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This paper examines the level of consistency, content and contextual information of six individual and two collaborative museum databases. A uniform set of elements within several categories was chosen, such as subject cross-referencing and syntax regularity, though some tests were modified to accommodate each museum's differing features. Due to the limited scope of the study and these variations, the conclusions are not intended as definitive judgments. Rather, they provide an outline and evaluation of museum databases and site features and, hopefully, generate ideas for further research.

Headings:

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AN EVALUATION OF ONLINE MUSEUM DATABASES

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I. INTRODUCTION

Long considered repositories of the past, museums are now embracing the future by incorporating new technologies into their websites. One-page sites that were little more than electronic flyers in 1995 have since become dynamic, database-powered entities in themselves. These developments have revolutionized the way museums view the potential of the internet and are reshaping their outreach and educational goals – allowing formerly difficult or impossible tasks, such as providing access to those abroad or displaying the many works never brought onto the exhibit floor. Archival research and image or catalog perusal, once the privy of researchers on location, are becoming available to anyone who can point and click. These transformations will ideally allow users to stroll through search query results and virtual galleries more easily than a crowded wing of the Guggenheim.

What stands in the way of this utility is an evolving but constant need of standards and information regarding syntax, language (both computer and human), formats, content, context and cross-references. Well-developed user interfaces, information retrieval techniques and browsing preferences are also essential to maximize in a new way the old mission of museums – preservation, education and interpretation. This paper examines all of these issues through the following research question and resulting study: How do deficiencies in consistency, content and context diminish the effectiveness of browsing and retrieval in museum databases.

To clarify the parameters of the study, the question's key terms have been defined as follows. Deficiencies may be either objectively incorrect, such as wrong spellings or word forms, or subjectively lacking, such as minimal or vague information or lack of cross-referenced content. Consistency may refer to mere similarity, as in site design cohesiveness or record display, or it may require an exact match, such as artist names that will only allow success if identical. Content refers to field query definitions (the clarity and cross-referencing of field headings such as Type or Description) or the amount and type of information offered. Context encompasses everything from related-work or cross-collection linking to integration with tours or other aspects of the site. Diminished effectiveness is sometimes objective, such as the failure to retrieve works by an artist that are known to be in the collection. It is also at times subjective, such as the lack of basic content and context for a retrieved image. Finally, database (or browsing) information retrieval includes all forms of inquiry a user may perform on a site – from direct searches for a particular image to general-interest collection browsing.

The study evaluated the websites of six individual museums with relatively advanced databases – The Metropolitan Museum of Art (MFA), The Fine Arts Museums of San Francisco (FAMSF, which includes the de Young Museum and the Legion of Honor), The National Gallery of Art (NGA), The Los Angeles County Museum of Art (LACMA), The Museum of Fine Arts, Boston (MFA) and the Getty Photo Study Collection (Getty) – and two collaborative image databases, the Online Archive of California (OAC) and the Art Museum Image Consortium (AMICO). The institutions, and their reasons for inclusion, are further explained in the methodology.

The question has two parts, based on a combination of the literature and previous art database use. The first is based on form and content. It is anticipated that queries are often kept from their matches for two reasons. The term in question may be mismatched, or there may be a misunderstanding of the search field definitions. These mistakes may come from either end. The user may not know the proper form of an artist's name or the exact distinction between fields like Object and Classification. Equally, the data author may disregard controlled vocabularies or field definitions. The second hypothesis element deals with the lack of agreement upon standards. It is expected that many relevant records will not be linked due to lack of proper integration or field input. Authors may skip fields entirely due to time constraints, or there may not be adequate guidelines in place for subject or theme designation or integration.

Each part of the investigation focused on specific areas using pre-determined term lists (Appendices E, F and G). For example, the evaluation of search term consistency includes diacritics, name order, word form, alternate spellings or forms for all sites. Differences among sites, such as the size and scope of their collections and their database formats and complexities, led to variations in the evaluation methods. The only objective comparison is that of attributes, such as the presence of search fields and format options (Appendix A). Consequently, the analysis is ultimately an assessment of the weaknesses of museum databases based upon a small sample, rather than a comparative study.

II. LITERATURE REVIEW

A foundation of background information and context for the study required articles and other information on several related subjects: museum databases and their components (standards, vocabularies, methods of access), analyses of these components and their success, and ideas for future developments. These formed a base of knowledge and a set of expectations for the ensuing analysis. Their theories and data were tested and suggestions posited where there are current gaps in research – keeping in mind the limited range of the study. Its conclusions do not provide definitive answers. Rather, they highlight issues that future testing and resulting literature will ideally examine.

The writings sought span a wide range of topics. One end of the spectrum involves human-centered aspects, such as interface usability and the matching of a site's functionality with the museum's audience and goals. For example, one of the study's initial theories proposes that institutions geared toward a more scholarly audience, such as LACMA and the Getty, may benefit from a more advanced and search-oriented interface, as their users will require options that allow for more specific queries. The other end of the spectrum is more technically focused, with evaluations of various mark-up languages as they pertain to museums or learning institutions. These components govern the underlying structure and clarity of the material and ultimately determine its usability. Some languages are more suitable than others for image mark-up, detailed entries and linking various media objects (journal articles, images and sound). Others are less detailed but provide a common base that many disciplines may use. As both of these

elements are central to research – detailed information and its cross-linkage to other contexts – a desired goal is the integration of the two.

Most important are the issues of interoperability and compatibility, which encompass controlled vocabularies and format standards. These allow for uniformity among author entries and conversion from one standard to another – MARC to XML, for example. More than any other factor, they were expected to influence the reliability of database results in the study. Literature that covers current developments and crosswalks, that places the sites examined and their level of development in context, is crucial. The most immediately relevant articles, and those first sought, were those whose goals are similar to this study – to test the usability and consistency of the databases, as well as the added value of browsing and other features.

Analysis rather than straight description was preferred in all areas – pieces on “how” and “why” rather than “what.” When resulting data is taken to this level of interpretation, it can better aid in site and database improvements. Finally, any suggestions for future versions of schemas, vocabularies or interfaces may provide springboards to new solutions or suggest what went awry in prior tests.

Desirable non-scholarly writings were also indispensable, as the bulk of the particulars of each site reside in its informational pages. These include the histories, goals, developmental strategies and technical specifics of each museum: expected user base, metadata schemas and any migrations into that format, standard or customized vocabularies, and descriptions of special interactive features and browsing interfaces. These paint a picture of the site’s purpose and structure, which allows for a clearer

assessment of its functioning. Without knowing what the site is hoping to do and what is in place to do it, it is difficult to determine the efficacy of what it does.

These scholarly and informational items were pursued with varying degrees of success. Factual and analytical materials surfaced on several subjects pertaining to databases, mark-up languages, format conversion, browsing and searching, vocabularies and usability. Few, however, focus on museum environments with any degree of analysis. For example, a fabulous piece on controlled vocabulary usage in 30 museums (Gilcrest, 2003) discusses whether or not vocabularies were in place, not how they had improved retrieval success. Still, the articles provide a context and a solid base for research.

The paper's question is based upon published usage and analysis of general vocabularies, syntax, searching and browsing strategies, as well as personal usage of each site. Known problems cited in the literature, such as the format of artist names or the ambiguous meanings of fields like Style, School and Category, guided the establishment of evaluation methods. They indicate which areas to focus on and, coupled with the specifics for each site, which type of test may best reveal a site's effectiveness. These and other related analyses buttress the study's conclusions and suggestions. The analysis of the results is supported by other findings in related areas, and recommendations for future research. Some technical suggestions are merely fixes for known problems, while others are entirely new ways of arranging, displaying or retrieving information. The articles and other data served as a frame of reference, tethering the study to covered ground while it explored new territory.

As the sources mounted, they seemed to sift themselves into four main categories, which are best ordered from concrete to theoretical. They also follow the progression of

considerations when creating and testing a site: the background, goals and specifications of the sites, the standards and vocabularies available for their development, analyses of site usability and functionality, and suggestions for improvement. These last two sections are the most plentiful and important, even though the articles within them refer to non-museum interfaces and databases. Their insight into the roles of standards and vocabulary, site design and user behaviors can easily be transferred to the realm of cultural repositories. Within each of these categories there was far more explanatory than analytical material. This is not surprising, considering the time, breadth and technique required to make credible interpretive judgments about complex factors such as user browsing strategies. There were also no articles found that mirrored this study's methods or goals, though pieces of many articles can be put together that, together, cover similar ground.

The amount of information available about the histories, missions and contents of the museums varied widely but was consistent with the size and level of sophistication of the institution. The collaborative, ground-breaking AMICO and OAC were discussed in dozens of journals, conference proceedings and articles from their own websites, making it simple to determine their holdings and goals (though AMICO's outdated statistics are often two years old). There were detailed descriptions of the controlled vocabularies and standards used, which is particularly important when many contributors must conform to basic standards. AMICO has several pages on its website specifying not only which vocabularies are used, but also in which fields. The semantics and syntax of these fields are explicitly defined in table format. OAC, having been developed in response to the creation of Encoded Archival Description (EAD) at UC Berkeley in 1995, is closely tied

to the incorporation and improvement of such standards. OAC also uses its own multi-image metadata schema, the XML-based MOAII (Rinehart, 2002), which allows for sub-groups of images to be catalogued like individual objects (Rinehart, 2001). It also allows one to view its XML data, the only site found to offer this.

The individual museums did not have nearly as much technical and background information, particularly concerning metadata. This was the most disappointing aspect of the readings, as it made it difficult or impossible to determine the origins or intended format of the database terms and fields. However, the more research-oriented the museum was, the more information was available. LACMA uses MWeb, a proprietary, customizable museum database, whose advanced features and search methods are itemized in detail on its site. This made it simple to test its claims and see if truncations, quotes and diacritics work the way they are supposed to.

The Met uses the database software of RLG (Research Libraries Group), who describe their requirements and specifications on their site as well. While not as specific (little syntax is mentioned), RLG does outline preferred formats (XML, MARC), basic fields like ID numbers and used vocabulary (The Getty's Art and Architecture Thesaurus, or AAT. Some Getty collections also use RLG.) (Giral, 2000). However, the Collections Management Coordinator at the Met, Michael Jenkins, states they do not yet use any controlled vocabulary in their online collections (e-mail June 28, 2004), despite the fact that RLG does.

The other museums have little information on their database structure and appear to use their own formats. Two of them have major consistency issues, FAMSF and MFA. Another, NGA, has only two basic text box fields. The rest are drop-down or radio button

menus and consequently do not require supplementary information to use them well. NGA is particularly detailed in other more contextual areas though, and has several in-depth paragraphs about the museum's holdings, the nature and scope of information available in the database (provenance, biographies and exhibition histories) and its origins. This museum's audience is the general public, and they would be more interested in these aspects than would a Getty patron, who prefers specifications for research.

The Getty photo site does not mention any vocabularies used, but considering the nature of the searching, vocabularies are not as commonly relevant (several images have no standard classification or artist). The site does have syntax specifications for each search field, however. All museums have information on the size of their online and offline collections and what is being searched in the database, though some are more up to date than others. Considering the fact that many of the databases have more than doubled in size since fall of 2002 (The Met's collections went from 3,500 to 6,500; and OAC's skyrocketed from 50,000 to 120,000), constant online updates of these numbers are important.

The second set of articles discussed what the first lacked – controlled vocabularies, general metadata, schema standards and interoperability – but did not often do so in the context of museums. Some focused on learning institutions or image-based sites, however, which made them relevant. A few were descriptive only, but most discussed the benefits and liabilities of particular schemas regarding crosswalks and bridging disciplines.

General metadata recommendations revolved around consistency, semantics, browsing versus searching, and consideration of future uses. Discussions of syntax and

semantics were common and stressed the importance of syntactical consistency throughout semantically varied disciplines. A fine example is that of Lego sets that span decades and themes, yet all fit together to create unforeseen combinations (Duval, 2002). This may be translated to the museum world when considering that conservators (scientists), registrars (administrators), docents (educators) and curators (academics) may be using a common database. Articles also stressed consistency among object groups and recommended the inheritance of properties from parent to child record (Besser, 2002).

Conflicting needs for common standards and specified subject sub-fields were tackled by recommending specialized extensions (sub-categories) for uniform fields, with or without a set range of values (Duval, 2002). Namespaces, such as Dublin Core, XML or the Library of Congress Classification System, can be used in succession to format different chunks of data according to the most appropriate schema. Each namespace identifier will let other systems know which standard is being followed for that particular segment of code. A few sources recommended the use of Dublin Core as a general schema in addition to more specialized standards, as its 14 fields are structured to link general content across disciplines (Bearman, 1999). Cross-discipline connections and interoperability facilitation were the standard's initial intention (Weibel, 2000).

Incompatibilities within the museum community itself include multi-cultural conflicts. These extend beyond the obvious issue of language – for instance, native-versus-English or current-versus-ancient terms for cities or objects such as rhyta (Greek vases). Other aspects, including calendar and date orders, character sets and text direction, varying interpretation of icons, even name orders (Hungarians use the last name first), must be integrated and cross-referenced if these databases are to serve a truly global

community (Duval, 2002). These obstacles must be set aside, though, as there are still several problems with consistency with English alone.

The two main standards used in databases are EAD (for finding aids) and XML (for images). Both are Document Type Definitions (DTDs) used to encode content about items. The main benefit of both, stated in a few articles (Yeates, 2002; Rinehart, 2002), is flexibility. The formats allow for as much detail as necessary and do not conform to any particular content standard or order, though unofficial standards are emerging for various fields. This is also their great liability, however, as records vary widely in scope, depth and format (Yeates, 2002). For institutions such as OAC, EAD and XML must also be able to communicate, as images (XML coded) are often parts of archival collections (EAD) whose records point to each other.

MARC records can be converted into XML format, making it easier for museums and libraries to transfer their collections to an online format, but MARC is complex and difficult for non-librarians to read, and it is not easily reversible without creating a massive XML file (Yeates, 2002). This hinders the most obvious way of converting records, particularly museum library records that will be integrated, yet many museums find it the best alternative.

Several controlled vocabularies were discussed, though the one in widest usage is AAT. The Getty has also funded the development of the Union List of Artist Names (ULAN) and the Thesaurus of Geographical Names (TGN), though the only institutions discussed here that claim to use those two are the consortiums, AMICO and OAC. Theoretical standards also exist, such as the Categories for the Description of Works of Art (CDWA, <http://www.cdwa.org>), which suggests a conceptual framework for

describing and accessing information and images rather than set a particular format. The Getty does provide a set list of defined terms on their website, however, and suggest personal indexing rather than an automated system that pulls every term as a keyword. FAMSF utilizes this second technique, and reveals its disastrous, if amusing, consequences.

Discussions of other methods of image categorization, such as Iconoclass, illustrated the benefits of thinking outside the textbox. A unique system of classification, this indexing system uses a series of numbers and letters to identify thematic data (Appendix I.). Due to its lack of words, it is inherently multi-lingual. The hierarchy is also inherent in the coding, as removing one end letter or number reveals a more general category. This type of classification may blend particularly well with semantic result displays and tree structures based on contextual hierarchies.

Table 1

Iconoclass Sample Hierarchy for Bible story of David and Bathsheba

7 – Bible
 71 – Old Testament
 71H – story of David
 71H7 – David and Bathsheba
 71H71 – David, from the roof of his palace, sees Bathsheba bathing
 71H713 – Bathsheba receives a letter from David
 71H7131 – Bathsheba alone with David's letter

Iconoclass also mirrors semantic distance concepts, something mentioned in the readings but not yet found anywhere on the sites. By delineating the benefits of query expansion, semantic proximity (the number of horizontal and vertical transversals between terms) and faceted vocabulary, these articles suggest a more complex, potentially effective strategy for finding images. AAT is a faceted vocabulary, with seven

descriptors and 33 subdivisions representing conceptual classes in order of abstract to concrete (from associated concepts to materials) (Tudhope, 2002). This organization resembles that of Iconoclass. Knowing about the emergence of these search strategies helps one to realize that linear searching is not necessarily the only, or ideal, method. It also allows a more informed analysis of the current websites and how these new technologies may be implemented to improve them.

The analytical group of readings was the most helpful in that it offered insight into the principles and goals of the technologies and how successful they are based on user studies. It contains pieces on best practices, evaluations of current systems and uses, problems and specific usability tests. The “Framework of Guidance for Building Good Digital Collections,” which the Institute of Museum and Library Sciences published in 2001, is akin to the CDWA in its proposal of guidelines rather than specifics (Cole, 2002; Cunliffe, 1997). It stresses technological development and digitization, thoughts to future usage and interoperability. It notes, however, that the realms of usability and sustainability were lacking.

This gap was partially filled in the form of various image retrieval database tests, which provided new insight into user habits and desires. Some discoveries may hamper the quality of record creation: users greatly prefer quantity and ease of access over quality, which could mean sloppy and incomplete records (Besser, 2002). Others will help database and interface creators cater their products to users: browsing is more helpful in large and varied collections, but experts prefer searching to browsing (Marchionini, 1998). This is reflected in the businesslike interface of the Getty website. Standard toolbars, consistent layouts, tables of contents, overviews and previews help orient users.

They develop a set of expectations that will help them navigate the site more effectively. Sites whose links are layers deep confuse them, though tree structures (an expandable list of folders and files) on the left side of the browser window have been effective in allowing quick jumps to buried pages. When looking at the museum sites, it was beneficial to have these guidelines to more objectively gauge how user-friendly a site may be, given its audience.

Much of the study for this paper was based on the next subset of articles, those which discussed problems with image-retrieval sites. These issues tended to fall into four categories, in increasing levels of difficulty and abstraction: technical (storage), semantic (controlled vocabulary), content (field control) and context (thematic issues) (Hastings, 1999). Bringing more information to the user was a common theme, including letting users know the number of items in a particular category or potential search (an estimate), how changing parameter effects will alter query results, and definitions and visualizations of terms (Cunliffe, 1997). Different institutions also have varying definitions of success. Some stress design goals and scalability to the size of a collection, others component autonomy and ease of contributing those components (Paepcke, 1998). Design challenges include serving a wide variety of users, distinguishing between different object types in results, linking to different collections or institutions and multi-media searching (Marchionini, 1998).

These and other hurdles were tested in a few key trials beneficial to this study: an AMICO survey (Sayre, 2003), an analysis of controlled vocabulary usage among 30 museums (Gilchrest, 2003), an examination of hierarchical faceted metadata effectiveness (Yee, 2003), and a comparison of iterative (HiB), directory (Yahoo!) and

keyword (Google) searches (Bruza, 2000). The AMICO survey pointed out one major drawback in this study, that of variation in user bases, interfaces and capabilities. Each AMICO distributor (five as of 2003) caters to a different audience, from kindergarteners to scholars, so it is difficult to “compare apples to apples” (Sayre, 2003). These sites differ in the usage (and success) of natural language capabilities, truncation, indexing methodology, fields for query, fields searched with Keyword and Boolean queries. This is also true among the eight museums and consortia analyzed below, particularly concerning collection content. The study also echoed what became a common theme, the importance of user consideration and future use in the creation and success of these sites. One noted conflict among these studies is that users say they want depth and context, yet prefer quantity over quality – by 69 to 31 percent in one AMICO study, and 72 percent of those participants were librarians and professors (Trant, 2003).

The study of controlled vocabulary revealed that only 14 of 30 museums considered the availability of a vocabulary when purchasing software (Gilchrest, 2003). Only seven of the 14 had that software installed. Nineteen said they have a vocabulary in place, but only 11 use it. These low numbers are partly explained by common comments of the participants, which reflect problems inherent in some of the eight databases evaluated here: the vocabulary is difficult to learn and oriented toward Western terms, no foreign or ancient terms can be used, and people do not want to learn new habits. Following user surveys, museums would like to post as much material as possible and deal with quality later. Users also prefer queries and do not want to look at the vocabularies (this is not a shock, as the museums do not either). Consequently, users will not know which terms to input and the vocabularies will be useless. The study’s

conclusion proposes what AMICO distributors and Dublin Core aim to be – a third-party system that allows the integration of various customized systems.

A more innovative and seemingly successful solution for the terminology issue is query-based (or query by) navigation (Bruza, 2000). This iterative search is based on hierarchical faceted metadata that groups results by theme and allows for refinement, criteria addition and redefinition of terms (Yee, 2003). While keyword searching is faster and brings more results, it is a less accurate and satisfying method, according to the majority of the 32 art history students in the study. Museum databases have an intimidating proliferation of fields and drop-down lists. The ability to cluster items by something like function (how is the object used?) rather than merely search by material or culture would make searching more accurate and simple. This interface also had a viewable tree structure, so alternate categories and relations between fields, currently invisible on museum sites, could be searched.

Based on these and other studies, the literature broached fixes for current problems and ideas for continued research. Iterative, semantic and field-specific searching seemed most important, as well as the importance of browsing (and the ability to understand how and why it is done) (Toney, 2003). Grouped results and more specialized sorting, including viewing options, object type and granularity level, were also stressed, as museums put more items and formats online. Cross-referencing alternative spellings, forms and contextual data were predicted to improve retrieval comprehensiveness and the intellectual content of the databases. At the integration level, sources suggested open-source shareware that groups can edit or expand with specialized

modules. The bottom line, however, was the ability of the user to get a decent number of results with a basic query.

While these articles and site pages helped form a solid basis for research, some topics were inadequately covered. Primarily, more concrete information about the structure of the museum databases is necessary. While this is not something the average visitor would use, more serious researchers or professionals may benefit from such information on the (otherwise excellent) Search Help pages. Some sites, such as LACMA, also have automatically updated statistics incorporated into their searches that indicate how many images are in their database – a simple yet valuable tool.

A particularly helpful study would be an examination of the tradeoff between simple mark-up that can handle many disciplines or formats (i.e., Dublin Core) and a more complex mark-up that allows for rich detail but few conversion or subject matter options. How might they be integrated? An analysis of how users actually incorporate vocabularies like AAT into their searches would determine if they are useful even when implemented by the museums. Would they be looked at? And finally, taking the summarized studies further, how do different goals and levels of proficiency alter how people use searching and browsing methods? Would it be beneficial to have different interfaces for different levels (some are said to dynamically respond to the user's apparent level) or would that only confuse visitors? The basic theme in many of these articles is simply balance – between simplicity and precision, breadth and depth, customization and universality.

III. METHODOLOGY

Criteria for Museum Choices

When choosing candidates for the study, the primary considerations were the complexity and depth of the databases and, secondarily, browsing capabilities. Given the rudimentary searching capabilities of many otherwise informative and appealing museum websites, there was not much weeding in the selection process. A target participant number for the study was not established. Rather, after spending up to an hour on approximately 50 large museum websites, those that seemed particularly fit to test desired issues were singled out. Inclusion required an adequate number of search fields (the two with only four and five have other valuable features), auxiliary forms of browsing and searching (drop-down lists or search limiters) and a large enough collection to ensure sufficient test results.

While these factors largely determined inclusion, the chosen sites have an array of user groups, goals, sizes, database variations, interfaces and scopes. The group is a satisfactory representation of the diversity of fine arts museums. The main type missing is the highly specialized museum, as such a collection is generally not large enough to be suitable for the study's tests. The final list consists of six individual museums and two collaborative institutions that harvest images and data from several sources. Five of the six museums chosen are members of AMICO (<http://www.amico.org>), itself included in the study. The museums' AMICO memberships indicate commitments to digitization and

integration, as well as minimum standards of record metadata (which AMICO requires).

The final institution is also a collaborative effort, the Online Archive of California (OAC, <http://www.oac.cdlib.org/>).

Latest tallies of the museums' collection sizes (images online and off) and a summary of their abbreviations are listed in Table 2. These statistics and facts throughout this section regarding the institutions are all from their respective websites.

Table 2

Museum Abbreviations and Collection Sizes

Museum	Abbrev.	Online and in-house collections
Getty Photo Study Collection	Getty	300,000 records of 700,000 photos
Online Archive of California	OAC	120,000 images. 7,400 finding aids
Art Museum Image Consortium	AMICO	100,000+
Fine Arts Museums of San Francisco	FAMSF	82,000 of 110,000
Los Angeles County Museum of Art	LACMA	46,100 of 100,000
Museum of Fine Arts, Boston	MFA	30,000 of 350,000
Metropolitan Museum of Art	Met	6,500 of 2 million
National Gallery of Art	NGA	5,600 of 106,000

AMICO and OAC are the most well known consortia and leaders in integration, consistency (AMICO for ambition, OAC for success) and influence. AMICO is the largest collective database of art objects, with approximately 40 museum members, more than 300 subscribers, six distributors and well over 100,000 image records. The Consortium seeks to offer collaborative, comprehensive and cross-referenced information about images in museums and repositories around the world. Its ambitions pose unique problems when considering the range of user levels, from kindergarteners to scholars, and the array of technical standards, such as controlled vocabularies and metadata schemas.

Developing protocols for format and content that successfully balance and integrate these needs is a challenge. The complexities of creating standards and ensuring minimum interoperability make AMICO an ideal subject of study. OAC is the best example of a collective database of photographs (and integrated finding aids). It contains more than 120,000 images, 50,000 pages of oral histories and over 7,400 related finding aids. As OAC was the first to implement the newly minted EAD, it is unsurprising that its underlying structure facilitates the most consistent and cross-referenced information of any database surveyed.

Visiting each of these museums offers a different experience, one tailored to its collections and users, but just as often circumscribed by its technical, financial or informational limits. Each institution, with its attributes and reasons for inclusion, will be discussed in increasing order of user sophistication – from the general public to scholars. This is often, but not always, equivalent to information or database sophistication, as some in-depth and highly interlinked sites have a basic user base. This format highlights how differences in interfaces and options reflect user needs and institutional goals.

The Fine Arts Museums of San Francisco (FAMSF, <http://www.famsf.org>) is candid about its goal to put as much of its collection online as possible to service the public, disregarding contextual or detailed metadata. Its basic site professes a minimal level information and analysis but promises “tens of thousands of images indexed by keywords.” This quantity-over-quality approach, repeatedly preferred by users (Besser, 2002), is apparent in the number of images online (nearly twice that of LACMA). With four search fields, it has the fewest of any museum, a reflection of meager metadata. It is the only museum without a title or a specific date field (keyword takes the place of a title

search). This combination of high content and low structure engenders unusual features and results.

The Museum of Fine Arts, Boston (MFA, <http://www.mfa.org>) is a more sophisticated looking site and ties LACMA for the most search fields offered (11), though LACMA's options are far more complex. It does not have controlled vocabularies or standards created especially for the web, but it does use them in its offline objects and collections databases: content standards cover field definitions, and style standards cover grammar. Other uncommon elements, however, indicate that it is geared toward public use – a “popular searches” section, a browsing-focused interface, and lengthy help pages that describe provenance and how to create diacritic marks.

Despite an elaborate area for young visitors, the Metropolitan Museum of Art (Met) has the goals of an advanced, research-oriented site. It uses the more detailed Research Libraries Group (RLG) interface and is developing documentation standards to create authority-based guidelines that will increase retrieval accuracy. Its search results are not as richly detailed as the research giants', but it has unparalleled browsing features – in aesthetics, content and high-tech navigation.

The most unlikely combination of attributes is found on the National Gallery of Art (NGA, <http://www.nga.gov>) website, which combines an amateurish template (complete with mismatched text colors, textured wallpaper and a dot-com era feel) with a remarkable wealth of contextualized, exhaustive information. The site has many more text records than images (the entire collection is online in text format) and the fewest online images of any studied site. This reveals the museum's commitment to quality over quantity, as many images have research-level data and fabulous cross-referencing. One

would never guess this, as the search interface includes only two fields that are not drop-down lists. The reason may lie in the user base. As a government-owned museum, NGA has a wealth of resources, but also a responsibility to reach the broadest community possible. This is a curious combination of scholarly level information locked underneath a basic and constricting interface, which is the main reason this site was chosen.

The last two sites are scholarly-level institutions with library records (LACMA, <http://www.lacma.org>) or finding aids (Getty, <http://www.getty.edu>) that are searchable and integrated with image data. LACMA has three study centers within its museum and the Getty is the epicenter of art world research, so it is natural that their sites would cater to high-end users with advanced needs. Using MWeb's interface, LACMA has 11 advanced fields and as many sorting options (ascending or descending). It is the only site that gives an indication of its classification system by way of elaborate hierarchical field menus in every category. Unlike the Getty, however, it has a friendlier, simpler interface for the regular visitor and fabulous browsing options, which make LACMA the most versatile site. Its ability to cater to professional and lay audiences, as well as manage the largest amount of data elegantly, makes it a good candidate.

The Getty's Photo Study Collection, a minute corner of the Getty labyrinth, was chosen for its uniquely research-oriented focus (the word "research" occurs twice in its URL: http://www.getty.edu/research/conducting_research/photo_study_collection). Unlike LACMA, this imageless database of photographic records is meant as a precursor to visiting the site for research, preferably by appointment with a librarian. The five fields offered on this black and white, text-only website come with their own search guides and a browsable keyword index with pages of terms like "Aa.10" and "Aartsbisschoppelijk."

The site, whose parent institution invented the AAT, does not use it because the Photo Study Collection was created years before standardized vocabularies existed (1983). This site does not acknowledge the needs of the general public, nor does it need to. It is an extreme example of a user-specific art site that is an impeccable resource for its audience and potentially abstruse one for everyone else.

Criteria for Tests

Rather than choose a set of identical tests for every museum, as differences among them made this impossible, a list of desirable qualities, including terminology consistency, cross-referencing and accuracy of results, was developed. These elements were based on common problems and crucial factors mentioned in the literature, museum database specifications, promised functionality and issues that arose while testing the sites. Certain tests were possible for all museums, and they tended to cause the most problems: name format consistency (did partial or complete names, reversal of name order, or use of diacritical marks bring up different results?), consistent and proper use of word form (France versus French, cat versus cats), and subject / keyword / descriptor / title tests (does a painting titled *Crucifixion* have that term listed in any other descriptive field?).

A set list of words was chosen for each of these trials (see Appendices E, F and G), though additional terms were occasionally added to increase the level of certainty. The two common problems when retrieving artists' works by name were the haphazard use of diacritic marks and variations in the format for ambiguous artist names. To search for uniform use of diacritic marks, two graduate level art dictionaries were consulted and

all but the most obscure names with such marks were used (44 total). Only the part of the name with the diacritic was entered, first or last, to increase results by also retrieving other artists with that name. Not all selections were used for each museum. When at least 10 retrieved helpful results (a clear conflict or regularity in the use or non-use of marks), the search was stopped. Names used on all sites include Cézanne, Dürer, André, Eugène, Miró and Honoré.

A list of artist names, for use in format consistency and general tests, was compiled from the Popular Searches table on the MFA site, web searches on museum or art sites that listed top viewed artists, and personal knowledge of the most well-known, collected artists. Websites visited were places a casual art admirer might visit, such as Artcyclopedia (<http://www.artcyclopedia.com>, the top hit for “fine arts” on Google) or ibiblio’s Web Museum (<http://www.ibiblio.org/wm/>). Artists chosen for form had compound names or a pseudonym, such as Rembrandt (Rembrandt Harmensz van Rijn) or Domenikos Theotokopoulos (known as El Greco). Twentieth century artists were not considered, as copyright restrictions generally prohibit their online use. Table 3 on the following page lists two examples of names tested on all sites, and various forms found in one of the databases. Each version retrieved different art works.

Table 3

Retrieved names for Rembrandt van Rijn and Honoré Daumier

Rembrandt Van Rijn	Honoré Daumier
Rembrandt	Daumier, Honor
Harmensz, van Rijn Rembrandt	Daumier, Honore
Rembrandt Harmensz van Rijn	Daumier, Honore-Victorin

For word form (singular / plural, noun / adjective) and category cross-reference tests, a list of 15 common nouns from the random image generator of LACMA and the Met's Art Daily Archive and the five most exhibited countries were selected. Terms include France / French, China / Chinese, horse, crucifixion and umbrella. Nouns were used because they are the most likely to be used in fields such as Subject and Descriptor. Irregular use of country and culture terms and the lack of crucial art work title words in Subject or Descriptor fields were particular troubles in preliminary searches, and so they were chosen as standard tests. Other aspects considered were the clarity and number of search fields, visibility of metadata, controlled vocabularies and search help, navigation and browsing effectiveness, appropriate search complexity for user base, matching of query and results, contextual and cross-referenced information, and special features.

The analytical articles suggest that users feel browsing is an integral part of searching, as it reveals the scope and focus of the site. Evaluating a museum's browsing options – whether high-end interactive tours or basic click-through collection overviews – increase query quality and retrieval. When browsing is integrated into searching through drop-down lists or other controlled field entries, errors due to vocabulary mismatches or incorrect field usage are eliminated.

Details in Search Help pages of the underlying structure, term choices and syntax also increase search accuracy and are a consideration in site effectiveness. Sometimes, however, even the best formed searches bring back inaccurate results. This occurs when the database lacks standards for syntax and terminology and is particularly common when more than one person or group is inputting data. Where possible, information about standards and practices used for data input were figured into the results.

The depth and interlinking of results information not only offers specifics about one particular work, but also shows its place among other works with the same artist, theme or location. Some sites have links that lead to related subjects or other pieces in that collection. Even though these links are more akin to browsing than searching, their accuracy and structure vary widely and share similar consistency issues. Their presence also makes searching more valuable by enriching the retrieved content.

Special features allow a different kind of cross-referencing, usually the ability to save images to a workspace for future viewing and comparison. Other sites allow multiple views of an image or the option to sort by many different categories. As previously mentioned, this will become more important as online museum collections increase in size, or as thematic or iterative searches gain popularity. Together, these factors determine the experience and success of a user's retrieval process.

Testing Environment

Many of these tests were originally performed in October and November of 2002, though the methodology at that point was not identical to or as structured as the tests done in 2004. Relevant information from 2002 retrieved with the current methodology,

such as Subject / Title / Descriptor tests or collection number tabulations, has occasionally been included as a comparison. Tests done January through March 2004 were redone during the last week of June upon discovering the rapidity of changes in the databases over a short period of time. The Table of Attributes (Appendix A) was modified many times during the research as museum sites grew and changed. The current results, consequently, are a snapshot of eight museum and collaborative databases at a specific window in time. All tests were done on IBM and Dell computers, though ability to read diacritics varied (an informative discovery) and screen resolutions used were 1024 x 768 and 1280 x 1024 (this did not appear to alter any tests or the efficacy of browsing).

IV. RESULTS

The tests broke down into three basic categories, terminology consistency or clarity, basic cross-referencing and indexing, and thematic or contextual linkage. The first is comprised of name and title formats and parts of speech. The second involves subject / descriptor / title / keyword agreement and clarity, and the final involves links to related works or subjects. A final catch-all category deals with information depth and management, including syntax and format assistance, results display options, and special features (including advanced browsing). Several of these topics are briefly interspersed with the main categories where appropriate. Results will be discussed in general for each institution where relevant (not all tests apply to all museums) but will be represented in detail by selected institutions in the interest of brevity. These specifics focus on the problems, as they are what provide insight into possible improvements.

The most popular search terms on all sites are in the Artist category. As this is the shortest (two names, and often one, will do) and least ambiguous field, one would think it would be a simple one for finding works. In most cases this is true – typing in Max Ernst or Pablo Picasso will often retrieve several, though possibly not all, paintings by or about those artists. However, in order to be considered effective, such fields must work with trickier names whose variations tend to break the results into groups.

There were a few general problems with diacritical marks, as many sites do one or more of the following: make one guess whether to use them, use them for some works and not others by the same artist, display them incorrectly, prohibit them but show them

in the results, say “use them” but really mean “don’t use them” (and vice versa), and say “use them, but only when we feel like you should.” Only LACMA and OAC escaped with no errors. This is not surprising, as they are research-level institutions. LACMA was refreshingly consistent in its prohibition of marks, an MWeb specification and easy solution. OAC went the other route with equal consistency, requiring marks and retrieving unique results that matched the query for all records.

MFA also required marks, with almost as much consistency – the only times a required diacritic was left out and retrieved a result was when the record itself lacked it (one Albrecht Dürer and one Paul Cézanne record; both were works about them by other artists, which suggests the absence might be in the title itself). The Getty allows the inclusion or omission of marks. The novice-friendly NGA not only allows either format, but also retrieves records with incorrect diacritics, such as Mirò for (Joan) Miró.

Other museums did not fare so well. AMICO’s Duke University interface (one of at least five distributors) performed poorly due to the vast number of record authors. Despite lengthy descriptions of recommended standards on AMICO’s website, they are clearly not used often on this database (other AMICO distributors with different databases and interfaces will function differently). Such standards are hard to enforce, as museums often do not or cannot spend time and money altering their catalog records. Each of 10 diacritic names tested had multiple formats in the drop-down menu of artist refinement choices, and each option had different works attached. One could tell by the metadata which works might have been entered by the same institution.

FAMSF now requires diacritics, yet many artists are retrieved when they are omitted, and some results do not display them properly. RenÈ Magritte and Albrecht

D,rer were common (though Dürer appeared correctly elsewhere). Géricault and Gericault both retrieved the same 11 results (nice but not consistent with the museum's requirement), but Durer retrieved none while Dürer brought back 206.

The Met also supposedly requires marks, but either format retrieved the same records for nine of the ten chosen artists. Of course, there were exceptions in the additional artists tested, such as the requirement of diacritics for Eugène Carrière and the occasional lack of results when putting only one of multiple diacritics in a name like Jean-Louis-André Théodore Géricault or Jean-Léon Gérôme. This only mattered on computers where diacritics were displayed properly. Computers that displayed Jean-Léon Gérôme as Jean-L?n G??e brought back identical results with all, some or no diacritics. There were also records with missing marks, such as several compound names ending in Francois (well known to have a “ç”), which were skipped when searching François.

Name formats were much worse, as there are more options and more names that may be ambiguous. Records differed in which names they included (last name, first and last, middle names) and in which order they appeared. Certain popular artists were tested on all sites, such as Rembrandt, Honoré (and of course, Honore) Daumier, Edgar Degas and El Greco.

The Getty's Union List of Artist Names is freely available on the Getty website, yet only used by AMICO (despite ample evidence to the contrary) and OAC. The top name is the preferred term, and the rest are vernacular (hence the V) – foreign terms or alternate versions. Rembrandt has 32 forms (Appendix D). El Greco had many more, but he was consistently listed as El Greco on websites and therefore only tested for linkage to his real name. ULAN lists 13 options for Edgar Degas, shown in Table 4.

Table 4

Union List of Artists Names for Edgar Degas

Degas, Edgar ([preferred](#), [index](#), [V](#))
 Edgar Degas ([display](#), [V](#))
 Degas, Hilaire Germain Edgar ([V](#))
 Degas, Hilaire-Germain-Edgar ([V](#))
 De Gas, Hilaire Germain Edgar ([V](#))
 Hilarie Germain Edgar Degas ([V](#))
 De Gas, Hilaire-Germain-Edgar ([V](#))
 Degas, Edgar Hilaire Germain ([V](#))
 Degas, Edgar Germain Hilaire ([V](#))
 Edgar Germain Hilaire Degas ([V](#))
 de Gas, Hilaire Germain Edgar ([V](#))
 Gas, Hilaire Germain Edgar De ([V](#))
 Dega, Edgar ([V](#))

FAMSF had typical results in its inconsistency, as Table 5 indicates, but was the only museum to favor the preferred term, Rembrandt Harmensz van Rijn:

Table 5

FAMSF Results for Rembrandt van Rijn

Name Format	Results
Rembrandt van Rijn	346
van AND rijn	346
Rembrandt AND Harmensz AND van AND rijn	346
Rembrandt	181
Rembrandt Harmensz van Rijn	0 (but listed this way in all results)
“van rijn”	0 (but listed this way in all results)

LACMA had 29 records for Rembrandt Harmensz van Rijn, the preferred term, or any combination thereof. Rembrandt alone retrieved 289. MFA came up empty with Rembrandt Harmensz van Rijn but brought back 329 with Rembrandt. The Met brought back 23 works when inputting Harmensz or van Rijn in the artist or keyword fields (Rembrandt retrieved 100s by many artists and was therefore not relevant). But when

Rembrandt Harmensz van Rijn was entered as an artist or keyword, only one work appeared – a watercolor of him by John Singer Sergeant. NGA circumvents this problem by requiring the last name only in the artist field, though Rembrandt van Rijn works as well as Rembrandt (like Degas, where his last name begins, exactly, is apparently an unresolved matter). It includes alternate names in the record, which is helpful unless incorrect: “Also known as Rembrandt Harmenszoon van Rijn.” OAC’s collection was not relevant for this test.

Saving the worst for last, AMICO produced the results in Table 6 on the following page for sample artists. Rembrandt fared better than others. All names listed below were those in drop-down menus of creator names (including those with no results) or in the artist field in results records. They indicate why an intermediate database that uses the ULAN to standardize all possible combinations is clearly necessary. Note that Daumier as a keyword retrieves nearly 600 records, most of whom are for Honoré Daumier.

Table 6

AMICO Creator Search

Creator Search Term Options	Results
Rembrandt Harmensz van Rijn	363
Rembrandt Harmensz van Rijn	2 (note extra space between Harmensz and van)
Rembrandt van Rijn	1
Rembrandt	1 (different than above)
Creator Search Term Options	Results
Honoré	0
Daumier, Honor,	0
Daumier Honor,	0
Daumier, Honore	1
Daumier, Honor	0
Daumier, Honore-Victorin	0
Name Formats Listed in Results	Results When Pasted Back into Creator Field
Daumier, Honor-Victorin	0
Honore Daumier	0
Daumier, Honor, Victorin	0
Keyword Entries	Results
Daumier	~ 600
Honore Daumier	3
Creator Search Term Options	Results
Degas, Edgar Germain Hilaire	249 (this should be reversed: Hilaire-Germain. The creator is also listed in these records as Edgar Degas.)
Degas, Hilaire-Germain Edgar	11
Degas, Edgar	3

Titles were quite consistent at most museums, with the notable exception of MFA. Titles of representative items from ten sections of the One Hour Tour were pasted back into the Title field of the advanced search (Appendix J). Two were retrieved by that title (one lacking the tour image), six were retrieved by other means (shortening title names; filling in Material or Country fields rather than Title), and two were not found at all. Two

retrieved were under a shorter title, and one had an extended title. Only John Singleton Copley's *Paul Revere* returned the same title that was requested.

Shortened titles were common with ancient objects (descriptive elements were ostensibly removed for brevity) and failure to retrieve titles that matched was a recurring issue with paintings. Paul Cézanne's *Self Portrait with Beret* was not found by searching with "beret AND Cézanne" or "self-portrait AND Cézanne." AMICO had similar troubles and inconsistencies, with titles or parts thereof known to be in the collection retrieving no results. The same test was tried with NGA's *American Portraits of the Late 1700s and Early 1800s* and *Medieval Metalwork and Enamels* tours (eight objects in each, the latter tour being works without standard titles, such as the ancient examples at FAMSF). Both had a 100 percent success rate, save one diacritic that was improperly displayed and consequently not found when pasted into the title search field.

The Met's results for the *Arms and Armor* and *Asian Art* tours were equally positive (ten objects in each tested), with only one lengthy title not appearing if the post-comma words were retained (*Armor of George Clifford, Third Earl of Cumberland*). Even titles lopped off at the end ("Spouted ritual wine ves" for "Spouted ritual Wine Vessel [Guang]") or the bracketed ends of rambling titles (*Krishna Battles the Armies of the Demon Naraka: Page from a Dispersed Bhagavata Purana [Ancient Stories of Lord Vishnu]*) returned correct results.

LACMA's *Chinese and Korean Art* (seven items) and *American Art* (11 items) tours were tested with complete success. Nothing from LACMA's *European Painting and Sculpture* was online, but such a consistent absence must have an underlying reason that was, unfortunately, not explained on the site. Search terms from the predetermined

list were entered into the Getty, FAMSF and OAC databases, as they had no online tours. The resulting titles, ten in each museum, were entered back into the database with 100% accuracy.

The next searches tested the clarity of fields and consistency of parts of speech used within certain fields – nouns for Country, adjectives for Culture, or at least a consistent format for the form chosen. This includes the usability of drop-down lists and the distinction of fields like Culture and Place, or Material and Type. These terms can be ambiguous. Marc Chagall is a Russian-born painter who worked in France. He is listed as Russian in FAMSF. LACMA and MFA miss him entirely, and NGA and the Met catch him with both. Viewing numbers alone, several museums were consistent with Culture (adjective) and Country (noun) fields, with culture the more common term by a factor of up to ten. OAC's keyword-only interface was not relevant for this sort of test. However, they claim to retrieve identical results for plurals and singulars of a word, yet their own example, "farm" and "farms," retrieves separate numbers (1,967 vs. 1,338), as does "cat" (141) and "cats" (27).

Many sites, such as FAMSF, had too many results for cultures and would not return any records (their repeated return of 3,696 or 8,130 blank pages was an indication that the system was overloaded). Others were logical, such as MFA, whose results for German and Indian were numerous as keywords, present in Culture (a more restrictive field), and absent in Place (which requires a noun). Germany and India, however, also returned zero and six results in Place respectively, suggesting the field may not often be filled.

It was often easy to determine if these fields were entered uniformly, as their relative numbers were consequently consistent. Greatly varying distributions, however,

signified an uneven entry format. At the Met, France, Germany and America have identical rankings when comparing Culture and Keyword. As Table 7 demonstrates, the adjective form (French) + Culture is the most commonly found and noun (France) + Culture the least. One would expect the Keyword field to take precedence over Culture, as it usually encompasses that, plus other fields. Non-Western countries India and China, on the right side below, have the adjective + Culture combination as the *least* common result.

Table 7

Rankings of Culture and Keyword Entries at the Met

French + Culture = 854.	India + Keyword = 49
French + Keyword = 351	Indian + Keyword = 39
France + Keyword = 279	India + Culture = 25
France + Culture = 80	Indian + Culture = 3
American + Culture = 3308	Chinese + Keyword = 46
American + Keyword = 337	China + Keyword = 39
America + Keyword = 160	China + Culture = 27
America + Culture = 110	Chinese + Culture = 8
German + Culture = 172	
German + Keyword = 116	
Germany + Keyword = 100	
Germany + Culture = 25	

Moving to field cross-referencing success, there are similar tests to determine if works of art are catalogued across fields like Subject, Keyword and Descriptor (or Description) in addition to Title. These references will become increasingly important as sites increase their online collections and rich linkage. Media, such as bronze or woodcut, may also be compared this way, though only with Keyword. For example, MFA had 1,538 “bronze” records in Medium and 1,660 in Keyword in 2002. This is logical, as

maybe eight percent had “bronze” in other fields. The relation two years later is similar (though the numbers have more than doubled): 3,577 and 3,740. With title words, one can more easily see how complete the metadata is. LACMA, the most well-organized and thorough site, has inexplicable gaps in its Subject and Description fields. The terms in Table 8 were inputted into each of the four categories shown. Tallies from 2002 are in parentheses.

Table 8

Prevalence of Title Words in Other Fields at LACMA

	Title	Subject	Description	Simple
Jesus	4 (2)	0 (0)	0 (0)	9 (2)
Crucifixion	87 (0)	0 (5)	5 (2)	92 (7)
Woman	>1600 (1175)	0 (0)	317 (83)	>1700 (1257)
Bridge	148 (88)	0 (0)	15 (3)	164 (91)
Wine	59 (44)	0 (0)	2 (1)	63 (46)
Costume	1563 (203)	144 (114)	32 (1)	>7700 (>3300)
Umbrella	5 (2)	0 (0)	5 (1)	11 (4)

The vast majority of these title words were main visual features, particularly the first two (titles such as *Kitten Bathing, with Crucifixion in Distance* were not found). These results indicate that most of the works are missing metadata that would contextually link them in the future, when subject-themed collections are dynamically generated or users become accustomed to thematic jumps between works. Description terms are a bit better, but the only one whose results there are similar to Title is “umbrella.” Unfortunately, none of the results in Description match those in Title. Why “woman” or “umbrella” in either Description or Subject did not return images such as “Woman with Umbrella” is puzzling.

AMICO's cross-referencing was sparse in general and nil if one discards ineffective results. Given its myriad contributors and focus on the more basic aspects of language and field consistency, this is expected and forgivable. It is difficult to link a title to related artist or subject works if those field terms are catalogued in many different ways. MFA had similar issues, with a 156-item tour titled Italian Paintings and no results for "Italian + paintings" as keywords (Italy + paintings returned 17 works). The Met was little better. "Horse" was entered into the Subject field to retrieve ten known works with "horse" in the title and as an obvious subject. Only three were found.

OAC, as always, had a 100 percent success rate when testing its subject consistency and hierarchy of terms. Because it does not have an advanced search, and because it focuses on browsing, its subject / keyword evaluation was based on its extensive browsing tree structure, in which six main subjects (People, Society, Technology, Places, Nature and History) are broken down into second and third tiers, all arranged alphabetically and thematically by subject. These few hundred subject headings are linked to photographs in the archive. Some images have zero subjects linked, some a dozen. The terms horse, cat, pitcher and umbrella were searched, and every other retrieved record was selected. Images without subject headings were discarded. The remaining lists of subjects, such as "cat, men, children, people, fences, monkeys, animals," were fed back into the search field to see if the original photo reappeared. The searches retrieved all 20 selected photographs.

The Getty's site was "too" successful. All inputted titles, even *Allegory of the Triumph of Fame with the Figure of Fame in a Tondo supported by Sphinxes, pulled by Elephants, and with a Crowd Behind*, were entered into the subject category equally

successfully, which makes one wonder what exactly is thrown out in a subject search. FAMSF is even more unusually cross-linked. There are no Subject or Descriptor categories, but each image record generates a clickable list of Related Keywords taken from fields from Title to Accession Number. One record can contain 50 such keywords, many of which return no results when clicked (not even the painting that lists the word). For this reason, the number “3” receives 1,693 results.

Concrete keywords, such as nouns and adjectives, fared best, while abstract, small or provenance-related words were generally useless. Such automatically-generated lists would be of great help if they restricted themselves to Subject, Descriptor and Keyword fields – assuming, of course, they were actually filled in. Figure 1 is the keyword set for Edwin Austin Abbey’s *One More Mouth to Feed, - p.29 Harper's Weekly 13 January 1877, 19th - 20th century*. Terms highlighted are of little use to the average user, being ambiguous or throwaway words.

Figure 1. *Result Set of Related Keywords at FAMSF.*

<u>Related Keywords</u>
1877 January 13 Weekly Harper's p29 Feed to Mouth More One Arts Graphic Achenbach America North States United Print engraving wood father console girls little 2 baby new cuddles old room shabby bed Woman Edwin Austin Abbey American 5050161216220048 A0527471963.30.18867 AFGA

A test of 15 records was devised (one result from each Subject Term in Appendix G) to determine an average number and type of terms listed. The 472 resulting terms were classified into seven categories: nouns, names, culture/places, adjective/adverbs, verbs, medium, and small words (letters, prefixes, numbers, prepositions, etc). Ambiguous

words that could have fit into more than one category were allocated to the one that seemed most relevant to the related artwork. For example, two terms – horse and marriage – brought back the term “groom.” The word was considered a verb for “horse” and a noun for “marriage.” Table 9 is a breakdown of word forms found.

Table 9

Prevalence of Word Types in Related Keywords at FAMSF

Word Type	Number
Noun	120
Small Word	117
Name	72
Culture/Place	60
Medium / Object Type	39
Adjective/Adverb	36
Verb	28

The average record had 31 keywords. Twenty-five percent (117) were considered small words (not helpful when searching), and another eight percent (38 words) were ambiguous, fitting into two, sometimes three categories (marginally helpful when searching). Only the primary category was tallied in the results shown in Table 9. Approximately 50 of the names were provenance-related, and none were differentiated as artist, title and provenance names – another form of ambiguity. These small and ambiguous words comprise more than half of all keywords. Fortunately, nouns were the most common terms, as they are the most objective term of the group. One hundred twelve of the 120 were concrete, rather than abstract, nouns.

Another area where an embarrassment of riches can make things difficult for the user is field categories. When left blank, they can be an issue because users, particularly novice ones, do not know what to fill in. When equipped with massive option lists, often

in an attempt to remedy such problems, they can be just as daunting, as is the case at LACMA. Ultimately, this is not a drawback, as their simple search is adequate for beginner and intermediate users, and their advanced search is meant more for researchers. Still, a look at their field lists reveals their complexity. They offer an insight into how data collections are organized and how off-putting it can be to try to navigate them. If one would like to find a sculpture at LACMA through the Type of Art field, there are approximately 2,000 options. Some fields differ only by the inclusion of a superfluous semicolon. A searcher may type “sculpture,” however, and retrieve 166 hits – a number that oddly jumps to 1,349 when selecting “sculpture” from the Type / Classification field list. When perusing the subject lists, one cannot help but double-check the conspicuous lack of “Jesus.” The following four subjects appear, each of them retrieving one imageless library record:

Table 10

Subjects Listed for Jesus at LACMA

Jesus Christ--Art
 Jesus Christ--Crucifixion--Art--...
 Jesus Christ--Family.
 Jesus Christ--Passion--In art.

The overabundance of field options at LACMA contrasts with NGA’s site, which has been the most user-friendly thus far. Its Extended Search provides only two textbox fields, Artist’s Last Name and Key Words, and a Year Created span. The rest – School (German, Spanish), Style (Renaissance, Fauve), Medium and Popular Subjects – are all lists. Other searches, such as Provenance and Accession Number, are separate, one-box searches. The radio buttons (contained in a separate Subject Search) and drop-boxes are

wonderful for those who are not sure what they want or what is available, but those who would like to comb the site for specific types of works are quite restricted. An advantage of both LACMA and NGA is that they provide indexes – NGA an artist index and LACMA an alphabetically divided, then sub-divided index of every field – so that users can see their options before inputting something.

While the above methods mix browsing and searching for retrieval, another method involves browsing *after* retrieval. After finding a desired work, one may click on links like Related Works, Related Themes or Other Works By Artist links. These allow visitors to crawl about the site based on the nature of their interest, whether themes or specific artists or types of works. Such links are rare and, when present, sparse (most are Artist links that merely give a list of his or her other works – barely different from an Artist field search). One promising cross-linking is LACMA’s inclusion of an object set record for each series, which includes links to each work in the set. For example, the search “Return of Eurydice” (a series of nine lithographs by Max Beckmann) returns 10 results, one for each lithograph and one for the series. Other series at LACMA, however, did not have object records.

MFA links its more famous works to online collections they reside in, such as French Paintings or Collection Highlights: Master Prints. These collections may have hundreds of works, however, and are little different than Culture or Medium searches. NGA links its records to content-rich tours that include them, a more informative way of gaining context. Monet’s *Oysters* can take you to the tour *Manet and His Influence*. The Met also does this but neglects to tell you that you are leaving your result set and moving onto a tour. Users searching through Monet paintings are then surprised that the next

painting is by Pissarro. The Getty lists the File Category of the work, which can then be pasted into the Subject Words search, an indirect cross-reference. As noted, this field is the size of an unabridged dictionary and should be comprehensive, if excessive. OAC is the only site in the Table of Attributes (Appendix A) that has all six Related Items features. Records are connected to others with the same artist, theme and type, works in that and other collections, and the corresponding finding aid (whose tree structure makes for simple navigation). AMICO and FAMSF do not have any cross-referencing, aside from FAMSF's infamous Related Keywords.

The final considerations in the success of these museums' usability are browsing capabilities and special features. These vary as widely as the budgets, sizes and missions of the institutions. Recent high-tech features include virtual gallery tours that allow one to click on a map or move a cursor through gallery hallways in a Quicktime window. Zoom options bring far walls into focus. FAMSF's is high quality but does not let users know where they are on a map. This is even more disorienting in a virtual gallery, as there are no security guards to flag down for guidance.

NGA has extensive virtual tours of specific artist exhibits, including Vincent Van Gogh and Alexander Calder. MFA has smaller themed tours, but some even include audio. These tours, as well as larger Collection tours and several Related Themes and Objects, are found on individual records. So, if inconsistently-titled records cannot be retrieved through their One Hour Tour, at least tours can be found through those records.

The most impressive browsing feature, with an exponentially higher level of information and visual sophistication, is the Met's Timeline of Art History. By the time one viewed all of its contents, its once-current articles would be out of date. To begin,

one clicks on a 200-year period, then zooms in on a continent and country relevant to that era. Pages of history, artistic movements, and links to related special exhibitions, collections or countries would be daunting if they were not so flawlessly organized, both visually and thematically. Given the inconsistencies and lackluster options of the Met's searches (Appendix A), visitors would be far better off visiting the Timeline and moving to more specific areas from there. The Getty has no browsing capabilities (outside of field lists) or features, and OAC's remarkable hierarchy of subjects has been discussed.

Other notable features include OAC's drop-down list of suggested spellings when too few or too many results are returned. Every word in the query has its own list. Several museums allow users to save images to a personalized gallery, though FAMSF only mentions this in their About page, which most visitors would not look at.

Some of the museums stand out through exceptional contextual and background information. OAC's finding aids are extensive, and MFA has a remarkable amount of provenance information, as this is an ongoing project at the museum. NGA has extensive technical and historical information for some records and several fields other museums lack: exhibition history, conservation notes, narratives (not as common), inscriptions, exact museum location with links to surrounding works, and information for those who would like to purchase a reproduction. Conspicuously lacking, however, are artist biographies outside of birth and death dates and country of origin. If one happens to be included in the *National Gallery of Art's Brief Guide*, that entry is included. Several tours with pages of introductory information are also available, often providing context that the artwork records lack.

As a whole, the museums have consistency problems in many areas, though severity and type vary from institution to institution. The most severe are name and diacritic consistency and Subject and Descriptor searching. Cross-referenced works, artists and themes are rudimentary on most websites, and where they are available, they are more practically than conceptually linked. The few sites that use or claim to use vocabularies do not seem to benefit from them. However, recent developments such as Related Themes and Objects, conceptually or technically advanced tours, narratives, and increased awareness (if not implementation) of metadata standards are promising.

V. DISCUSSION

Analysis

The levels of proficiency and the types of issues found during the investigation mirror the tiers of the tests – consistency (technical and objective), basic-cross referencing and indexing (technical and subjective), and thematic context (conceptual and highly technical if involving algorithms to determine multi-factor relativity). These seem to be developed at each museum according to its mission, though with varied success. Some aspects are more important than others, depending on an institution's focus. Museums with notable problems in tier one may do beautifully in tier two. Objectives and resources often determine their strengths – as with the scholarly prowess of the Getty, the wide scope of NGA, and the abundant funds of both. Browsing capabilities may mitigate their weaknesses in spots, as is the case with the Met.

The most basic elements are in the first tier. These include questions of syntax, such as spelling and controlled vocabulary, and word format. They are the most pressing for the functionality of databases and, fortunately, the simplest to solve. The Getty, OAC, NGA and LACMA have largely mastered this level. NGA's all-around simplicity and OAC and the Getty's small number fields make discrepancies rare. LACMA's main trouble – name formats – was found in several museums. It is minimal compared with AMICO or FAMSF. It is clear that vocabularies are largely not in use even when ostensibly incorporated into any of these databases. FAMSF, AMICO and the Met all had

major diacritic problems in consistency and display. The museum that escaped here, MFA, had major title consistency problems, something relatively successful in other databases. Note that MFA, FAMSF and the Met were put in the low end of user sophistication when the study began. This may indicate a lower level of interest in or resources for adherence to more accurate research and retrieval tactics.

The next level involves indexing, field clarity and agreement. Basic browsing is also linked to this level, as its underlying structure involves subject, type or artist correlations. Dynamic or highly conceptual browsing belongs in the third tier and has yet to be employed on the sites. Culture / Country / Keyword results were not as conclusive as other areas, as some were fairly consistent (Met and MFA), others bringing back only error pages (FAMSF) or lacking one or both fields (LACMA, OAC, NGA, Getty). Field cross-referencing, such as Title / Subject / Description / Keyword linkage, varied widely and was possibly the key area in the study. Every museum had fields in place to test, and each was clearly successful or not. This will also be the likely area for improvement in the next few years, as it is more lacking and complex than consistency, yet currently more feasible than conceptual searching or browsing. It is, in fact, a step toward that last category. Much of the literature focused on refining technical and conceptual standards that will improve these areas.

While it is simple to determine if museums passed the tests designed for them, it is difficult to compare them, which is why this is not the aim of this study. One must consider the large number of fields and records when frowning upon LACMA's absence of Subject and Descriptor tie-ins with Title. They also have integrated library and museum records. AMICO's lack of cross-referencing is due to the multitude of

contributors and difficulties in implementing standards. The success of the Getty's site when inputting entire titles into the Subject field, and FAMSF's multitude of keywords, must be weighed against the fact that no filtering is in place. All of this makes OAC's success more remarkable.

More than other areas, browsing success must be measured by the mission of the museum. The Getty's lack of browsing and LACMA's lengthy field lists are not inconsistent with their advanced user base. FAMSF and the Met, both tier one failures, have quality browsing, as one might expect for a lower-end user base more interested in the casual perusal of a collection. OAC's interface is based on browsing (the only one), which explains its impeccable subject hierarchy. Searching among photos with no names or artists would be frustrating and largely futile. While subjective, those who fared best in cross-referencing and fields seem to be OAC (particularly with the finding aid linkage) and LACMA, and the Met's browsing capabilities far exceed those of other museums.

The only institutions to offer a glimpse of the thematic context to come are the Met and OAC, though the Met's Timeline of Art History is not yet integrated with searching. The Met has one aspect of high-level conceptual linking – uniquely large amounts of context and background information. However, they have no hint of the technology to dynamically link this information to records. While OAC is several steps away from such hierarchical searching and linkage, they are developing in a manner that suggests this possibility. With impeccable and visible hierarchies, consistent and detailed subject listings, complex cross-referencing, exhaustive finding aids and anecdotes about seemingly inconsequential photographs (of which there are an impressive 120,000), OAC is an outstanding resource. The only thing it lacks is complex browsing (beyond subject

and keyword), but like the Getty, this does not conflict with the goals of the site. A combination of the Met's browsing and content and OAC's consistency and dynamic cross-referencing would be a formidable educational resource.

Suggestions

What is required in the first two tiers is exactly what the literature has suggested – standards in both format (platform) and content (vocabulary). Intermediary interfaces, such as those envisioned for AMICO distributors, may compile all possible entry formats and convert them to a standard that will be used as the format for retrieval. More subjective format issues, such as name order, diacritic use and alternate spellings, would be best determined on a broader level, but may still be decided locally based on individual criteria. Input programs might even be designed to block or convert entries that do not match syntactical or vocabulary standards.

After adhering to such standards, museums would assist users by including explanations on their websites to help them understand how the search process works. Help pages on or links to the vocabularies and structures on which the databases are based would improve query and browsing quality. Museums not already doing so would also benefit from showing the number of retrieved records and the search terms used at the top of the results page. The framework and resources for these developments are already in place – committees convene to compare standards, and database contributors refine vocabularies. All that is required is their implementation and (the bigger challenge) the required resources.

On the user end, ambiguous terms such as “arms” or “china” could be thrown out (not ideal), queried for refinement in meaning or field designation, or automatically defined by surrounding terms, if possible. For example, “coat of arms” and “Venus + without + arms” are easily distinguishable, as are “china vase” and “china + dynasty.” Results might also be grouped according to such differences. There are also times when many fields in a database are blank. One option is to keep those barren fields in the database for future use, but not show them to users on the site who will continue to query empty fields.

Conceptual and interpretive issues with the added difficulty of advanced technology are complex, particularly dynamically-generated and iterative hierarchical browsing. These techniques retrieve terms that are weighted by their horizontal and (with less certainty) vertical distance to the inputted terms, which may also be weighted. The results are displayed in groups determined by the nature of the query, which can be refined to produce different results and groups. This method of searching appears to be the most exact, following the way the mind works – in a succession of branching paths rather than one exact linear path.

Similar searches in the visual realm are those which have users drill down to a particular set of images, then choose those of a similar theme or appearance to the type of image they seek. While these methods of searching require more mental energy and time from the user, the results they return are more accurate and satisfying (Yee, 2003). They require indexing that is both broad (many terms for each image) and deep (detailed hierarchies) and seem beyond the scope of current sites.

Linking records, collections and disciplines is a more feasible contextual goal, but it requires the cooperation and understanding of experts in several fields. For museums alone, this includes anthropologists, chemists, historians, librarians and the computer wizards that must develop the tools necessary for their collaborations. Each one has a unique focus and way of organizing the same information. The sarcophagus of an Egyptian pharaoh may be filed under “Pharaoh: Djoser” by the historian, “artifacts: funerary” by the anthropologist and “painted stone: 1400-1300 B.C.” by the chemist. Each of these designations will also require fields that are irrelevant to the other disciplines.

Despite its limitations, Dublin Core (DC) seems the best cross-discipline interface, with 14 basic fields that can be customized with attributes. These fields can link broad themes among disparate subjects, which can then be searched in further depth after hopping from one DC subject database to another, or linking to an XML schema. A more complex bridge – one beyond the scope of this paper – is the one lacking among languages. As virtually all museums contain items and receive guests from many countries, developing linguistically-integrated fields and concepts is of primary concern. While character sets and word orders may be tricky, they are also mostly technical. Aspects such as iconographic interpretation are more problematic. This is particularly relevant to places and websites like the Getty, which are primarily geared toward precise research on an international level.

VI. CONCLUSION

Recalling the concerns and proposed solutions mentioned in the literature, it is clear that some problems uncovered in the tests, and the underlying deficiencies that caused them, will be more difficult to solve than others. In addition to the above suggestions, ideas for future research revolve around the juggling of multiple, even conflicting, needs. Users want quantity but dislike meager records. Data creators desire interoperability but dislike limited field flexibility. Easy interfaces can be vague or limiting, complex ones precise and daunting, and compromises like long drop-down lists aggravating. Providing more than two search types, simple and advanced, seems excessive. Simplifying things by adding options only seems to complicate them. The answers may lie in a balance between simplicity and thoroughness.

This study aimed to investigate the chosen museum databases in an effort to evaluate problems discussed in literature and discovered while doing preliminary tests. The methods were necessarily tailored to each museum, but based on a set list of criteria. Consequently, while exact comparisons were not always possible, basic deficiencies surfaced and the differing strengths of each museum could be assessed in light of the others. All of these aspects were evaluated according to the mission of each museum and in consideration of the small test sample.

The original question that prompted the study – how these deficiencies affect searching and browsing success – will continue to evolve as databases do. Its results offer no definitive answers (a caveat in the literature review), but do prompt some very general

questions: How will the evolution of these and other educational websites change how people process and contextually link the information on them? How closely can the searching process resemble human thought? Will the linear thinking that became more prominent with language and texts find a counter-balance in this lattice-like, cross-disciplinary realm? These are long-term questions that may never be answered, but their continued consideration, coupled with the more substantial tasks of database and standard refinement, will bring museums and similar institutions closer to their educational goals.

APPENDIX A

TABLE OF ATTRIBUTES FOR SEARCH AND RESULTS

		AMICO	LACMA	OAC	FAMSF	NGA	MET	GETTY	MFA
FIELDS	EXAMPLES								
Artist	Van Gogh	✓	✓	✓	✓	✓	✓	✓	✓
Title	Mona Lisa	✓	✓	✓	-	✓	✓	✓	✓
Date	1879	✓	✓	✓	✓	✓	✓	✓	-
Object / Type	sculpture	✓	✓	✓	-	✓	✓	N/A	✓
Medium	bronze	✓	✓	N/A	-	-	-	✓	✓
Nationality	French / France	✓	✓	-	✓	✓	✓	-	✓
Genre/Era	Renaissance	-	-	-	-	✓	-	-	-
Collection	Levy Prints	✓	✓	✓	-	-	✓	-	-
Location	Getty Museum	✓	-	✓	-	-	-	-	✓
Provenance	(history of...)	-	-	✓	-	✓	-	-	✓
Subject	Hercules	-	✓	✓	-	✓ radio	-	-	-
Description	temple, funeral	-	✓	-	-	-	-	✓	-
Keywords	sunflowers	✓	-	-	✓	✓ title	-	✓	✓
Phrase	“water mill”	-	-	auto	-	-	auto	-	auto
Assigned ID#	FASF.330092	✓	✓	✓	✓	✓	✓	✓	✓
OPTIONS	EXAMPLES								
Date Span	1750-1800	✓	✓	-	-	✓	✓	-	-
Drop Down(s)	(list of options)	✓	✓	-	✓	✓	-	✓	✓
End Truncation	religio*, 178?	✓	✓	✓	✓	for artist	✓	✓	✓
Inner Truncat.	wom?n	✓	✓	-	-	-	-	-	-
Partial word	ation / Rembr	✓	-	-	-	-	-	-	-

		AMICO	LACMA	OAC	FAMSF	NGA	MET	GETTY	MFA
exact / contains	(all/part of title)	✓	-	-	-	-	-	-	-
Boolean choice	and/or/not	✓	-	✓	✓	-	✓	✓	✓
Show Term	Results for 'cat'	-	✓	✓	✓	✓	-	-	-
Diacritics	é, š, ä, ü	prohibits	prohibits	req'd	in results	either	req'd	either	req'd
Browsing	(available?)	-	✓	✓	-	✓	✓	✓	✓
Default boolean	and / or	or	and	and	either	and	either	and	and
RESULTS									
RESULTS	EXAMPLES								
Artist	Van Gogh	✓	✓	✓	✓	✓	✓	✓	✓
Title	Mona Lisa	✓	✓	✓	✓	✓	✓	✓	✓
Date	1879	✓	✓	✓	✓	✓	✓	✓	✓
Object / Type	sculpture	✓	✓	✓	✓	-	✓	✓	✓
Medium	bronze	✓	✓	✓	✓	✓	✓	✓	✓
Nationality	French / France	✓	✓	-	✓	✓	✓	✓	✓
Genre/Era	Renaissance	-	-	-	-	-	-	-	-
Collection	Levy Prints	✓	✓	✓	✓	✓	✓	✓	✓
Location	Getty Museum	✓	✓	✓	✓	✓	-	✓	✓
Provenance	(history / gift)	✓	✓	✓	✓	✓	✓	✓	✓
Subject	Hercules	✓	✓	✓	-	-	-	✓	-
Description	temple, funeral	✓	✓	✓	-	-	-	✓	-
Keywords	sunflowers	✓	-	✓	✓	-	-	-	-
Assigned ID#	FASF.330092	✓	✓	✓	✓	✓	✓	✓	✓
Artist Info	basic	✓	✓	✓	✓	✓	✓	-	✓
Artist Info	biographical	-	-	✓	✓	✓	✓	-	✓
Work Info	contextual	-	✓	✓	-	✓	✓	-	-
Bibliography	(references)	-	✓	-	✓	✓	-	✓	-
Dimensions	110 x 203 in.	✓	✓	✓	✓	✓	✓	✓	✓
Collection	Greek Vases	-	✓	✓	✓	✓	-	✓	✓
Metadata	(visible?)	-	-	-	-	-	-	-	-

		AMICO	LACMA	OAC	FAMSF	NGA	MET	GETTY	MFA
Technical Data	.jpg, 117 pixels	✓	-	-	-	-	-	-	-
Date Added	June 13, 2003	✓	-	-	-	-	-	-	✓
RESULTS: RELATED ITEMS									
Works by that artist		-	✓	✓	-	✓	-	✓	-
Works in that collection		-	-	✓	-	✓	-	-	✓
Works in another collection		-	-	✓	-	✓	-	-	-
Works at another museum		-	-	✓	-	-	-	-	-
Works of a similar type		-	✓	✓	-	-	-	-	✓
Suggested keywords		-	-	✓	✓	-	-	-	-
INTERFACE OPTIONS									
Save images for later retrieval		✓	✓	-	-	-	✓	-	-
Follow links on results page		-	✓	✓	✓	✓	-	✓	✓
Refine search		-	-	-	-	-	-	-	-
Multiple views (not just zoom)		-	✓	-	-	✓	✓	-	-
Display (# of works on page)		-	-	-	-	-	✓	-	-
Sorting options (title vs. date)		-	✓	-	-	-	-	-	✓
File structure is visible		✓	-	✓	-	-	-	-	-

Abbreviations

AMICO – Art Museum Image Consortium

OAC – Online Archive of California

LACMA – Los Angeles County Museum of Art

FAMSF – Fine Arts Museum of San Francisco

NGA – National Gallery of Art

MET – Metropolitan Museum of Art

GETTY – John Paul Getty Museum

MFA –Museum of Fine Art, Boston

Notes

Museums are listed as having an attribute even if it is only occasionally present, as it indicates intent to provide such information. Collections with N/A in the Object Type field are of one medium only. In rare instances, a field's term name differs from the norm but contains the same information, such as Classification for Object Type at Museum of Fine Arts, Boston. Location refers to a more specific designation of a work's whereabouts, whether at a particular institution (as in the case of AMICO or OAC) or a particular room in the gallery (MFA, Boston)

APPENDIX B

Sample form for Museum Tests

MUSEUM: _____

of images total / in database / text only:
non-image items:
controlled vocabulary / metadata schema:

Navigation

Structure (layout, layers):

Browsing:

Integrated w/search OR tours integrated with individual records:

Divisions (collection / material):

Supplementary information provided (context):

Special ways of browsing (timelines, maps, eras or periods):

Simplicity / clarity:

Functionality (menus, options):

Consistency of format:

Consistency of Search / Results

Spelling, diacritics, name formats:

Word form (woman, women, France, French, truncation):

Consistent subject grouping / hierarchy:

Other fields found in keyword / Other consistency with how object is found:

Ways to refine search (type of material, era, other unusual search features):

Context

Biographical information:

Related works (image / art or text):

Bibliography:

Keywords or “see also” references:

Special Features

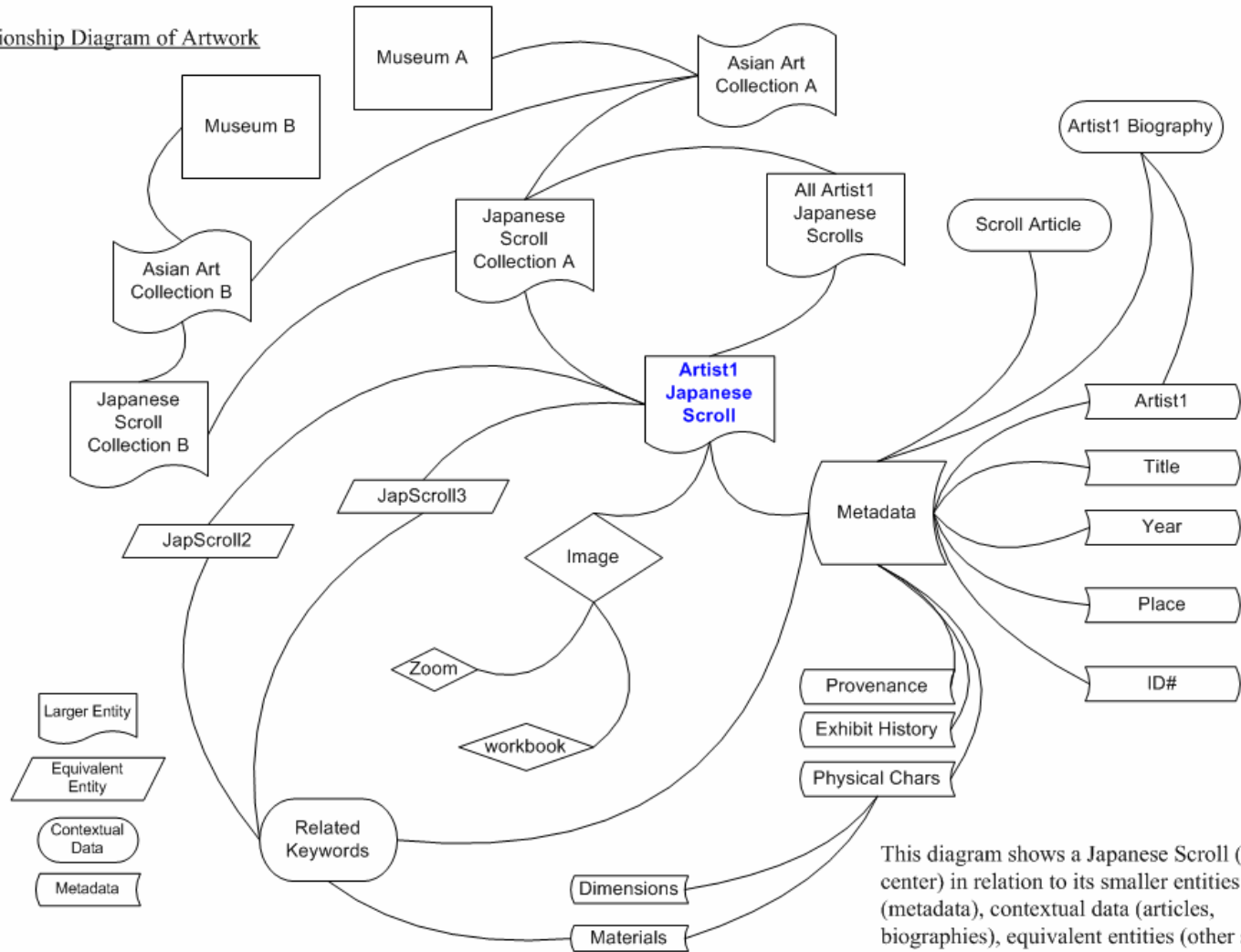
Viewing options – sorting, multiple views:

Saving images to a workbook:

Other:

APPENDIX C

Relationship Diagram of Artwork



This diagram shows a Japanese Scroll (near center) in relation to its smaller entities (metadata), contextual data (articles, biographies), equivalent entities (other scrolls in this and other collections) and larger entities (scroll collections, museums).

APPENDIX D

Getty Union List of Artist Names**Degas, Edgar** ([preferred](#), [index](#), [V](#))Edgar Degas ([display](#), [V](#))Degas, Hilaire Germain Edgar ([V](#))Degas, Hilaire-Germain-Edgar ([V](#))De Gas, Hilaire Germain Edgar ([V](#))Hilarie Germain Edgar Degas ([V](#))De Gas, Hilaire-Germain-Edgar ([V](#))Degas, Edgar Hilaire Germain ([V](#))Degas, Edgar Germain Hilaire ([V](#))Edgar Germain Hilaire Degas ([V](#))de Gas, Hilaire Germain Edgar ([V](#))Gas, Hilaire Germain Edgar De ([V](#))Dega, Edgar ([V](#))**Daumier, Honoré** ([preferred](#), [index](#), [V](#))Honoré Daumier ([display](#), [V](#))Daumier, Honore ([V](#))Daumier, Honoré Victorin ([V](#))Daumier, Honore-Victorin ([V](#))Daumier, Honore Victorin ([V](#))Honoré Victorin Daumier ([V](#))Honore Victorin Daumier ([V](#))**Rembrandt van Rijn** ([preferred](#), [display](#), [V](#))Rijn, Rembrandt van ([V](#))Rembrandt Harmensz. van Rijn ([V](#))Rembrandt Harmensz van Rijn ([V](#))Rijn, Rembrandt Harmensz. van ([V](#))Rembrandt ([V](#))Rembrandt van Rhyn ([V](#))Rembrandt van Ryn ([V](#))Rembrandt van Rhijn ([V](#))Rembrandt Harmensz. van Rhyn ([V](#))Rembrandt Harmensz. van Rhijn ([V](#))Rembrandt Hermansz van Rijn ([V](#))Rembrandt Harmenszoon van Rijn ([V](#))Rembrandt Hermanszoon van Rijn ([V](#))Rembrandt Harmensz Van Rijn ([V](#))Van Rijn, Rembrandt ([V](#))Van Rhyn Rhembrandt ([V](#))Rembrandt Van Rhyn ([V](#))Rembrant van Rhijn ([V](#))Rembrant van Rijn ([V](#))Rembrant Van Rin ([V](#))Rembrants van Rijn ([V](#))Rembrand van Rijn ([V](#))Rembradt van Rijn ([V](#))Reimbrant van Rijn ([V](#))Rambrandt van Rijn ([V](#))Rijmbrand van Rijn ([V](#))Rembrandt Olandese ([V](#))Reymbram Olandes ([V](#))Van Ryn, Paul Rembrandt ([V](#))Paul Rembrandt ([V](#))

APPENDIX E

Search Terms Used: Artist Names

This list of a dozen artists was compiled from the Popular Searches table on the Museum of Fine Arts, Boston (grey table below), web searches on museum or art sites that listed top viewed artists (including Artcyclopedia, <http://www.artcyclopedia.com>, and ibiblio's Web Museum, <http://www.ibiblio.org/wm/>), and from personal knowledge of the most well-known, collected artists. Twentieth century artists were not considered, as copyright restrictions generally prohibit their online use. Other artists' names were used in addition when beneficial, such as when further testing was desired or when an artist was known to be popular in a particular database. OAC's database was not relevant for artist searches. Note that the charmingly misspelled "Sargent" (MFA table) was taken to be John Singer Sargeant, a popular artist on several sites.

Popular Searches			
Monet	Renoir	Japanese	Rembrandt
Sargent	Copley	Van Gogh	Chinese
Millet	Picasso	Greek	Sculpture
Homer	Paintings	China	Spanish
Egypt	Degas	Turner	Dürer

Museum of Fine Arts, Boston

Artists Chosen

Paul Cezanne	Winslow Homer	Pablo Picasso
Marc Chagall	Edouard Manet	Rembrandt van Rijn
Honore Daumier	Henri Matisse	John Singer Sargeant
Edgar Degas	Claude Monet	Vincent Van Gogh

APPENDIX F

Search Terms Used: Diacritic Marks

To search for uniform use of diacritic marks, two graduate level art dictionaries were consulted and all but the most obscure names with such marks were used (44 total). Only the part of the name with the diacritic was entered (first or last) to increase results by also retrieving other artists with that name. Not all selections were used for each museum. When at least 10 retrieved helpful results (a clear conflict or regularity in the use or non-use of marks), the search was stopped. Bolded names were used in all museum databases.

Álvarez	Édouard	González	Mirò
André	Émile	Grünewald	Müller
Andrés	Edmé	Honoré	René
Bartolomé	Étienne	José	Sébastien
Böcklin	Eugène	Krüger	Séraphine
Carrà	Fernández	László	Théodore
Carré	François	Largillière	Tristán
César	Gellée	Léger	Valdés
Cézanne	Gérard	Léon	Valdéz
Dalí	Gérôme	Martínez	Velásquez
Dürer	Géricault	Mérida	Velázquez

Sources

Chilvers, Ian, Ed. (1990). *The Concise Oxford Dictionary of Art and Artists*. Oxford: Oxford University Press.
 Murray, Linda and Peter Murray. (1965). *Dictionary of Art and Artists*. New York: Frederick A. Praeger.

APPENDIX G

Search Terms Used: Subject and Title

These are words taken from random image titles in two databases, the Los Angeles County Museum of Art Random Image and the Metropolitan Museum of Art Daily Archive. The terms were chosen because they were found to be common in previous searches and tests.

Bridge	Door	Saint
Cat	Horse	Umbrella
Child	Marriage	War
Crucifixion	Palace	Wine
Costume	Pitcher	Woman

Country, Culture and Nationality Search Terms

These are the most common country and nationality names, and they were found (or supposed to be found, as several works were from the area) in all databases.

France, French
 Germany, German
 China, Chinese
 India, Indian
 America, American

APPENDIX H

Online Archive of California: Subject Hierarchies

Farm Laborer & family LNG41048.1, from Dorothea Lange Collection 1919-1965.

Source: <http://ark.cdlib.org/ark:/13030/ft5t1nb151/>



This image may be filed under the following subject headings and sub-headings. All headings are from the OAC, but the actual subject classification of this or other photos is neither visible nor determinable due to the vast number of photographs in each section (it requires scanning 10,000+ photos). Note cross-referencing in Technology and People of “farmer” and “farm worker.”

PEOPLE

- Children
 - boy
 - child
- Family
 - father
 - son
- Male
- Men
- People at Work
 - farmer
 - farm worker
 - male farm worker

TECHNOLOGY

- Industries
 - Farm Building
 - Farm House
 - Farmer
 - Farm Worker

SOCIETY

- Clothing and Garments
 - Overalls
 - Hats
 - cowboy hat

PLACES

- U.S. States
 - California (Southern)
 - Los Angeles

APPENDIX I

Iconoclass: Subject Hierarchies.

The nine main divisions:

0 Abstract, Non-representational Art	5 Abstract Ideas and Concepts
1 Religion and Magic	6 History
2 Nature	7 Bible
3 Human being, Man in general	8 Literature
4 Society, Civilization, Culture	9 Classical Mythology and Ancient History

Sample sub-classifications of the Nature (2) category.

- 24 – the heavens (celestial bodies)
- 25 – earth, world as celestial body**
- 26 – meteorological phenomena
- 29 – surrealia, surrealistic representations

Sample sub-classifications of the Earth (25) category:

- 25D – rock types; minerals and metals; soil types
- 25E – geological chronological division; historical geology
- 25F – animals**
- 25G – plants; vegetation
- 25H – landscapes

Sample sub-classifications of the Animals (25F) category:

- 25F1 – groups of animals
- 25F2 – mammals
- 25F3 – birds
- 25F4 – reptiles
- 25F5 – amphibians

A sample hierarchy:

- 7 – Bible
- 71 – Old Testament
- 71H – story of David
- 71H7 – David and Bathsheba
- 71H71 – David, from the roof of his palace, sees Bathsheba bathing
- 71H713 – Bathsheba receives a letter from David
- 71H7131 – Bathsheba alone with David's letter

APPENDIX J

The Museum of Fine Arts, Boston: One Hour Tour Titles

Each of these titles was taken from the One Hour Tour and pasted into the Advanced Search Title field. Those not found were searched for by other fields. Unspecified entries are title entries or clear in field type. Successful queries are preceded by a *.

Format: (Artist) Title in Tour Title in Results	Retrieval Terms and Success
Ganesha and His Wives Ganesha with His Consorts	title sandstone (medium) India (object place) * sandstone + Indian (culture) Indian + Ganesha
(Renoir) Dance at Bougival Dance at Bougival	title * Dance * Bougival Dance + Bougival * Renoir French OR German + paintings
Bracelet of a Queen	title bracelet (title) + Nubia (object place) bracelet (keyword)
(Copley) Paul Revere	* title
(Davis) Hot Still-scape for 6 Colors	* title (no image)
(Sergeant) The Daughters of Edward D. Boit	title Sergeant Daughters Edward Boit John Singer + 1882
(Rembrandt) Artist in His Studio	title * Rembrandt (in Artist) + artist (in Title) * Rembrandt (in Artist) + studio (in Title)
(The Pan Painter) Krater Bell Krater (mixing bowl)	title * pan painter (artist) + krater + Italy
Posthumous Portrait of Augustus Augustus	title * Augustus
King Mycenius and Queen Kha-Merer-Nebty II King Mycenius	title * King Mycenius * (above) + greywacke (medium) + Egypt * (above) + greywacke + Egyptian

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