge management solutions. Together, the companies will manage the museum's Web site and in-house software applications that are critical for business operations and collections management. The companies are currently devising a single product architecture that is designed to offer Web content management, document management, collaboration, records management, and digital asset management functionalities.[10] The new system would give internal users and museum staff immediate access to up-to-date content from a variety of resources. It would also increase the functionality of services offered to museum patrons and the general public through its Web site, www.DallasMuseumofArt.org.[11]

It is expected that the system created by Stellent and eForce would permit the Dallas Art Museum to offer an array of content contribution and content delivery mechanisms. Because of its flexibility, the system would essentially enable users to contribute content into the system for conversion, management, and delivery to Web sites or applications. Bob Robertson, chief financial officer of the Dallas Art Museum, said, "The flexibility of the Stellent content management platform not only meets all of our

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[10] "Stellent Integrates Stellent Content Management with Corel Xmetal; Allies with eFORCE; Signs Dallas Museum of Art as Joint Customer," EContent, Press Release, November 18, 2003.

[11] Ibid.

initial requirements, but will help us easily accommodate future needs of the museum."[12] Other key features of the museum's new system include highly customized advanced collaborative workflows for multiple departments within the museum, Word templates designed to manage the Web content, comprehensive content taxonomy and metadata, and robust security created to manage access control of the content.[13]

The project is in its early phase of knowledge management implementation, but already there are high hopes of it being successful. As noted by Dave Batt from Stellent, "The DAM project is an excellent example of how a world-class organization is utilizing the integrated enterprise content acquisition and sharing capabilities enabled by the Stellent system to achieve its operational goals."

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[12] "Fixed-Price, Fixed-Time Deployment of Stellent System Enables Interdepartmental Collaboration of Web Content Development and Document Management by Dallas Museum of Art," eForceGlobal Press Release, October 31, 2003.

[13] Ibid.

Section II: Defining Information and Knowledge Management in Museums

"An immense and ever-increasing wealth of knowledge is scattered about the world today; knowledge that would probably suffice to solve all the might difficulties of our age, but it is dispersed and unorganized. We need a sort of mental clearing house for the mind: a depot where knowledge and ideas are received, sorted, summarized, digested, clarified and compared."

H.G. Wells, "The Brain Organization of the Modern World," 1940

What is Knowledge Management?

In 1959, Peter Drucker, the father of modern management, stated that the working force needed to pay attention to knowledge work and to the people doing such work. Knowledge, as Drucker pointed out, would be the key to long-term organizational growth and sustainability.[14] It would become a valuable and strategic resource to develop new applications of storing, disseminating, identifying, and indexing information within an organization or institution. Knowledge management, therefore, would be the process through which organizations generate value from their intellectual and knowledge-based assets. Generating value from such assets would involve sharing them among employees, departments and even with other institutions in an effort to devise best practices.[15]

Knowledge is often complex. It is more than simply gathering data and information and transforming that into meaningful contexts. It is a mixture of various elements; it is fluid as well as formally structured; it is intuitive and therefore hard to capture in words or understand completely in logical terms. Knowledge involves "... [a] fluid mix of framed experiences, values, contextual information and, expert insights that

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[14]Davenport, Thomas H. "The Mysterious Art and Science of Knowledge-Worker Performance." Sloan Management Review, Fall 2002, p. 23.

[15] Santosus, Megan and Jon Surmacz. "The ABCs of Knowledge Management." http://www.cio.com/research/knowledge/edit/kmabcs.html

provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of 'knowers.' In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms."[16]

Knowledge management can also be described as activities that are "building databases, measuring intellectual capital, establishing corporate libraries, building Intranets, installing groupware, sharing best practices, leading training programs, leading cultural change, fostering collaboration, creating virtual organizations."[17] Other disciplines and technologies of knowledge management include technical writing, document management, relational databases, object databases, full-text and search retrieval, and support systems. But in order for all of these activities to come to fruition, how do individuals obtain knowledge? Where will knowledge management be most useful? Where and how will individuals find the data in the records? These questions can be answered by understanding the determinants behind knowledge management.

In his book, Working Knowledge, Thomas Davenport states, "Knowledge derives from information as information derives from data." To understand this concept even further, let us take a closer look at the definitions and meanings of data and information.

Data is defined as a set of discrete, objective facts about events.[18] Using this definition within the context of a museum, data can be described as structured records

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[16] Blair, David C. "Knowledge Management: Hype, Hope or Help?" Journal of the American Society for Information Science and Technology, October 2002, p. 1019.

[17] Swartz, Nikki. "The 'Wonder Years' of Knowledge Management." The Information Management Journal, May/June 2003, p.53.

[18] Davenport, Thomas H. and Laurence Prusak. *Working Knowledge*. Boston, MA: Harvard Business School Press, 1998, p. 2.

that are related or associated with one another. Data is usually stored in some form of technology by departments, either in development, collections management or education, for example. Data has typically been managed by individual information systems by separate departments. Until recently, the trend has been for the data to be available on demand from desktops for all to use. An example of this would be having a scholar perform individual searches across all departments in order to research a particular object, rather than search for the data from one location and/or system. Recordkeeping and effective data management is therefore essential to track the thousands of transactions and entries.

Even though data is fundamental in describing an objective fact, it does not, however, provide interpretation. Data says nothing about its own importance or relevance. But data is important to museums because it is vital raw material for the creation of information within a museum.[19]

Information is described as a message that usually is in the form of a document or some form of visible communication. It is a collection of data within a context from which logical patterns or judgments can be deduced. In other words, information is meant to change the way the receiver perceives something, as said by Davenport.[20] The information becomes relevant and purposeful. Yet, it also measures quantity and quality. For example, a quantitative measure of information would be: How many paintings are in a museum's collection? How many exhibits are displayed online? Whereas a qualitative measure of information would be: Does the painting provide new insight

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[19]Ibid, p. 4.

[20] Ibid, p. 3.

about the painter's background? Does multimedia contribute to the learning of an exhibition?

In the world of museums, information can go beyond the definitions mentioned above. Information, therefore, consists of two factors: explicit and tacit information. Explicit information can consist of knowledge that can be documented or archived and can be easily accessible and searchable for the end-user. In other words, explicit information is the data that is typically comprised of some form of a structured record so that it can be disseminated to others. Examples would include reports, databases, search engines or central information system records that play an essential role in providing factual and accurate information. An automated catalog database in a registrar's department of a museum is a clear example where data is efficiently tracked. Data, however, only describes a part of the record entered in the catalog. It provides no judgment or interpretation and no sustainable basis of action, as stated previously.

Tacit knowledge, on the other hand, involves experiences, skills or attitudes produced by an individual, existing within their heads. It is personal, undocumented knowledge that is context-sensitive, dynamically created and derived.[21] Tacit knowledge often resides in human minds and is based on the experience of the information holder.

By capturing both types of knowledge, a museum will be able to create, capture and re-use knowledge to achieve its institutional objectives. Sharing knowledge could eventually lead to more knowledge creation. It could, in essence, change the way one perceives something. The information received through shared experiences or skills

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[21] "Knowledge Management vs. Records Management." Condar Consulting. http://www.condar.ca/CONDAR%20Presentations/KMvsRM.pdf

could shape the person who gets it, to make some difference in that person's outlook or insight. Moreover, the information passed or received would have relevant and purposeful meanings.

All in all, an effective and successful knowledge management system should convene basic principles and challenges. These are:

◘ Establishing a museum-wide, controlled vocabulary	◘ Ability to identify, model and explicitly represent knowledge
◘ Creating a culture that encourages knowledge sharing	◘ Providing structure, guidelines, and consistency throughout all departments of a museum
◘ Managing and allowing for shared resources across the board	◘ Improving efficiency/effectiveness
◘ Decreasing 'reinventing the wheel' notion (i.e., creating and/or duplicating records over and over again)	◘ Integrating informational databases from all museum departments into one relational database
◘ Designing and organizing a navigation system for searching and automating indexes	◘ Optimizing search engines to help users find what they are looking for (this is information architecture)

Why Implement Knowledge Management Within a Museum

Museums generate and hold vast amounts of objects and information associated with the objects or the museum (i.e., membership development, press releases, donors, etc.). They are information factories. There are records, images and many other types of documents related to the objects, to the donors, to the members, to the administration of the institution, to the history of the institution, to the building and to the people who work there. Unfortunately, museum records and documents are viewed as discrete sets of material usually controlled and maintained by those who created them (i.e., curators, registrars).[22]

Traditionally, museums have existed to acquire, preserve, interpret and present works of art. Museums also possess and house more objects that are not presented to the public or displayed in exhibitions. Bernard Reilly of the Chicago Historical Society said,

> Museums customarily make their collections available on a selective basis. These limitations impose a regimen for the selection of works to be displayed and published that involves interpretation and judgment. Art museums and history museums usually present objects in an instructive or narrative framework. In choosing items to be presented under their aegis, museums routinely make decisions regarding the quality and importance of those items.[23]

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[22] "A Model for Museum Management." CIMI Consortium Integrated Information Management Working Group, 1999. http://www.cimi.org/public_docs/IIM_model.doc

[23] *Collections, Content and the Web.* Council of Library and Information Resources, January 2000.

Yet only a few institutions have developed an information system to control and maintain this information being generated or applied. For instance, every time an object is used, more information is generated, either by museum staff or academics researching the object. This includes exhibitions within the museum, educational use, museum web sites, publicity and press activities, answering public inquiries or private research.[24] As stated by Helen Ashby,

> Much of this information is retained in people's heads, some is published, some filed, some thrown away and much simply dies with them. This means that each time the same object is re-displayed or the same theme is revisited the information has to be researched again. Comparatively, little is recorded in information management systems and even less is published online so that others can see it. This is an incredible waste of intellectual effort and financial resource.[25]

However, information and content is often isolated within a departmental area of a museum. In some cases, information is not shared among the various departments. A recent Harris poll found that 60% of employees often found work being duplicated because they were unaware of each other's work. The same poll also showed 39% of employees could not determine which of their colleagues could potentially share

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[24] Ashby, Helen. *A New Spectrum Guide to Managing Knowledge.* http://www.mda.org.uk/200012h.htm

[25] Ibid.

[27] Results of the poll were published in the October 2003 issue of Harvard Business Review.

knowledge. 51% believed wrong decisions were being made because knowledge sharing was not effectively tapped.[27]

Departments within a museum may feel a sense of territoriality whereby they do not want to distribute their knowledge to others, such as researchers or visitors. The museum curator, for instance, acquires works, documents them and presents the finished product in an interpretive setting for the large-scale or broader audience. The information and data that curators usually acquire are for long-term art historical values. That is, curators have a sense to optimize their academic values, as well as to preserve and enhance other values to support and enrich teaching and learning experiences. Yet, despite the technology boom, art professionals sometimes pay little attention in which computer systems or other electronic devices can be made sympathetic to research/curatorial practices.

In the end, the content is presented in the context of an exhibition that is aimed for the larger audience, and in some cases, scholars and researchers. Rarely do curators present the materials on a patron-by patron basis. Curatorial works tend to be maintained and administered for long-term purposes that are overseen by a number of policies and practices. That framework addresses issues of retention, disposal, accessibility, and management of the museum's collection assets.[28] The availability of information could therefore become inaccessible, inflexible, or untimely. The outcome: users would not be to find the information they need; or staff members would not be able to determine where to put new content and when to remove old content, for example on the Internet.

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[28] *Collections, Content and the Web.* Council of Library and Information Resources, January 2000.

Museums need to redefine their standards in delivering, storing, and creating information in order to provide immediate, universal access.

Museums today are no longer institutions that merely store and showcase objects to the public. It has evolved into a service center as well. By that I mean, museums are institutions with various resources on hand ranging from research materials to educational programs to archives. Moreover, individuals with specific skills, abilities and expertise are the defining framework of the data and information collected and housed in these institutions.

By incorporating knowledge management tools and practices, museums could facilitate a system to extract content from the vast amounts of applications and information, as illustrated in Figure 2.

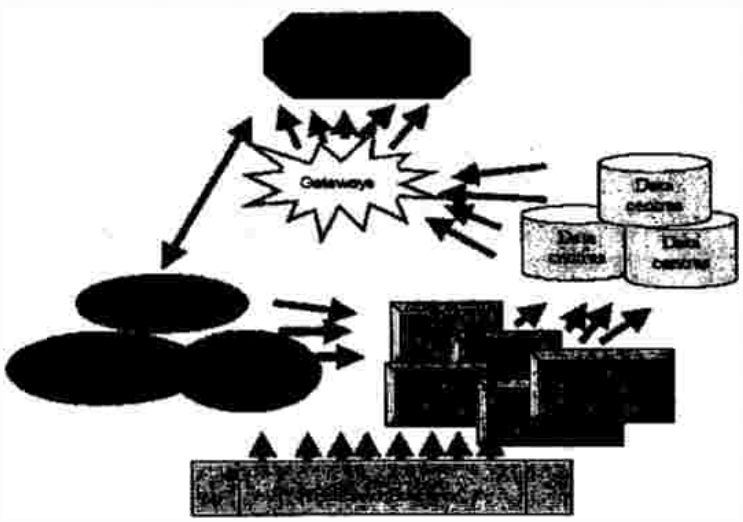

Figure 2: KM Model as presented at the National Museums Directors Conference [29]

[29] "Building the Digital Museum: A National Resource for the Learning Age," National Museums Directors Conference, August 10, 2000. p. 12.

Managing knowledge, therefore, becomes crucial and the shift toward that goal is imperative if museums are to meet information demands in the future.[30]

There are three principle ideas that contribute to the value of museum information. First, even with technology advances made by museums in recent years, results produced from automated systems are modest and sometimes worthless. Yes, improvements and enhancements to computer systems/technologies have contributed to the museum community. For instance, a user can download and view art images in lesser time. Or, the user can utilize the World Wide Web as a resource and finding aid for object information. However, the information that has been automated and provided to internal museum staffs and the general public is often measly. This is because either the content is not enriched or it is not presented in the most effective ways in terms of searching or multimedia interaction.

The second principle idea is to change collections management systems to information or content management systems. Basically, content management systems would be able to store the truly valuable, enriched information that museums produce on a daily basis. Enriched information would include things like multimedia elements (videos, images, graphics) and extensive object sources (object labels, didactic wall panels, research notes, education and interpretive materials).[31]

Third, the emergence of the Internet and the World Wide Web has changed the objectives and expectations of museum systems. Before the evolution of the Internet, registrars, for example, had workstations where the tasks (cataloging, inventory, etc.)

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[30] Sarasan, Lenore and Kevin Donovan. "The Next Step in Museum Automation: Staging Encounters with Remarkable Things." Willoughby Press, 1988, p. 1.

[31] Ibid, p.2

were done internally with the information that was given to them. Now, registrars can turn their attentions to the Internet for more information that would aid them in their research findings.

That is why the data stored in traditional museum systems do not answer questions well new audiences (internal and external) wish to have answered. Lenore Sarasan explains this further by saying,

> The general public wants more than a mug shot with a name, rank and serial number (a.k.a file photo with maker name, description and accession number). And they know from other types of Web sites... that it is possible to get more. If other fields provide context and interrelationships between information on the Web, why don't museums? Museums are massive repositories of complex, interconnected information. Why not store these connections in museum automated systems so that they are available to internal and external users?[32]

Knowledge management systems allow museums to create the interconnections between bits of information that accumulate to form context to an object, as described by Lenore Sarasan. The interconnected data may be stored as a central repository resource where everyone throughout an institution, including public audiences, can tap into. But, how does a museum begin to facilitate knowledge management? What are its

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[32] Ibid, p. 3.

components? Before those questions can be answered, the information repository system of a museum should be briefly explored.

Two-tier System of Museum Collections

Museum collections are generally comprised of a two-tier system—objects and content. Both are interrelated and both serve to facilitate the dissemination of information. Objects store and manage content, whereas content presents descriptive data on the object.

Objects are further divided into two sub categories—one being informative and the other being cognitive. Informative objects are characterized as well-defined contents that do not generally change over time such as pictures, texts and physical structures.[33] Informative objects are easily classified and managed. An example of an informative object would be Van Gogh's *Sunflowers*. The Van Gogh Gallery describes the informative object as:

> *Still Life: Vase with Fifteen Sunflowers*
> Oil on canvas
> 93.0 x 73.0 cm
> Arles, August, 1888
> F 454, JH 1562
> London: National Gallery

Additional information about the artwork could include that the painting was created during the Impressionist period and that it is currently on display at the Vincent Van Gogh Museum in Holland.

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[33] Yeh, Jian-Hya, et.al. "Content and Knowledge Management in a Digital Library and Museum." Journal of the American Society for Information Science and Technology, 2000, p. 371.

Cognitive objects, on the other hand, require a higher level of abstraction whereby the object and its content is defined piece by piece.[34] This typically includes persons, places and events. A cognitive object is a concept described by a collection of related informative objects, and a cognitive object does not have well-defined contents.[35] In other words, the meaning of the cognitive object may change over time. When new information is added to the existing informative object, human interpretation of that object will change.

Using Van Gogh's *Sunflowers* example again, if a curator discovered that the painting was a fake, its entire meaning will change because it has now been associated with that particular attribute and relationship. The attribute associated with the painting could then cause an array of consequences. For example, a great debate has stirred in the art community on whether or not the artwork is indeed authentic. The Van Gogh Gallery asserts that, "most experts, however, have come to the conclusion that the Yasuda work is genuine." Unfortunately, "the arguments about authenticity have detracted from more critical and analytical studies of the work themselves—involved critical commentary of the sunflower series is surprisingly difficult to find."[36] Therefore, the meaning of the object will reflect the prior knowledge and information attained for future learning, decision-making, and interpretation. Why are descriptions and meanings relevant to collections in the context of a museum?

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[34] Ibid, p. 374.

[35] Ibid, p. 374.

[36] Van Gogh Gallery, "Sunflower Series." http://www.vangoghgallery.com/misc/sunflowers.htm

Collection-level Descriptions: Standards & Guidelines

Museums have an array of collections ranging from specimens to unique objects. They also have paper documentation and automated records that are supplemented by related materials and images. But, even within a single museum, the concept of a collection may have different meanings. By definition, a collection may be centered upon a medium or technique, a certain period or group of artists, a subject, or entire collection of a museum.[37]

A museum's collection may also consist of entire holdings or it may be part of similar items within the whole collection. For example, the collection may consist of works of a particular artist, a particular donor, or a particular medium. Presently, museum collections are extending beyond the physical walls of the institutions. Collections are now comprised of virtual exhibitions or online resources. Determining the components and conceptions of such collections becomes fluid. For example, researchers wishing to access information about virtual collections will have a difficult time gathering data due to new language or terminology set forth by computer standards and methods.

That is why collection-level descriptions are important for museums to grasp and incorporate into their knowledge management or content management systems. It is a "resource discovery" of object-level information meaning information and content is held within databases that can potentially be used to produce search results on the Web or a museum's Intranet. The Natural History Museum provides an example of how one

[37] As defined by the ArtLex Lexicon of Visual Art Teminology.

institution proposed to create a single database driven by collection-level descriptions that would be accessible across all departmental areas.

Case Study: The Natural History Museum

The Natural History Museum, located in London, England, is a national museum of nature that maintains and develops collections and uses them to promote discovery, understanding, responsible use and enjoyment of the natural world.[38] In addition to its collections, the museum houses a library, containing nearly one million volumes and over 500,000 artworks, as well as its own archive and collections of electronic images. Like most museums, a small portion of the museum's collections is available on display for the public eye or accessible for research. To overcome this issue, the NHM has devoted itself to implementing a system in which records from collection management systems and research systems are mapped and stored in one separate, publicly available, summary system.

Creating a system of this caliber would involve two main components. They are: 1) collection-level descriptions of each of the museum's collections, whether their records are in electronic form or not. The Encoded Archival Description (EAD)[39] is currently being evaluated for suitability in describing these collections in addition to those in the Museum's Archives; and 2) summary data for items within the collections, harvested from the research or management systems (where these exist) and held in a

[38] The Natural History Museum's mission statement. http://www.nhm.ac.uk/info/index.html -

[39] The EAD is a standard for encoding archival finding aids. The standard is maintained by the Library of Congress in partnership with the Society of American Archivists.

standard format, Dublin Core.[40] Taking a closer look into the museum's current database system will help us understand why the NHM embarked in this project.

As mentioned above, the NHM is comprised not only of collections but also serves as a library, research center and archival institution. Each entity of the museum, along with its corresponding departments, has their own databases and standards for recording and cataloging. If a scholar, for instance, wanted to know about a 'type' of specimen, he/she would have to make inquiries from different systems to retrieve archival data and other information pertinent to the type of specimen in question. As described by Neil Thompson,

> [T]he 'type' is the specimen to which the published name of the species is tied and which serves as a reference standard for a specific taxon: the Museum holds more than one-half of the world's currently existing 'types.' They might discover that we also hold a watercolour painting of the [specimen]; that an example of the species is on public display in the Museum's exhibitions area; and that our Library contains a copy of the published type description. The research process would, therefore, take place in separate systems.[41]

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[40] The Dublin Core Metadata Initiative is an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems.

[41] Thomson, N. "Towards a Whole-Museum Response: Discovering The Natural History Museum's Collections," Cultivate Interactive, issue 2, October 16, 2000. http://www.cultivate-int.org/issue2/natural/

Clearly, one would spend a great deal of time searching through various systems and produce different results. To combat this problem, the Natural History Museum opted to create a new single system that would:

- Provide a whole-museum response to a single enquiry. By mapping just the information likely to be used in an enquiry into a standard metadata format, it becomes rather easier to determine all the information which exists about a particular topic throughout the museum;
- Enable the whole-museum response to form the NHM's piece of a whole-community response with other organizations that use the same international standards in their systems; and
- Provide descriptive information for the non-expert, which points to richer information or hard scientific data, where it is available, to allow the enquirer to go deeper.[42]

The new database would benefit both the museum and users/visitors for two reasons: 1) consistent terminology and 2) collection-level descriptions. Because museum objects are linked to vast amounts of data and information, composing consistent terminology in a knowledge management system would, in turn, generate an accurate and complete retrieval process. The Getty Research Institute produces very helpful and useful thesauri that provide standard terminology associated with all types of museums (i.e., art, natural history). [43]

A collection-level description offers not only standards for records in a database but it also creates narrative descriptions of the objects. Using the Dublin Core and

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[42] Ibid.

Encoded Archival Description, as examples, will help assist and design these descriptions. The descriptions consist of metadata that are extracted from one record entry and re-inserted into the new database system. After the descriptions are entered in the database, the system automatically points to information that is related to that particular object. The end product results in a relational database.

Here is an example of how a relational database could work. Assume a curator at the Natural History Museum types in the name of an artist in the search field of the database. After entering your search term or keyword, a results list is presented on the screen, including the collections-level description. Next, the end user has the option of clicking on one of the records presented. Choosing one of those records shows the record itself (i.e. object information), including the narrative description. In addition, thumbnails of digitized objects are shown that are directly linked to other objects in the collection. Overall, the database is designed to pull data from all sources in the museum, whether it is from the library or the registrar's office.

As you can see, collection-level descriptions would ideally be created to formulate standards, which would be adopted on a global level and across all disciplines. Heather Dunn, of the Canadian Heritage Information Network, says that collection-level descriptions would be dynamically created according to user requirements meaning it would provide semantic links between object and class, and professional and public terminology. Further, developing standards for the creation, processing and encoding of metadata is vital step toward the goal of achieving "cross-domain interoperability."[44] Again, ideally, collection-level descriptions should provide access to both general and

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[43] See earlier definition of the *Art and Architecture Thesaurus*.

specific requests regardless of the knowledge level, discipline, or data requirements of the user. However, there are problematic issues that need to be resolved before this can be accomplished.

Questions of concern include: what terminology should be used to ensure access to both the general user and the specialist? How can terminology in collection-level descriptions be linked with terminology associated with objects? How can the operation process move forward when standards are still in development?

The reality is most museums use specialized terminology to describe their collections and objects, whereas your typical Internet user may use very general terms because he/she has no experience in the subject matter. On the other hand, museums may deploy general terms to satisfy the general user but this can potentially lead to inappropriate search results. Another reason is that there is not one single thesauri or controlled vocabulary that meets the needs of all museums. Many museums do not use standards at all. In this case, the public or researchers will not be able to use specific terminology if it is not in the collection-level description. The user would had to have to known to search for a particular term.

Despite the drawbacks and problems, Heather Dunn explains that there is possible for museums to use their collections databases as a "resource discovery" on the Web. It would be a matter of working backward to retrieve data from the object-level. She says, "If a museum has catalogued its collection using specific terminology, we may be able to run these specific terms through a knowledge tool that would determine the general class to which those objects belong." Unfortunately, more studies need to be done to

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[44] Dunn, Heather. "Collection Level Description-the Museum Perspective." D-Lib Magazine, September 2000, p. 3.

determine if this seems feasible. Although there are many challenges and problems in using collection-level descriptions as a resource discovery on the Internet, advancements and standards are continuously being made to increase the use of knowledge tools in museums.

Making the Knowledge Management Initiative Successful

Most museums have, in my opinion, a conventional attitude when it comes to knowledge development and information access via various technologies. Traditionally, museums preserve artifacts and display objects to the public. "Museums also exist to preserve traditions, and those traditions often include their own time-honored ways of doing what they do," says Anne Stuart. The use of multimedia technologies and other applications offers the opportunity to add new dimensions to traditional museum practice. More importantly, it offers new perspectives for "repurposing" information collected by the museum in a variety of ways.[45] However, the framework of any knowledge management system usually poses challenges and barriers, especially in real world environments.

One of the major problems of the development process of knowledge management in a museum is the lack of information management. According to a survey conducted by the Canadian Heritage Information Network (CHIN), most institutions use computer technology within the collections management area.[46] The survey indicated that there was very little cross-referencing of information among the different departments. A number of museums have collection management systems but rarely are the systems integrated within their organizational policies or educational tools. For example, the registrar's office might hold all of the object files; curators would maintain

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[45] Kavakli, Evangelia. *A Knowledge-Oriented View of Web Technology Adoption in Museums.* Mytilene, Greece: University of Greece.

[46] Results based on Canadian institutions and museums.

scholarly research, exhibition files and related documents; public affairs creates information for publication; and the educators provide the public with many types of learning materials.[47] These records or documents are viewed as discreet sets of material usually controlled and maintained by those who created them.

Although computers are the most commonly devices utilized for attracting, retaining, storing and preserving information in museums, some institutions reported not having computers at all. The CHIN survey also concluded that much of the collection information that was not catalogued in electronic formats, thus posing a problem for knowledge development and sharing.

Of those institutions that did not have computers, a majority showed an increased awareness of the necessity for more training in the use of technology. As cited in the report titled *Building the Digital Museum: A National Resource for the Learning Age*, staff training for use of specific software, and developmental technical skills were two crucial points for museums to build and share knowledge.[49] Skill sets would enable the museum to develop new approaches to maximize learning opportunities as well as disseminate knowledge via learning networks. The report also concluded that proper staff training would add value to the visitor experience by enabling communication amongst users and between users and the museum. Visitors could benefit from a combination of resources such as accessing museum content via an integrated collections

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[47] *A Model for Museum Information Management*. CIMI Consortium Integrated Information Management Working Group, 1999, p. 3.

[49] *Building the Digital Museum: A National Resource for the Learning Age*, National Museums Directors' Conference, August 10, 2000, p.11.

management system. As ideal as that sounds for all museums, not every museum can afford to supply training and/or computer equipment due to lack of funds or budget constraints. The reality is most museums provide few training opportunities in information management and digital technologies, conveying the belief that technology-related issues are institution specific and, therefore, not germane to broader theoretical study.[50]

Another case study conducted by the Consortium Integrated Information Management Working Group stated that many of the collections management systems were designed primarily to serve the needs of registrars. The systems would provide them with data to do their jobs rather than the idea that others might want information delivered as enriched content drawing from multimedia, extensive text resources, publications, or education materials.[51]

Information pertaining to a museum object or project should benefit all of those involved in the process. Stakeholders, researchers, assistants, and others also contribute to the wealth of information from many sources such as multimedia, publications, or research materials. The identification of these details for a specific object ensures accessibility to all those who need to access it. Therefore, the information such as provenance, legal issues, and financial transactions, would not remain static in one location under one department like the registrar's department. The information and other resources can then be managed and recycled. However, until a culture shift occurs within

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[50] Scott, Cynthia. "Museums, Libraries, and Archives: A Summer Institute for Knowledge Sharing." Visual Resources, Vol. XV, p. 78.

[51] "A Model for Museum Management." CIMI Consortium Integrated Information Management Working Group, 1999. http://www.cimi.org/public_docs/IIM_model.doc

the museum (i.e. transforming museum staff into stakeholders), incorporating enriched content and valuable information will be practically non-existent.

Subject knowledge of a particular collection or resource is another challenge for museums to build content for a knowledge system. Most museum professionals, staff, and volunteers are not subject specialists. Identifying keywords, creating categories and summarizing text, both internally and externally, is an important process to enrich content in any museum management system. It can lead to better search and retrieval. Consider the curator who needs to research a painting, the registrar who needs to comb through vertical files for information related to the painting, and the marketing specialist who needs to promote the painting via press releases for an upcoming exhibition. Each of these users requires access to specialized information resources. Without this process, a museum professional's understanding of a collection or a particular object could be minute, and therefore he/she could not contribute to the data input.

Probably the most underlying challenge associated with information and knowledge development in museums is cost. Table 1 provides a detailed look at how much a museum would need to spend for a knowledge-shared system.[52] The museum, in this case, is in the United Kingdom. Currently, it has adopted the concept of an integrated environment that is linked and connected by subjects and themes. Based on the results, the highest cost fell under 'Content & Services' whereas 'Maintenance' costs were much lower.

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[52] Costs are calculated in British pounds

Gateways	Funded elsewhere				
Data centres	Funded elsewhere				
Technical Enablers	1,100	100	100	200	
Content Production	16,000	1,200	750	250	
Collections & Communities	6,100	1,950	4,500	0	
Learning Activities	12,000	7,800	1,200	1,750	

Table 1: *Building the Digital Museum: A National Resource for the Learning Age*, p. 16.

The Kent State University Museum provides another example of a museum where costs to develop and maintain an integrated relational database is a major challenge. As shown in Table 2, the museum needs $275,000 over a five-year period to maintain the database. To keep up with its costs, the museum pursued different funding strategies, grants and donations.

Digital	Library software	$50,000
Hardware	Server, scanner, computer support	$30,000
Personnel	Photography, data entry, scanning, sorting, cataloging	$180,000
Promotion	Web design, collateral material communications	$15,000

Table 2: *Visual Dictionary of Costume*, Kent State University Museum, 2001.

Case Study: When KM Systems Go Wrong

Implementing knowledge management systems has proved successful in major corporations such as IBM and PricewaterhouseCoopers, as well as some well-known museums like the Dallas Art Museum and the Seattle Art Museum. However, research

has also shown that knowledge management systems have been unsuccessful in other cases. Reports suggests that 80% of KM systems failed.[53] Another study illustrated that only 45.4% of the represented companies currently benefit from a successful knowledge management initiative.[54]

Some may assume that a root cause for failure in knowledge management projects is technology. However, in most cases, technology has not been the main reason for failed implementations of knowledge management. As stated earlier in this paper, knowledge management is not solely a technology or application. It consists of multiple technologies supporting the strategic sharing of a corporation's information assets and intellectual properties. Simply put, KM aims to reduce duplication of effort, making existing staff and processes more efficient, and compete more effectively by managing knowledge.

The Athens Laboratory of Business Administration (ALBA) from Athens, Greece conducted a study suggesting that there are limitations and capabilities of the so-called knowledge management system. The findings of the study illustrated that the knowledge management technologies developed at Interactive Multimedia Systems (IMS), a software vendor for knowledge management systems, did not meet the claims of its creators. IMS claimed that its software products captured, transferred and delivered knowledge in organizational contexts. The ALBA study described the vendor as providing poor approximations of the horizons of understanding domain experts whose

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[53] *Exploring the Reality of Knowledge Management Systems: A Case Study*, p. 1. http://www.alba.edu.gr/OKLC2002/Proceedings/pdf_files/ID424.pdf

[54] *Results of Research: eSupport & Knowledge Management.* Conducted by supportindustry.com and STI Knowledge, June 2001. http://www.supportindustry.com/knowledgemgmt/

knowledge they purportedly captured and transferred.[55] An article in the Journal of Knowledge Management noted "...what many software vendors tout as knowledge management systems are only existing information retrieval engines, groupware systems or document management systems with a new marketing tagline."[56]

Here is the story behind the failed system. IMS created a state-of-the art knowledge management system for Coillte Teo, a state sponsored agency responsible for forestry plantations in Ireland. The purpose of its application was to manage the tree-planting program and provide best practices for it. Having developed a working prototype and effectively completing the first phase of development, a problem immediately surfaced that influenced the implementation and use of the system—end user acceptance.[57] Basically, the end-users of the application had little experience with computers, and those who were computer savvy would de-skill their trade.

Another cause for failure associated with the IMS project was the lack of management control by the forestry agency. There was an issue of data ownership of domain specific knowledge, such as skills and knowledge within the company. An example of this would be level of experience in software. Coillte's management and users of the system were reluctant to enter work-related skills as a shared resource. Coillte felt that the information was becoming redundant. Ultimately, the KM application was abandoned.

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[55] Ibid, p.2.

[56] "Knowledge management: linking people to knowledge for bottom line results." Journal of Knowledge Management, vol.1, issue 2, 1997, p. 113-122.

[57] *Exploring the Reality of Knowledge Management Systems: A Case Study*, p.7. http://www.alba.edu.gr/OKLC2002/Proceedings/pdf_files/ID424.pdf -

Knowledge management vendors often roar theories and abstract benefits to their clients, rather than linking KM to concrete and defined business goals and strategies. This is typically seen in systems where the focus lies entirely in one departmental area rather than a whole, functional organization. The practice of KM would work best when applied horizontally across an organization rather than vertically.

Another reason why KM initiatives do not succeed is because employees can not relate to how or why they should share information. A primary reason for their failed initiative is lack of senior level sponsorship, as reported by STI Knowledge and supportindustry.com. The study concluded that senior level sponsorship is vital to help build consensus and support from other key senior level executives throughout an organization. They are there to assist in removing financial, political and cultural barriers as a means to successfully implement a strategic KM initiative. It is the responsibility of key senior managers to provide clear goals and objectives to their employees. Brian Benz, CEO of Benz Technologies, stated,

> Leaders of an organization can see the benefits of or organizing and documenting the skills and specialties of their staff. However, their staff may not, and these are the very people who you must ask to contribute the most to the system. Herein lies the essence of most problems that result in failed knowledge management systems. Most knowledge workers react to requests for their documentation of their knowledge as asking them to give away everything that makes them

valuable to the corporation. They see the KM process as a threat to their positions and job security.[58]

Take for example Analog Devices Inc. of Boston, a company in the electronics industry. The company devised a plan to create a knowledge management system as a means to provide ready access to product specifications so that engineers could choose the most appropriate design for the product. If the application proved successful, Analog would have an advantage over its competitors in terms of product performance and selection. However, it too did not succeed in its operations.

Unlike Coillte's failure, the collapse of Analog Devices' knowledge management system was due to system and development-related barriers. Even though the application performed a useful search function, it did not provide accurate results. The problem stemmed from the methods and techniques used in creating the system. There was not only a lack of understanding on how users should apply their knowledge toward the application, but there was also a lack in assessing the methods used to design the application. The engineers failed to ask a few simple questions during the course of production. First, who will be involved in the development process? Second, who is ultimately responsible for maintaining and updating the content? And lastly, what is the most appropriate design method?

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[58] Benz, Brian. "Strategies for Success: Building usable knowledge management Systems." www.benztech.com

Barriers for Museums Employing Knowledge Management Tools

As ideal as knowledge management sounds for a museum, building and executing such systems is, in most instances, unrealistic. Figure 3 reveals an ideal model of how a knowledge management system should function and organize itself in a museum. Yet, there are other barriers preventing museums from forming or applying KM in the real world.

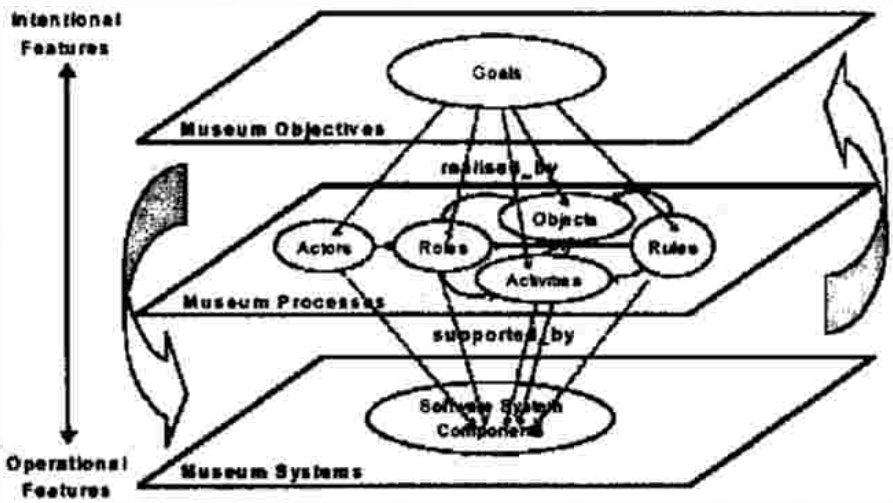

Figure 3: Enterprise Knowledge Modeling Views[59]

The first, and probably the most obvious, is that KM was planned for large, for-profit corporations and businesses. Museums, on the other hand, are mostly nonprofit organizations whereby they are limited in their financial resources. Simply put, museums do not have the funds to spend on a sophisticated knowledge tool, as this was discovered in the previous section.

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[59] Kavakli, Evangelia. *A Knowledge-Oriented View of Web Technology Adoption in Museums.* Mytilene, Greece: University of Aegean.

[61] Smith, Abby. "Library Collections Online." *Collections, Content and the Web,* January 2000.

Second, in today's ever-growing information highway, technology is typically, and directly, integrated with core organizational functions. In this context, museums continue to offer dynamic and interactive experiences designed to service the needs of special groups (i.e. schools, students, scholars). But, they rarely function as a centralized information powerhouse. Museums tend to collect rare and unique items where often times the objects and the information surrounding them are not accessible to the public. Moreover, museums provide historical and contextual interpretation about objects where curators and other staff have a deep knowledge about their collections. Unlike librarians, for instance, curators are not subject specialists whereby they are experts in the source base of one or more domains of information that build an excellent collection that can be used and interpreted by the researcher.[61]

In order for museums to jump this barrier and cross over to knowledge management they will need to turn their attentions to building a collections management system that provide a comprehensive source base for researchers to use onsite. For example, the need to create metadata has the potential to turn catalogers into curators, for creating metadata involves creating a context that provides layers of information to facilitate retrieval and interpretations.[62] In essence, the responsibility of the museum would not only be to collect and interpret objects, but also to acquire the best resources, organize them for ready access, and preserve them for future use.

The third barrier for museums introducing KM practices and tools to their institutions is technology. The question is, are museums embracing technological advances? Are they using these new capabilities to their advantage for exploiting their

[62] Ibid.

collections and the content of their collections in the virtual world? An answer to this is most museums provide selections rather than comprehensive collections on the Web. As Bernard Reilly from the Chicago Historical Society explains, selections are chosen for the Internet based on the following criteria:

- Masterpieces and other works chosen to illustrate the richness and range of an institution's permanent collection;
- Selected items from exhibitions that the museums have mounted, hosted, or both;
- Highlighted individual works, with educational, analytical, or other contextualizing commentary.[63]

The problem with posting and uploading certain content material to the Web is that it limits access to a museum's collection, as well as other information. Museums tend to revise their Web sites often, removing and replacing artifacts and works to provide fresh content to visitors rather than retaining them as permanent features.[64] Exhibitions featured on the Web are sometimes archived for a period but rarely are kept indefinitely. Once the exhibition or artifact is removed from the Web, a visitor will be unable to find it.

Some museums also pay more attention to marketing and promoting themselves rather than object content on the Web. Information about the museum such as directions, hours, membership, and current exhibitions/programs are more prominent than the objects themselves. This is not to say that marketing a museum's Web site is invaluable.

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[63] Reilly, Bernard. "Museum Collections Online." *Collections, Content and the Web*, January 2000.

[64] Ibid.

However, museums need to add functionality, particularly to their Web sites, if they want to effectively make knowledge management successful.

Developing a Knowledge Sharing Museum

Developing and designing an information system represents a focus on the fusion of content, structure and appearance of documents. It is usually intended to target a specific audience, as in this case museum visitors and/or staff. The planned design can consist of a document or a group of related documents that indicates the overall structure and interrelationships of the documents like the catalog database used by registrars. But in order for the system to succeed in taking the viewer toward the perspective content, distinguishing the purpose and the audience beforehand should be presented first. Identifying the context in which content will be communicated should also be prioritized first.[65]

Not surprisingly, museums need to rethink their information practices to successfully manage their systems. That is because an elaborate framework of laws, policies, and standards, which has evolved over many years, governs the long-term maintenance and administration of museum collections and their corresponding management systems. Rather than build individual databases or informational systems, museums may opt for integrating content, text and images across various knowledge domains. These can range from educational packets to interactive exhibitions. Using this approach, end users and museum staff could draw information from a specific topic in a museum, regardless of whether it was drawn from the objects collection, exhibition

[65] "Designing Better Documents," The Information Management Journal, Sept./Oct. 2002, p. 44.

catalogues, the library's holdings or visual resources.[66] An example of this idea is seen in Figure 4 where the database system consists of a single repository that contains and stores content and data within data, known as metadata. Metadata is simply data within data; that is data concerning data characteristics and relationships.[67]

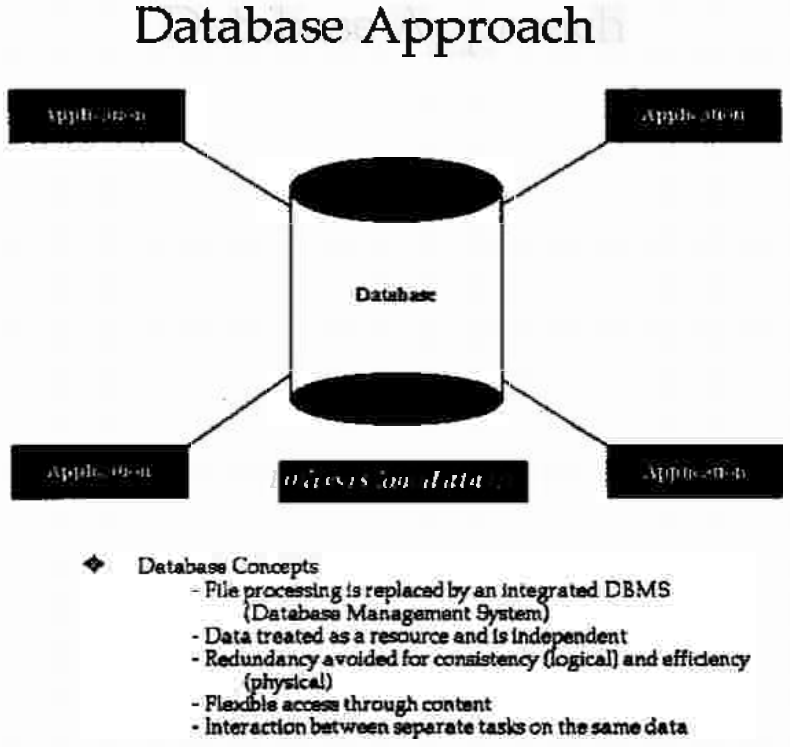

Figure 4: Concept of a database produced by the Mystic Seaport Museum

Museums need to focus on practical approaches to data organization and access and kick the habit of providing the public simply with object related data. As stated by Kevin Donovan, a presenter at the 1999 Museums and the Web conference,

[66] Dietz, Steve. *Telling Stories: Procedural Authorship and Extracting Meaning from Museum Databases.* Museums and the Web 1999.

[67] As defined by the library department of the Mystic Seaport Museum.

> To achieve ... value-added content that supplements label copy and object records with well-told stories that captivate and enlighten ... museum information systems must evolve from object-centric collection management systems to context capable content management systems.[68]

Most automated systems in museums were developed for recordkeeping and inventory control that eventually resulted in collections management systems. However, efforts have been made to convert collections management systems into integrated informational databases.

Basic collection management systems used in most museums set up relationships and associations that identify and classify objects. An example of this would be a museum using a manual file system, still widely used in museums. Consisting of a group of file folders, the contents within each file folder are logically related, by donor or year for instance. Manual file systems eventually evolved into computerized file systems that simply mirrored manual file systems. One might have a separate file for donors, and the other for accessions. However, as information continuously grows and turns to be more complex, the computerized and manual systems become too cumbersome. Timely information retrieval, therefore, is virtually impossible. More so, the information is not shared across files and there would be a great deal of data redundancy within the existing files. For instance, a museum would need to enter the name of the donor in both the donor file, as well as the accession file to make a connection with a museum object.[69] As

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[68] Ibid.

[69] Mystic Seaport's definition of a manual file system.

a result, vast amounts of data are created in separate files (i.e. aecession reeords, donors, membership rosters), preventing museum staff and other users to share the information on a museum-wide basis.

To provide a better illustration of this, picture a registrar who reeeives a new donation for the museum's eollection. Following standard registration methods using a basic, computerized file system, the registrar would first enter the name of the donor in the donor field. Next, the registrar reeords deseriptive data about the donated objeet such as, size, medium, and condition. Last, the donor information (i.e. name and address) is then recorded in the accession file in order to make a connection with the object. As you can see, this will lead to a higher level of data ineonsisteney and data anomalies because the information is all over the place so to speak. It does not rest in one integrated, relational database for all museum staff to share and input.

Managing Knowledge in a Museum

The variety of information objects continues to flourish in museums. Documents can be either paper based or in electronie format. Images can be analog photographs, or come in video or digital formats. The Internet, Intranet and World Wide Web make up the ever-growing information highway. Museum employees who manage these diverse information objects must understand the technologies, the processes involved and the interrelationships of the applieations used.[70] Numerous systems and databases do not capture, maintain or preserve the content or the context in which the information was

[70] Eiring, H. Larry. "The Evolving Information World." The Information Management Journal, Jan./Feb.2002,p.22.

generated. In other cases, museum employees lack the experience or skills required to capture the information in its entirety.

A museum needs to identify its primary source(s) of knowledge to maximize its information resources and to provide strategic value. The first step in mapping a museum's knowledge base is to look internally for resources. As mentioned previously, knowledge resides inside people's heads. Museum employees, from curators to docents to security guards, are information assets. These professionals could work as part of a cross-functional, collaborative team in order to ensure that knowledge is recorded or handed down. From there, museum professionals could turn to other internal sources such as procedures, software, databases, documents and repositories.

Information providers and users could have multiple roles. They are not necessarily museum staff (i.e. curators, registrars, archivists, educators) that create or administer the information. Information holders are also support staff that facilitate, create and administer information in a museum but do not necessarily deal with content development. Support staff consists of IT employees, Web masters, docents, and volunteers to name a few.

Visitors, including virtual visitors, are also great consumers of knowledge and information, as well as those responsible for financial and operations management within a museum's infrastructure. According to a CIMI case study,

> [T]here are other staff whose job descriptions might not reflect their role in information management such as a security person who accepts an object from a donor because it is delivered in off-hours and creates the first record of that object or a facilities person in

> charge of moving artwork who might be the most appropriate person to record new locations in the inventory record.[71]

These examples illustrate why it is important to go beyond job descriptions and titles to understand the relationship between the person and the information when developing knowledge management systems in museums. The key to knowledge management development is the application of information to the employee's job to make a positive difference in individual and institutional performance.[72]

Successful knowledge management requires that museum professionals become not only skill-based workers but also "knowledge facilitators." As knowledge facilitators, the museum professionals would be able to create new solutions and options using a broader blend of expertise, experience and intuition.[73] In other words, the museum professionals would be open and flexible to learn new skills in conjunction with their traditional modes of work.

Relational Databases: Integrating Content & Data in Collections

E.F. Codd, an IBM employee, first developed the concept of relational databases in 1970. As described by Codd,

> The relational database model gives us the luxury of forgetting the actual physical data storage characteristics, thereby allowing us to

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[71] Ibid, p. 11.

[72] Tobin, Daniel R. *The Knowledge-Enabled Organization.* New York, NY: AMACOM, 1998, p. 26.

[73] Ibid, p. 24.

concentrate on the logical view of the database. That is, we may focus on the human perception of data storage rather than on the often difficult-to-comprehend manner in which the computer sees those same data. Since the relational model achieves both data independence and structural independence, it becomes much easier to design the database and to manage its contents.[74]

The basic data components in a relational database are "entities and their attributes" whereas the basic logical structure is a table. One of the fundamental principles of relational databases is that each table is a separate and independent unit, although tables may be related to one another. Second, data in these tables can then be brought together in a wide variety of ways, resulting in vastly increased flexibility. This covers a wide area of collection types consisting of images, text and educational resources, and multimedia. Third, relational databases offer standardization keeping the relationship between the data and museum objects fairly uncomplicated.

Relational databases also incorporate metadata. As stated previously, metadata is data about data, or information known about the image in order to provide access to the image. It usually includes information about the intellectual content of the image, digital representation data, and security or rights management information. In the museum world, metadata would be a catalog system or indexes.

But how would departments in a museum or other institutions share data from relational databases between them? Within the museum community, considerable

[74] "Relational Databases," Mystic Seaport, 1997.
http://www.mysticseaport.org/library/msitia/reladata.html

diversity of descriptive work exists due to the uniqueness of collections and the approaches to cataloging, organizing, describing and presenting museum collections.[75] As mentioned earlier, one of the biggest challenges facing museums with informational databases is to use the data effectively without recreating significant portions of it. But, not every museum chooses the same technology or software application to catalog or describe art collections, even if two museums contain the same object and information of that object.

Innovative approaches to organizing and describing objects, text, and media have been in development for quite some time. However, depending on the mission of the museum, a relational database may not serve its need. It is understandably difficult to define areas that have common meaning, given the diversity of museum collections. However, standards do exist for structured metadata including guidelines for unstructured information. Unstructured data in this case would be full-text documents, collection catalogs or training manuals.

Case in point, The Norwegian Museum Project gives a good example of how museum professionals and other staff collaborated their skills and knowledge to create a relational database. Their aim was to extract all information concerning the finds and the museum objects written in the acquisition catalogues of archaeological museums of Norway. This knowledge management project attempted to develop a common database system. It was to manage the collections from a wide range of disciplines such as archeology, ethnography, or natural history museums. Ideally, these database systems

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[75] *Building Integrated Museum Information Retrievat System.* Jim Blackaby and Beth Sandore. Museums and the Web 97: Selected Papers. Pittsburgh, PA: Archives & Museum Informatics, 1997.

would be able to handle all reference information related to artifact and specimen collections inside and outside the museums.[76] Ultimately, as stated by Christian-Emil Ore, the database would "offer users centralized and efficient access to information regarding the Norwegian cultural and natural heritage. With the help of common user interfaces and links between data from different fields of study, it will be possible to generate new information combinations and new insights in the various disciplines."[77]

Creating a database system of this magnitude posed a great challenge for the Norwegian project. First, to make an integrated database requires interdisciplinary searches. To elaborate, each museum that participated in the Norwegian project had mostly stand-alone database systems and applications. In laymen terms, none of the systems were interconnected with one another to allow file or information sharing. A scholar or a curator from a visiting museum would not be able to conduct a complete search of archeological artifacts from across all disciplines because the information would be readily available to them. The idea of knowledge management, in this case, is to integrate informational databases from all museums participating in the project into one relational database.

The second major challenge for The Museum Project was that of controlling the structure and construction of the data and information inputted. Participating museums had their own categories for describing different types of objects within different

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[76] Ore, Christian-Emil. "The Norwegian Museum Project: Access to and interconnection between various resources of cultural and natural history." European Conference on Research and Advanced Technology for Digital Libraries, September 4-9, 2001, Darmstadt, Germany.

[77] Ibid.

databases. The databases did not have more elaborate systems capable of cross-referencing data, such as terms or descriptors, or execute queries for searching.

The systems group that led the project, therefore, had two goals in mind. One, to create a common interface tool and database functionality; and second, to establish common database solutions for common data types like geographical data, bibliographical data, data about persons, classification systems in cultural and natural history and so on.[78] These two simple goals paved the way for The Museum Project to create the informational management system they desired.

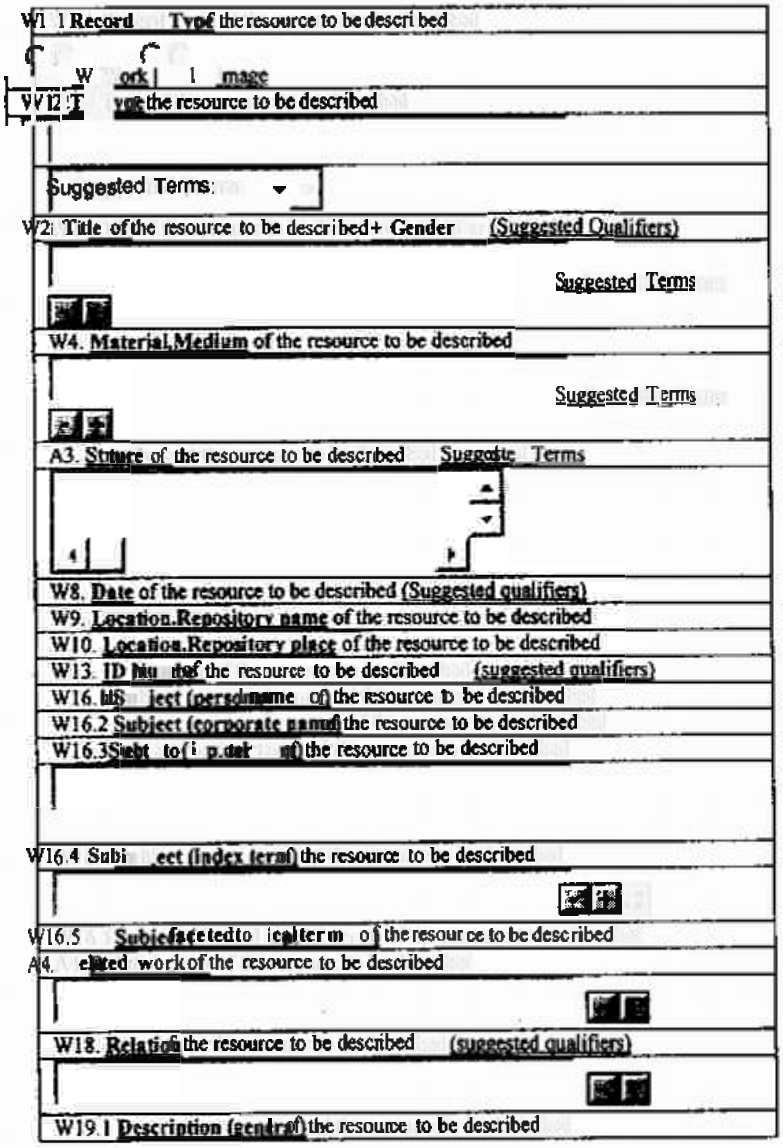
As a result, the databases from the museums were built on the same platform, which consisted of common user interfaces and links between data from different fields of study. Furthermore, each object entered into the system underwent a quality control procedure. The reason for this was to avoid duplication and to have consistency throughout the entire database. This also implied that, while each database accommodated the specific features of each collection, the different databases would nonetheless be compatible with one another. The computer programs and methods used for the electronic recording of data were determined by the structure of each collection, and to some extent by the traditions of each discipline.[79]

In 1999, the Kent State University Museum embarked on a similar project to that of the Norwegian museums whereby the museum implemented an integrated tool for generating metadata records. Dubbed the 'Visual Dictionary of Costumes,' the digitized collection project seeks to provide a global survey of 100 years of fashion history

[78] Ibid.

[79] Ibid.

accessible through the World Wide Web. Moreover, the project intends to allow students, faculty and colleagues from other institutions to access collections electronically, thus aiding conservation efforts.[80] Below is the data entry form used by the Kent State University Museum to catalog its collection of costumes and other fashion objects.[81]



[80] *Think Globally: A Museum Without Boundaries.* Kent State University Museum, 2001.

[81] The template shown has been altered to display only several elements and fields. The original template can be found at: http://circe.slis.kent.edu/mzeng/vra3template.htm.

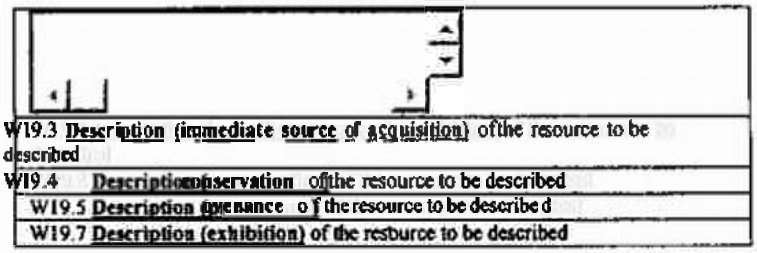


Figure 5: Catalog template from the Kent State University Museum

Each field was based on the *VRA Core* version 3.0[82] for creating descriptive records. Some of the fields use controlled vocabularies, particularly the Getty vocabularies or other standard authorities such as the Library of Congress, in order to control the content entered. Type, Title and Medium are examples of three fields that provide "suggested terms" for use in cataloging the objects. Taking this into account, the *VRA Core* not only describes the object but also describes the digital file for the object. The fields are also linked to element definitions. The element definitions give the user or cataloger detailed information on the definitions of each field, as well as guidelines on which terminologies to use or how to enter text or values.

The sample template above is an example of the complex structure of a relational database. To create simpler structures, a museum may choose certain fields that are necessary for the types of collections it has. This could hold particularly true for art collections. A record, displayed in Figure 6, from the *VRA Core* presents data to describe a sculpture and a slide of the sculpture in an art museum.

Record Type = work	Record Type = image
Type= sculpture	Type=slide
Title = Standing Buddha	Title= detail of head
Measurements/Dimensions = 64.5 cm	Creator = Nikon, Bill
Material/Medium = bronze	Creator/Role= photographer
Date/Creation = 5th cent.	Date/Creation = 1995
Location/Current Repository= New Delhi (IND), National Museum of India	Location/Current Repository= Northampton (MA, USA), Smith College Image Collections
Location/Former Site= Phophnar (IND)	ID Number/Accession = 40006l
Style/Period/Dynasty= Vakataka dynasty	Source= Indian bronze masterpieces: the great tradition: specially published for the Festival of India
Style/Period = Gupta	Rights = publisher
Culture = Indian	

Figure 6: Sample record of *VRA Core* version 3.0

[82] The *VRA* was designed to facilitate the sharing of information among visual resources collections about works and images.

Incorporating Controlled Vocabularies in KM Systems

One of the main reasons for documenting museum collections is that we wish to be able to find objects of a particular kind. The objects are given "names" so that they can become identifiable on index cards or computer files. Museum professionals can then search for those names and expect to find all items associated with it. This is the beginning of a thesaurus and/or data structure. But, once you have documentation, which has been built up over time, perhaps by many different people, problems creep in unless there are standards and guidelines to maintain consistency. How can museums implement controlled vocabularies to enhance retrieval? What are the data elements and components of vocabularies? Why are vocabularies and authority lists important to knowledge management systems?

Vocabularies are used in museums to control terminology in catalog entries. They are also used to provide access across disparate data sets in networked environments.[83] The *Art and Architecture Thesaurus (AAT)*, created by The Getty Institute, is one example of a thesaurus of terms and other information used to describe and catalog art objects, architecture, decorative arts and images.[84] Figure 7 provides a sample record of some of the elements found in *AAT*.

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[83] Harpring, Patricia. "How Forcible are Right Words!*: Overview of Applications and Interfaces Incorporating the Getty Vocabularies." Musuems and the Web 1999 Conference.

[84] "Art & Architecture Thesaurus On-Line." The J. Paul Getty Trust. http://www.getty.edu/research/tools/vocabulary/aat/index.html

Figure 7: Some elements of an *AAT* record[85]

The purpose of the *AAT* is to serve as a knowledge base for researchers or scholars who wish to learn about the concepts they are describing. More importantly, the *AAT* is an excellent source for use in retrieval methods to gain access to art information across different resources in digital form. As a knowledge base, the thesaurus offers users the ability to access the vocabularies through the Internet. For example, the *AAT* is hosted at the Getty and released in Web applications as a browser. It is used by various Getty projects, other institutions and the general public for research and to aid in making catalog records.

The browser application allows users to search terms by performing a simple query like spelling an artist's name or truncating the word (i.e. Picasso or Pic*). After performing the query, a results list is produced showing brief references associated with the term keyed by the user. What makes this system noteworthy is that the user can view the results as full records or as concepts in hierarchical display. Either way, the displays

are designed to present as much information as possible in a clear, coherent way.[86] The results list is also enhanced by supplemental information such as linking the terms or concepts to Web sites or other resources.

Why then are the *AAT* and other controlled vocabularies important to the knowledge management database? Firstly, the controlled vocabularies serve as cataloging aids. What is significant about this point is that the vocabularies have been integrated into some collection management systems to allow easier access. For instance, a vocabulary browser allows a cataloger to search for the term already incorporated in the database. Therefore, identifying vocabulary resources and descriptive practices will make information residing in diverse systems both more compatible and more accessible. It will also provide a framework to which existing art information systems can be mapped and upon which new systems can be developed.[87]

Secondly, controlled vocabularies increase speed, efficiency and consistency in cataloging or in retrieval process. Users can pick from a list of terms that have been embedded in the system. A registrar, for example, would have terms commonly associated with art collections. The work you can say is done for them. However, there is a drawback. Vocabulary terms required by a cataloger or a curator may not be included in the thesaurus list. An example is a museum containing objects in its collections that are not strictly classified as art. The object may be a video recording or a

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[85] Ibid, p. 2.

[86] Tough, Alistair and Michael Moss. "Metadata, controlled vocabulary and directories: electronic document management and standards for record management." Records Management Journal, Vol. 13, No. 1, 2003, p. 24.

[87] Categories for the Description of Works of Art. http://www.getty.edu/research/conducting_research/standards/cdwa/index.html

fossil. In this case, indexing a term associated with a particular object is important and necessary. Therefore, the user may want to access additional vocabulary sources or add the term to the thesaurus list for their own local use. But all in all, the standards and guidelines developed by the Getty Institute "hopes [to] provide a common ground for reaching agreement on what information should be included in art information systems, and what information will be shared or exchanged with other institutions or systems."[88]

[88] Ibid.

Section V: An Information System for Your Museum

Ideal Software Applications for Any Museum

Whether museums like it or not, the growing power and functionality of modern technologies are creating an unprecedented demand for information and increasing expectation that access will be quick, easy and affordable. Online digital archives, for example, would become easier and more widely adopted by museums. The idea of integrating all information related to an object would have a profound impact on museums and their audiences. This section examines two software applications, *xWave* and *The Museum System (TMS)*, that are excellent examples of how a museum information management system should function to capture knowledge and other relevant data in one common, shared database.

Numerous information technology companies are now developing software applications specific to the needs of the museum to successfully manage all aspects of knowledge and information management systems. Whenever and wherever possible, it is a good idea for museums to purchase products rather than build on existing systems. For this reason, museums should look for existing products that can be tailored to meet individual needs. Buying new software applications and products also ensures that system integrations, whether it is for searching/gathering or database management, will operate more effectively.

Before making any decision buying integrated systems or upgrading, museums should ask themselves two important questions: Does the museum have a preferred hardware platform, operating system or database management system? Will the museum use existing hardware for collection management system? Often times, museums will

obtain the wrong hardware or software not realizing that the product will not be able to interface with their existing system, for example the transfer ofmetadata, or the product is not compatible with the museum's information management system.

xWave, in collaboration with the Nova Scotia Museum, a network of25 separate museums, created one of the most ideal software applications presently used in museums. The software application manages information related to any type of collection, from historical artifacts to zoological specimens.

xWave combines flexible and versatile technological features that will successfully manage a museum's collection, as well as administration. Documenting the collection includes information in written, electronic, audio visual or graphic form pertaining to the identity, locality, provenance and transfer of legal title of artifacts and specimens in the collections, and other related information regarding significance, function, description, condition and usage after acquisition.[89] Multimedia capabilities also provide an added enhancement to manage images, recordings or other binary collection records related to an object as shown in Figure 8. As a result, the information is then stored as an electronic record according to an artifact's source, material, gender, cultural affiliation, decorative motif, age, region, or any other classification that may suit the user's particular needs.

[89] *Collection Management Policy for the Nova Scotia Museum*, October 2002.

Figure 8: *xWave*, multimedia capabilities to manage images, recordings and other parts to a collection

The Museum System (TMS), a database product developed by Gallery Systems, is another software application designed for museums, but could also be used by corporations with collections or by private collectors. *TMS* seeks to integrate all aspects of collections management within one relational database. The program manages exhibitions, catalogues, events and shipments, records and publishes complete information on cataloguing, conservation, location, documentation, provenance and more.[90]

Like *xWave*, *TMS* is capable of managing and sharing information from all areas and functions of a museum. By integrating various modules, or record types, in one single, relational database, the program can provide an intuitive interface for querying any field in the database, all of which are interlinked. For example, a record from the media module can be related to an object in the exhibitions module, to the authoritative person or department responsible for the object, to public programs associated with the

[90] Gallery Systems. *The Museum System*. http://gallerysystems.com/m_over.asp

object. The modules are consistent, flexible, accessible and easy to use, even for untrained personnel.

To ensure information is accurately entered and accessible, *The Museum System* created several enhanced features for entering and displaying data. These features include:

- Controlled authority and vocabulary using The Getty Institute's *Art and Architecture Thesaurus*, including cross-referencing to other content or information about an object.

- Password protected access for showing data online. This feature controls access to content by assigning rights to edit and view information.

- Three search functions capable of sorting results and saving them. Search options are basic (search by catalog number, title, or name); query assistant (a step-by-step process using several search screens); and advanced (Boolean searches).

- Fields in *TMS* can be configured to the needs of a specific museum, such as creating forms for objects, loans, or re-labeling particular fields.

- Data can be displayed in an array of ways from text only to text with images, as seen in Figure 9.

- Provides direct access to selected content on a museum's Intranet or Internet site using standard or custom templates.

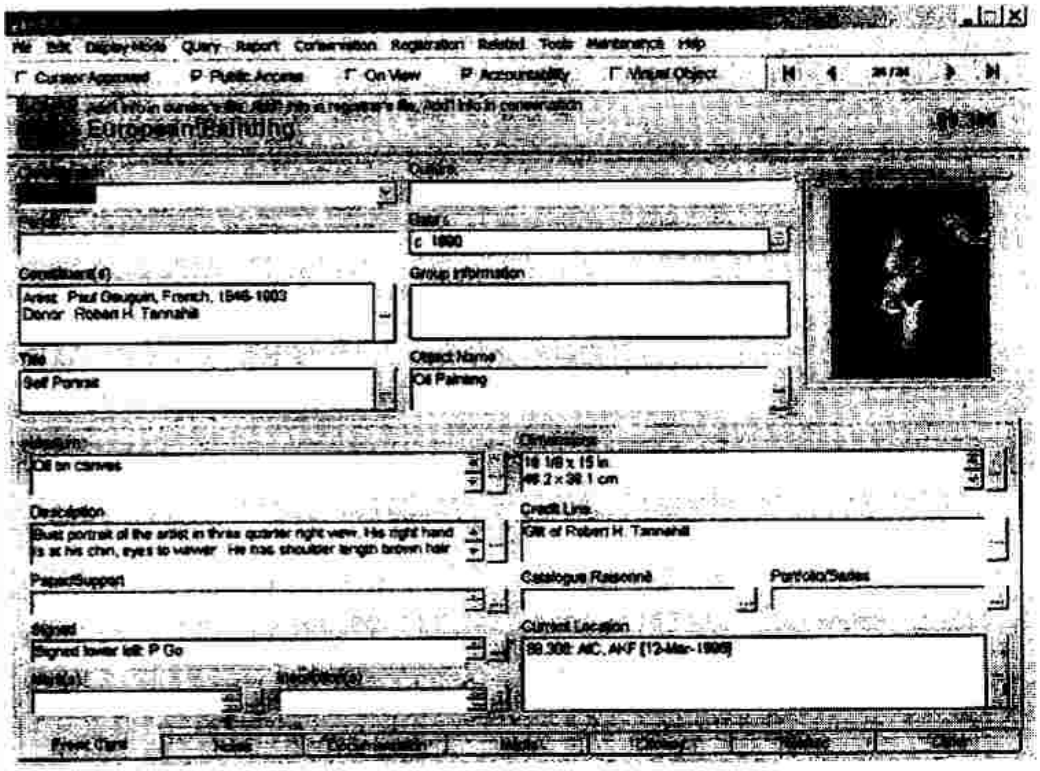

Figure 9: Gallery Systems, *The Museum System*, Object Field

The Museum System is one of the most comprehensive, relational databases for museums. Its features and capabilities are advanced and less complicated than most other software programs on the market. However, *The Museum System* is a 'client/server' application meaning that the database management system is only operational if the museum has Microsoft SQL Server 7 or higher or Oracle 8 or higher. A client/server application is basically a computer system that divides up the work of computing from many separate machines. It has the ability to input, process, store, and access data anytime, anywhere and on any device.[91]

[91] As defined by American eBusiness Solutions. http://www.amebs.com/

Choice of the database management system will then determine which server operating system will be used. In this case, Microsoft SQL runs only under Windows NT or Windows 2000, whereas Oracle runs under Unix, NT or Novell NetWare.[92]

As a true client/server application, *The Museum System* will operate successfully over wide area network connections. Sufficient amounts of disk space, disk storage, bandwidth, speed, and memory are necessary for the system to work properly. This software application would be ideal but unrealistic for most small to mid-size museums due to financial resources and constraints, lack of system requirements, or shortage of technical staff that are knowledgeable about database servers and applications.

Case Study: eMuseum

The Museum System has proven to be successful in cataloguing, storing, and managing collections of museum objects (i.e., art objects, projection slides, digital images, audio, and video). In addition to the collection management database, the producers of *TMS* also created *eMuseum*, a web-based, database-driven publishing system. What this means is *eMuseum* is capable of publishing collections information online, such as exhibitions and related media, within a matter of hours once it has been integrated with the collections management system.

One of the key features of *eMuseum* is its 'Collections' area. 'Collections' are pre-selected searches that take a visitor on a virtual tour of the museum's collections. The collections, for example, show themes or works by the same artist. Another feature is its searching capability. Every home page of an *eMuseum* offers a 'quick search' box where users can search for artist names, mediums, or descriptions of a particular object.

[92] Gallery Systems. *The Museum System.* http://gallerysystems.com/m_over.asp

The search fields are derived dynamically from the database, so any criteria can be added or omitted by the web manager, curator or registrar.[93] There is also an 'Advanced Search' screen where the user has up to five search criteria to choose from as shown in Figure 10.

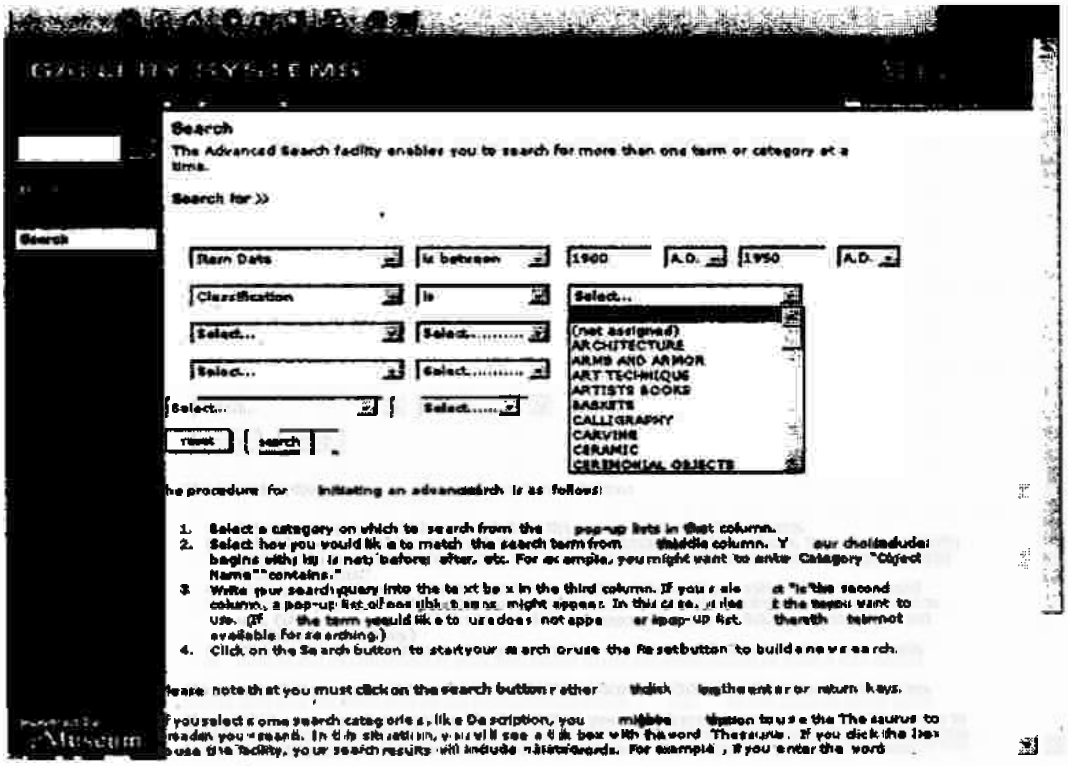

Figure 10: Sample screen shot of Advanced Searching taken from Gallery Systems

The search results allows the user to view the hits in three ways: 1) a text list, 2) six images at a time, or 3) detailed information about a single record, such as description, medium, description, catalog number, and visual (if available). In addition, the search results also produce hyperlinks, thumbnail images or textual information to other related objects and/or information such as exhibitions or biographical information.

[93] *eMuseum.* The Gallery Systems. http://www.gallerysystems.com/emFeatures.asp

Figure 11 provides a good example of a single, detailed record. The screen shows an image of descriptive text where the user can click on the image to enlarge it. The column on the right lists links to related objects. Navigation is also logical and simple as seen under the search results. With a click of a mouse, users can go back or forth to the previous or next object, or jump to another page. Patrons may also view the object in other formats either in text or with a group of other thumbnailed images.

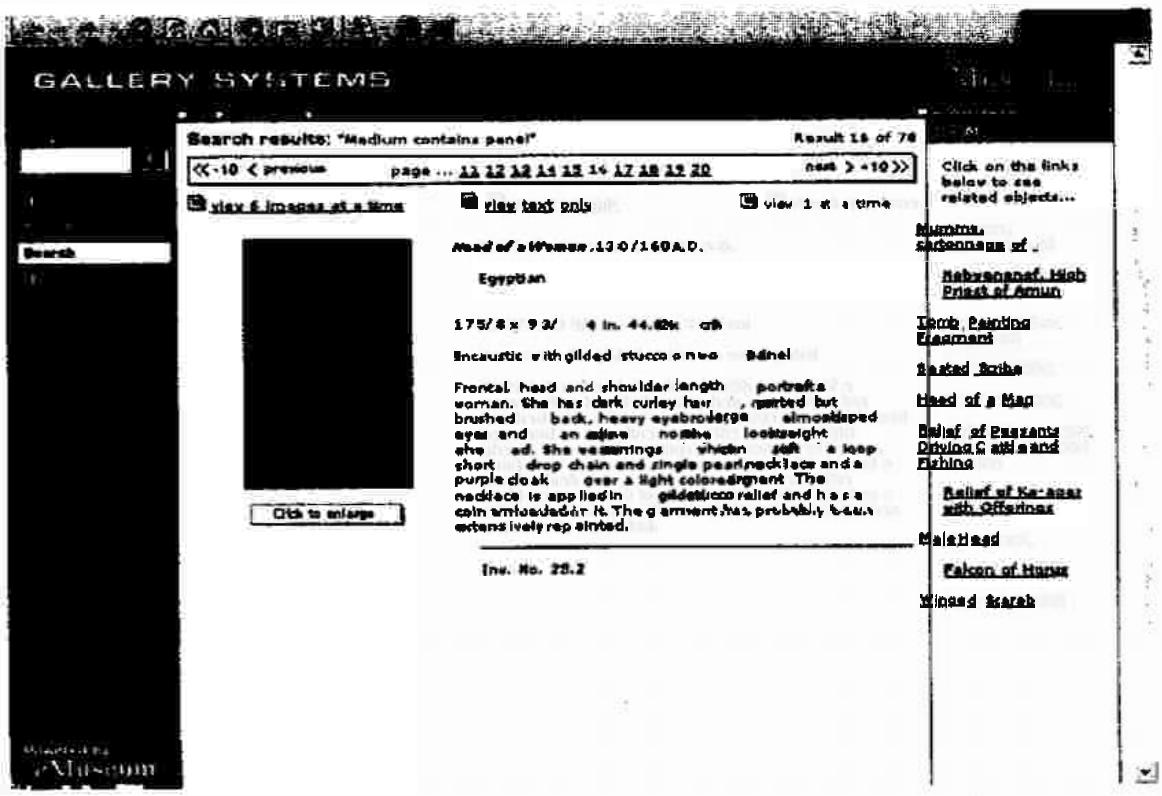

Figure 11: Screen shot of a detailed record from the Detroit Institute of Art

Other than its searching capabilities, *eMuseum* is a flexible and structured publishing tool that can easily add or delete fields from search lists or web pages. Curators, for instance, can carefully monitor and control information about an exhibition because it is the same system that manages the collections. Registrars can modify bibliographical information or provenance in a matter of minutes to update the existing

information online. Museum staff can also easily be trained to upload images and other documents associated with a particular object.

Section VI: Conclusion

However you organize it, the information that you have about your collection is a vital part of how a museum operates. Storing, accessing and producing that information can be as important as the arrangements museums make for managing the storage, care and interpretation of the collection itself. So it is worth planning to structure knowledge management with as much attention to detail as possible.[94]

Creating a museum knowledge system enables users to retrieve information across various existing systems and data formats. However, as my thesis has shown, implementing such a system does have its benefits and drawbacks. One benefit is that information across departments can be brought together in a meaningful way without having the user having to move it physically or virtually from one collection to another. On the other hand, the drawback is "merging data in different formats inherently dilutes hierarchical controls and poses the challenge of working with multiple formats for information."[95] Simply stated, data format and content from two databases can be identical but two very different results can be produced because of different retrieval engines.

Nonetheless, the idea and concept of museum information systems is to facilitate to the contribution of all manner of enriched data sources to a central knowledge base system where the intellectual assets of the museum can be stored and managed. Museum

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[94] "Deciding on Digital Tools for Collection Management." Museum of New Zealand, Issue No. 17, March 2003, p. 2.

[95] Blackaby, Jim and Beth Sandore. "Building Integrated Museum Information Retrieval System." *Museums and the Web 97: Selected Papers.* Pittsburgh, PA: Archives & Museum Informatics, p. 231.

staff and general audiences will have access to a networked system that will range from just facts to information enhanced by images and graphics. The information will be drawn from the content management system and published via the Net or a network using integrated toolsets that offers flexibility and user-friendly needs, such as easy navigation. The result will end with vast, interlinked informational data and content.

To end, Jim Blackaby and Beth Sandore, authors of *Building Integrated Museum Information Retrieval Systems: Practical Approaches to Data Organization and Access*, said it most splendidly:

> In the move from guided exhibits to knowledge discovery tools, it is entirely possible to preserve the rich context in which museum information and objects have been collected and linked. Perhaps even more exciting is the reality that it is possible to create methods to link information that is similar in content, but has been physically and institutionally isolated until is has been made digital. The most exciting aspect of this work is demonstrated in the opportunities to enhance scholarship at all levels through new knowledge discovery and interaction.[96]

[96] Ibid, p. 232.

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