

Art Museum Image Consortium (AMICO): a collaborative structure for creating, distributing, enhancing and using humanities digital information

Project Description for National Science Foundation Digital Libraries Initiative II

I. What is AMICO?

I.A Organization and Structure

The Art Museum Image Consortium (AMICO) AMICO is a non-profit consortium of museums dedicated to enabling educational use of museum multimedia documentation. Formed in October 1997, by 23 leading North American museum as a program of the Association of Art Museum Directors Educational Foundation, AMICO was separately incorporated as a non-profit, open membership, organization in June 1998.

AMICO's Founding Members are:

Albright-Knox Art Gallery, Buffalo, NY
Art Gallery of Ontario, Toronto, Ontario
Art Institute of Chicago, Chicago, IL
Asia Society Gallery, New York, NY
Center for Creative Photography, Tucson, AZ
Cleveland Museum of Art, Cleveland, OH
Davis Museum & Cultural Center, Wellesley, MA
Fine Arts Museums of San Francisco, CA
George Eastman House, Rochester, NY
J. Paul Getty Museum, Los Angeles, CA
Los Angeles County Museum of Art, CA

Metropolitan Museum of Art, New York, NY
Minneapolis Institute of Arts, Minneapolis, MN
Museum of Contemporary Art, San Diego, CA
Montreal Museum of Fine Arts, Montréal, PQ
Musée d'art contemporain de Montréal, PQ
Museum of Fine Arts, Boston, MA
National Gallery of Canada, Ottawa, ON
National Museum of American Art, Washington, DC
Philadelphia Museum of Art, Philadelphia, PA
San Francisco Museum of Modern Art, CA
San Jose Museum of Art, San Jose, CA
Walker Art Center, Minneapolis MN.

Membership in AMICO is open to institutions with collections of works of art. New AMICO members in 1998 will include the Frick Collection / Frick Art Reference Library, the Library of Congress, and the Canadian Museum of Civilization.

AMICO represents an unprecedented level of collaboration among the largest art museums in North America. Realizing that it is not possible to serve growing educational demand for digital documentation of their collections, these cultural heritage institutions have come together to create an authoritative digital library of art resources in all genres. The benefits of consortial activity are many, but the prime motivation for participating museums, that have funded all their own activity to date, is the enhancement of their educational mission. AMICO members want to see their collections used, for research, education and enjoyment, in universities, public libraries, and other museums.

The members' accomplishments to date are a testimony to their desire to enable access and use of their collections. In six months in 1997-98 (working primarily by electronic communication) AMICO developed shared data specifications and compiled a testbed Library of 65GB of data about approximately 20,000 works of art. The library will grow through annual contributions by all members.

II. The AMICO Digital Library Model

AMICO is self-consciously demonstrating a new model of social and economic relations that significantly reshape existing processes for digital library creation and dissemination. Many factors prompted AMICO members to rethink traditional relationships:

- capturing primary documentation in digital form involves great cost and institutional commitment
- developing digital services best suited to educational use involves changes in museum practices
- existing distribution systems have the potential to reach university, K-12, and public library users

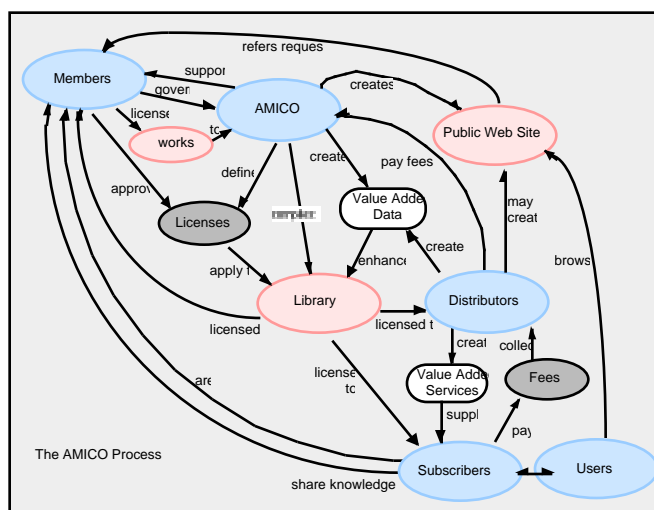
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- different end-users require a range of tools and methods of access
 - existing distribution services can tailor delivery appropriate to specific user needs
 - obtaining and providing intellectual property rights requires new relations between the institutions.
- AMICO has consciously identified and atomized each of these functions to allow participants in the process to play the roles they are most skilled to fulfill. In planning AMICO, the design of the economic and social model included open discussions of license terms, open agreements with distributors, and open membership in the consortium – all designed to create a partnership between primary materials holders and subscribers (many institutions can wear both hats); full background and 6-months of planning documents are available on the AMICO web site <www.amico.net>.

II.A Social foundations of AMICO

The AMICO consortium is a non-profit, self-governed, open membership organization. Any non-profit collecting institution, willing to adhere to the Membership Agreement and pay dues, may join. AMICO develops and supports best practices and guidelines for members, collates, edits and enhances the collected resource (the Library), develops the licenses required support the work of different educational subscribers (universities, museums, K-12 schools, and public libraries), and administers the licensed distribution system through a wide range of educational data distributors. The publishing model being demonstrated by AMICO builds on traditional roles. But rather than tie these

together as a vertically integrated publisher, AMICO has consciously separated the role of creator and distributor. This separation has clarified the crucial functions of digital library creation and distribution, and freed members of the Consortium from having to serve both functions.



Non-profit data distributors serving universities, schools and libraries (multiple distributors potentially competing for same clients) collect license fees for AMICO and service fees for providing access, authenticate end-users for access to services, maintain data on use (that preserves subscriber assigned individuation codes), enable feedback to content providers on the resource, support requests for additional rights to licensed works, and may cross-license software they develop to other distributors. The purpose is to encourage both diversity and specialization, providing benefits to all users of the AMICO Library. The Research Libraries Group (RLG) was the first to partner with AMICO to distribute the Library; other distributors are currently in negotiation for 1999-2000.

Educational institutions, including museums, are subscribers. They promulgate and enforce intellectual property policies in place of technical means of protection, administer user permissions, and manage content mounted locally or created by the institution from the licensed resource (the license permits this). In addition, they integrate product/service with local resources and tools and may cross-license tools they develop to distributors or other subscribers. Users designated by the institutional subscriber, may use the resource from any location, as often as they wish, and for any licensed (educational, non-commercial) purpose without further permission. Users are encouraged to provide feedback to the member museums. A public web site, providing access to a limited sub-set of the Library, ensures access for all users, and serves to build awareness of the AMICO Library.

This model has will be further developed during the course of this demonstration project. For example, AMICO is now exploring mechanisms to enable subscribers to contribute content to the Library, and to encourage users to annotate, comment and provide feedback to content creators. These new relationships will require new means for acknowledgment and reward.

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II.B Economic foundations of AMICO

To enable the system to function, AMICO has introduced economic innovations into traditional publishing relations as well. The museum members, as content owners, bear the full cost of creating digital documentation and obtaining rights. This extends their normal business practices, which historically made rights clearance an end user problem. Through the Consortium, members assume the risk of the joint publishing venture, share liability for rights offered by content owners and develop subscription prices *based only on cost-recovery for data collation and enhancement*.

The non-profit distributors invest in distribution software, and in developing and marketing their service, and recover fees to cover those costs. All distributors must compete with other distributors, and with subscribers who may distribute to themselves.

Educational subscribers, including museums, pay annual fees for unlimited use license and service based on the numbers of their user population (calculated per-user/year and projected at approximately \$0.25 per student/faculty per year in universities; \$0.10 in schools, and \$0.01 in public libraries). Distribution agreements require that the Library be free at the point of use to encourage end users to take advantage of it. Affordability is a known barrier to wide uptake of digital library resources. AMICO sets subscription fees as low as possible to enable the broadest possible use, which will in turn permit further reduction of fees. Our agreements also enable subscribers to earn income from licensing tools. Reserving all roles in the AMICO model for not-for-profits ensures that only real costs are passed along to users.

II.C Technical foundations for AMICO

The AMICO Model reflects technical assumptions we feel are essential to constructing future digital libraries. Digital resources are held at many repositories and will be accessed in a wide variety of settings, so AMICO has separated standards for the creation of content from tools for its access, delivery and use. Content owners are establishing data specifications for the many genres of material in their care, and sharing common best practices for their digital representation. The consortium enhances this primary resource documentation by maintaining concordances between AMICO Library content and reference vocabularies and thesauri. AMICO enhances access by developing an open knowledge model shared with publishers of related disciplinary resources.

We recognize the hybrid nature of resource delivery in the digital library, and have created a technical and licensing structure that enables portions of the resource to be copied and delivered locally by subscribers. Educational institutions may choose to mount portions of the resource and metadata for value-added purposes, and integrate resource metadata and tools of the distributor with locally provided facilities. Delivery options remain sensitive to the bandwidth limitations of different situations.

Common models, data capture methods, and metadata standards enable distributors and subscribers' site administrators to provide access to an integrated resource. Distributors can enhance access with searching through expanded, regularly updated, vocabularies and thesauri, enable multi-resource queries with protocols such as Z39.50, and create tools appropriate to end-users purposes and work methods. The AMICO Library on the Internet is placed within a context of secondary and tertiary literature, through link-types supported by the disciplinary knowledge model.

III. A Demonstration Project

In this major collaborative demonstration project coordinated by AMICO, four universities, four museums, a publisher of art reference resources, and two non-profit digital library distributors will show how the AMICO Library can model technical and intellectual structures and economic and social systems, that support a large, growing, multi-institutionally created digital library in the humanities. The project will document how the AMICO Library model can enable primary materials repositories to create and sustain the economic, social and technical means to build and distribute digital libraries for educational use. In support of this, the project will develop and publish best practices guidelines for capture, enhancement and integration, distribution and access, use and evaluation of digital libraries containing primary, secondary and tertiary resources.

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III.A Art Museum Image Consortium Project Partners

Member Museums

Art Institute of Chicago
 Fine Arts Museums of San Francisco
 Frick Art Reference Collection
 Walker Art Center

Universities

Carnegie Mellon University
 Hampshire College
 Rochester Institute of Technology
 University of Illinois

Publisher

Macmillan Reference/Grove Dictionaries Inc.

Distributors

Art Museum Network
 Research Libraries Group

III.B Issues in Digital Library Creation and Delivery

We believe the AMICO Model enables the cost-effective licensed distribution of digital library content. However, independent institutional roles and relations in the AMICO model, and any other distributed, multi-institutional system, create opportunities for structural weakness. During this project we will study these issues and develop methods of overcoming them. In particular, the:

- creation of educational documentation requires investments in sophisticated and sometimes costly representation; research is required to establish costs and benefits and user needs
- compilation of an integrated resource requires enhancement with additional reference data
- distribution of a resource that can be accessed remotely and used effectively requires standard authentication, search and metadata delivery and exploitation functions
- delivery to end-users requires integration with other digital libraries and tools
- use requires appropriate interfaces, mechanisms for dialog with other users and feedback to resource providers

III.C Sustainable growth

During this course of this three year demonstration project, based on distribution plans negotiated to date, it is estimated that over a million university students and faculty at more than 75 institutions, plus 500,000 K-12 students and two million public library patrons, will have access to the AMICO Library. The Library, which will consist of over 50,000 works of art in the first year of general release (1999), could grow to over 100,000 works during the grant period (a very small proportion of works in public collections).

Table One: AMICO Growth Projections: 1998 - 2002

AMICO	Contributors			Library			End Users			
	Year	Members	University	Nations	Est. New Works	Total Works	MB	University Students	K-12 Students	Library Patrons
	1998/99	23	0		20,000		65,000	410K	N/A	N/A
	1999/00	35	2	1	30,000	50,000	162,500	800K	125K	1M
	2000/01	50	4	1	40,000	90,000	292,500	1.2M	500K	2M
	2001/02	75	8	2	60,000	150,000	487,500	1.6M	1M	4M

Based on this estimate of growth, AMICO has developed cost and revenue projections. Within five years, with a conservative uptake of 10% of the users in each sector (universities, public libraries, and K-12 education) the consortium becomes self-supporting. The costs of establishing shared procedures, designing and implementing best practices, and developing distribution agreements require an infusion of support at the initial stage. We believe that the model, with adjustments we will discover during this demonstration project, is generalizable and could enable similar consortia to make large volumes of primary materials digitally available.

III.D Beneficiaries

In addition to wide availability of the Library, this demonstration project will have benefits to those not par-

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icipating directly. The articulation, documentation and economic analysis of the model itself will contribute to other digital library projects. The best practices will assist digital capture in any primary materials collecting institutions. Fine-tuning distribution mechanisms will help all users of digital libraries. Model licenses will support access to museum content by universities, public libraries, and K- 12 schools. Visual interface developments will benefit users of digital museum documentation and other visual information, and those for whom text-based interfaces are a barrier to use.

Traditionally, access to the collections of museums has been greatly limited. Much of the rich documentation about museum collections—exhibition histories, provenance, conservation history and the like—is only available to museum staff and scholars able to make site visits. However, the data structure developed by AMICO enables the distribution of these kinds of documents, and their use by humanities scholars in all disciplines.

Experiments, such as the Museum Educational Site Licensing Project (MESL; involving many AMICO participants), have a great potential for the use of museum digital documentation in education. In two years, MESL saw curricular use in Religious Studies, History, and Studio Art as well as traditional art history. The Digital Blake Project at the University of Virginia, (Blake) has similarly shown the value of visual materials in English language and literature studies. The availability of a large body of visual materials is of use beyond humanities; classes in visual databases at the University of Illinois used the MESL dataset. Despite the potential for widespread use of visual materials across education, systemic weaknesses in distribution have been a major impediment (Lynch 1997). Consortial activities such as AMICO, operating under cost-recovery economic models that aim to recoup only new costs, can provide users in many disciplines with consistent and predictable access to digital museum documentation.

IV. How will the project be conducted?

The AMICO Demonstration Project will be directed by David Bearman, Director of Strategy and Research and Jennifer Trant, Executive Director of AMICO. Trant and Bearman have extensive experience in managing collaborative projects, and have been instrumental players in the Consortium for Computer Interchange of Museum Information (CIMI), the *Categories for the Description of Works of Art (CDWA)*, the Museum Educational Site Licensing Project (MESL) and CIDOC, the Documentation Committee of the International Council of Museums. They also managed the successful planning phase of AMICO itself. Their direction of the project will be supported by AMICO staff members.

IV.A Building on the University Testbed

This Demonstration Project will build on the activities of the Art Museum Image Consortium to date. Prior to the commencement of this proposed project (the 1998/99 academic year), 16 universities are partnering with AMICO and RLG in a first testbed release of the AMICO Library. Selected after an open competition and peer-review, the testbed participants will be conducting research on users and uses of the AMICO Library. This project will extend the work of the testbed year, by enabling four “lead” AMICO museums and four testbed universities to continue their research, constructing, deploying and evaluating resources of use across the humanities. In the fall of 1999, the AMICO Library will be available to any educational institution wishing to subscribe. We will use this large scale demonstration as a context in which to “fine-tune” the model. AMICO is a permanent entity, not a project. This study can have a lasting impact.

IV.B Methodology

Trant and Bearman will coordinate the activity of specialized teams, in the areas of 1. Capture, 2. Distribution and Access, 3. Enhancement and Integration, 4. Use, 5. Evaluation, and 6. Economic and Social Impacts (Specific descriptions of each area of activity follow.). Each team includes at least one AMICO museum staff member, and a university researcher. Where appropriate staff of the distributors and publisher also play roles. Generally, we will articulate the elements of our model for end-to-end creation and use of a digital library in the first year, identifying possible limitations, and defining methods that are expected to produce the best results in its ongoing implementation. During the second year, proposed solutions will be implemented, tested and evaluated at each of the critical institutional interfaces: Capture, Distribution/Access, Enhancement/Integration and Use. In the third year, we will evaluate and document

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these solutions both in university and museum educational settings. Best Practices for Text and Image Capture, and detailed reports in the areas of Use and Economic and Social Models will be published. Details of activities, schedules and costs of each thread are found in the Budget Justification.

All participants will meet semi-annually to share strategies, review preliminary results and coordinate research agendas and schedules. Throughout the project, we will remain in continuous dialogue through shared HyperNews Discussions which have sustained the AMICO planning and start-up process (now involving almost 340 people on 8 different topical lists). These will be extended by electronic collaboration tools used in Milekic's co-taught course between Hampshire College and the Institute for Conflict Resolution in Zagreb, Croatia. We will use a secure web space to distribute drafts of documents within the project, and maintain a public web site as a focus for the public consultation critical to the development of widely useful results. All key participants have extensive experience in working collaboratively on complex projects involving many players (including AMICO, MESL, CIMI, REACH, CIDOC) and are committed to ongoing research in digital library development.

IV.C Project Personnel

Senior personnel involved in each team are listed below; biographical sketches are appended.

Project Direction

David Bearman and Jennifer Trant, Art Museum Image Consortium

Capture

Images: Alan Newman, Art Institute of Chicago; Franziska Frey, Image Permanence Institute, Rochester Institute of Technology

Texts: Robin Dowden, and Steve Dietz, Walker Art Center; Pat Barnett, Frick Collection and Art Reference Library ; Diane Fortenberry, *Grove Dictionary of Art*

Distribution/Access

Willy Cromwell-Kessler, Research Libraries Group; Michael Robinson, Rochester Institute of Technology; Denise Troll, Carnegie Mellon University; Brian Boigon, Art Museum Network

Enhancement and Integration

Willy Cromwell-Kessler, Research Libraries Group; Pat Barnett, Frick Collection and Art Reference Library; Jeremy Macdonald, Grove Dictionaries Inc.; Steve Dietz, Walker Art Center; Brian Boigon, Art Museum Network

Use

Slavoljub Milekic, Hampshire College; Henry Pisciotta and Mary Schmidt, Carnegie Mellon University; Pat Barnett, Frick Art Reference Library; Steve Dietz, Walker Art Center

Evaluation

Beth Sandore, University of Illinois; Denise Troll, Carnegie Mellon University; Slavoljub Milekic, Hampshire College

Economic and Social Impacts

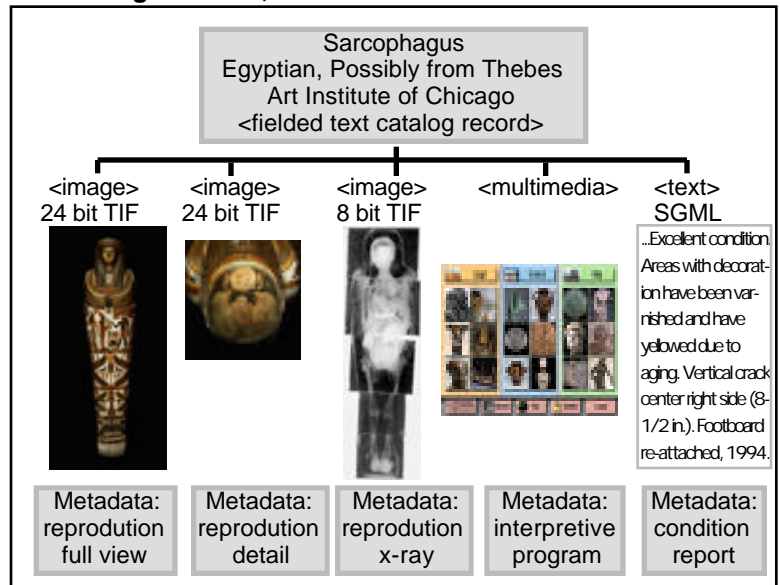
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Michael Shapiro, General Counsel, AMICO; Dakin Hart, and Ann Stone, Fine Art Museums of San Francisco

IV.D Data Capture

The creation of digital resources with scholarly value for the humanities requires sophistication (British Library 1998; c.f. Beowulf). Humanities scholars traditionally have relied upon a wide range of document genres as source material for their research and teaching. In the digital library, these genres may be either digital conversions of documents, or “digital originals” –documents which only exist in digital form. Assessing the informational quality of digital research sources is an essential step in determining their relevance to a particular research question (Bearman/Trant 1998a). Methods for digital representation of structured and unstructured texts, images, sounds and multimedia which adequately communicate the informational content, are affordable to the primary materials repositories, and can be supported by existing distribution and access tools must be defined. Access across media genres must be facilitated.

AMICO Library Content: Catalog Record, Media Files and Media Metadata



Decisions at data capture affect the long term utility of information. Based on its philosophy of separating data from delivery methods, AMICO members have agreed on specifications for structured textual data, image/ multimedia files, and multimedia metadata, as the underpinning of the AMICO Library (AMICO DataSpec 1998). The data elements found in the AMICO Library are based on and mapped to CDWA, MARC, the VRA Core, the CIMI Access Points, SPECTRUM, and the Dublin Core (AMICO Map 1998) In this project, AMICO and its research partners, will further analyze digital representations of the many genres of text and image documentation found in museum collections. These include:

Primary sources:

images: types works of art; unique photographic documentation;
texts: structured catalog records; museum reports (e.g. conservation, provenance)

Secondary sources:

images: photographic surrogates; analytical diagrams; contextual photographs
texts: articles and papers; museum publications, encyclopedia; auction catalogues

Tertiary sources

images: thumbnail images in indexes
texts: abstracting and indexing services; bibliographies; thesauri; authority files

Draft recommendations will be reviewed by the AMICO Technical Committee, posted on AMICO.net for comment, and subjected to peer review by representatives of universities, museum and archives worldwide in a process directed by RLG.

IV.D.1 Best Practices for Imaging of Works of Art

Pairing the Image Permanence Institute (IPI) with the Art Institute of Chicago (AIC), the Image Capture team brings together theory and practice. Alan Newman and Franziska Frey will identify or develop best practices for the capture of image genres represented in art museum collections. Guidelines will address both capture of digital images and the creation of metadata about the imaging process and resulting file.

In the first year of the project, best practices for capturing various types of art work will be researched. A

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common sets of tools will be developed and tested within the AIC and other AMICO Member museums. Where possible, recommendations will be implemented in the year 2 edition of the Library, so that user testing can assess when and how perceptions are influenced by quality controls such as color management. User testing and museum feedback on the implementation of the guidelines will be incorporated into the final recommendations for best practices. Subsequently, processes for legacy data will be defined and tested, that include mapping to a common capture and quality control framework.

IV.D.1.1 Image Capture

First, we will develop a typology of the genres of art and art documentation for which different guidelines are required. The many genres in the AMICO repositories (currently classified as painting, works on paper, sculpture, textiles, ceramics, furniture, silver, photography, architectural drawings etc.) must be analyzed to determine where distinctive methods are required. Best practices for direct digital capture and scanning of photographic surrogates will cover the four main areas of image quality: tone reproduction, color reproduction, resolution, and noise. IPI will put a special emphasis on color fidelity and management. AIC will coordinate the statement of museum requirements and the museum-based testing of recommendations. Questions that will be addressed in the guidelines include:

- *issues in conversion of photographic surrogates:* e.g.; Ektachrome may show a blue sky turning toward magenta and shadows becoming overly cyan. It's insoluble with global photographic filtration but a digital file can improve the film. Can we systematically correct transparencies?
- *issues in direct digital capture:* e.g.; Without a film reference how do we create a digital image that is relatively true to the work of art. How do we compare the digital file against the art, under studio conditions? Can the work of PIMA(ANSI)IT/10 be applied here?
- *issues in quality assessment and control:* e.g.; do adjustments to gamma and color based on captured color bars and gray scales yield more "perceptually valid" results than intuitive corrections by a trained imaging specialist?
- *issues in capture methods and strategies:* e.g.; should we recommend digital file sizes based upon the relative dimensions of the original art?

IV.D.1.2 Image metadata

Adequate metadata about the imaging processes and systems is key to the assessment, management and migration of digital image files. However, despite discussions for some time (Besser/Trant 1995), metadata that documents production processes and links images and their derivatives is seldom captured in imaging projects (The MOA II project tackles this head-on for some types of documents.). We will build on the Multimedia Metadata in the AMICO Data Specification (AMICO DataSpec 1998), and ANSI IT10 (Electronic Still Imaging Standards Group). AMICO's format metadata has already provided major input into the Dublin Core on this topic (Cox 98). We will define and capture elements including view description, lighting (e.g. raking light, radiograph, UV illumination, IRR Mosaic), and record the characteristics of scanners and the resultant image files, their transaction history, and copyright metadata. The resulting community-validated definition of process-related metadata will be incorporated into AMICO Library. AMICO will develop additional tools, such one it designed to extract technical characteristics from the header of a TIFF file, to aid in the automatic collection of image metadata.

In the first year metadata requirements will be defined and articulated. These metadata will be captured in controlled tests and general use of the guidelines during the second year. In the third year of the project, the tests of the second year will be evaluated and refined routines developed that take into account the experiences of the various users of the AMICO Library. Once defined, the utility of these metadata for assessing collections of diversity captured images will be assessed.

IV.D.2 Best Practices for Representation of Unstructured Textual Documentation of Works of Art

The Text Team includes partner museums, libraries and publishers, bringing together individuals with established track-records in the creation and implementation of museum and art documentation standards. Robin Dowden oversaw the National Gallery of Art collection documentation and web site development; Steve Dietz integrated museum multimedia, publications and production at the National Museum of American Art; Patricia Barnett was involved in CDWA and AAT development and analytical document cataloging; and Diane Fortenberry has managed the indexing of the 34 volume *Grove Dictionary of Art*.

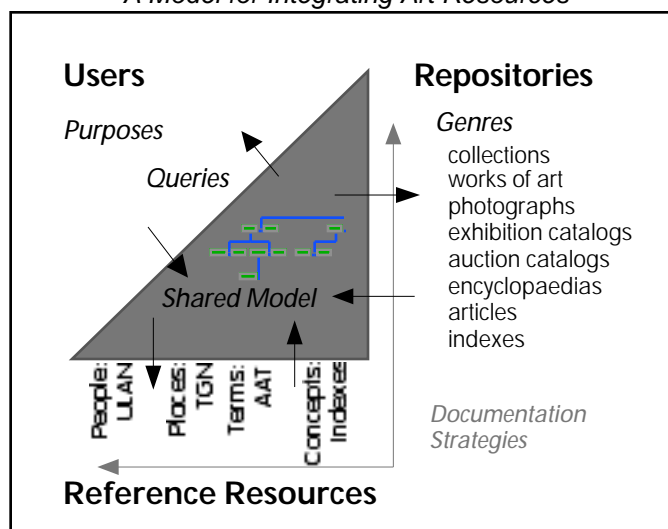
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This team will be aided by significant in-kind support provided by I4I (Infrastructures for Information) an SGML tools development company.

Many model DTDs and draft standards exist that could be applied to textual art documentation, including that of the Consortium for Computer Interchange of Museum Information (CIMI, in which Dietz and Dowden were active from the outset), the Text Encoding Initiative (TEI), Encoded Archival Description (EAD) and extended Dublin Core (in which Bearman is a leading participant). Strategies for representing unstructured text documentation will be assessed that use a combination of metadata (AMICO formatted and/or Dublin Core/RDF) and internal markup (SGML, XML/RDF). AMICO data has already been used to prototype a DC implementation in XML/RDF at OCLC (Miller 1998) We will integrate these varying strands into a data model with attribute-level granular reference to existing data models of the Documentation Committee of the International Council of Museums (ICOM/CIDOC) and CDWA (in which the principal investigators were instrumental participants) and test them in a large, multi-sourced, digital library.

In year one, art documentation from museums, reference libraries, and published secondary and tertiary art reference sources will be gathered and analyzed. Markup needs to address identifying people (Monet), movements (Impressionism), places (Paris) and for events in cultural history (the first Impressionist Exhibit, 1874) provide a context for the study of the work. In year two, the resulting knowledge model

A Model for Integrating Art Resources



will be applied to semi-structured documents including some of the 74,000 art sales catalogs from the past three hundred years in the Frick Art Reference Library, and the entries in the 34 volume *Grove Dictionary of Art*. RLG will explore integration with tertiary index tools such as the SCPIO art sales index, the Getty Provenance Index, and the *Bibliography of the History of Art*. A shared, public, SGML DTD will allow publishers of secondary and tertiary sources to link to works of art in the AMICO Library. Grove Dictionaries Inc., through its parent Macmillan Reference Publishers, has agreed to implement the model in the online edition of the *Grove* and it will be applied to the AMICO Library, enabling navigation between the two sources.

In the final year, recommendations will be made for application of the model to museum publications systems to enable reuse of digital texts created in the layout process. This work will build on the work of CIMI (DTD for Exhibition Catalogs) and draw on the expertise of I4I. In addition, AMICO will work with member museums and the Collections Information Systems vendor community throughout the project to develop export tools that ease the process of moving data from one system to another.

Any model for the integration of diverse information genres must reflect the reality that the methods of museums, archives, libraries, publishers are necessarily different. Each documents according to traditional strategies. Models for translating between different documentation methodologies, were first proposed by Bearman for the Getty Information Institute, and since elaborated by the Principal Investigators (Bearman/Trant 1998b). These propose that digital information objects need appropriate metadata to enable the simultaneous retrieval, collation and analysis of document genres.

IV.E Distribution and Access

AMICO has enabled several means of access to its Library: a public web site offers free access with limited depth; RLG offers secure access to and distribution of the full AMICO Library; and AMICO agreements

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permit hybrid distribution systems with a mixture of local and remote delivery of data. Such an approach may be critical since in the near-term, individual user access to Internet-delivered resources may not be a practical way to exploit large image files or support some desired uses. Managing relationships between local and remote data sets is an issue. Placing the AMICO Library within an overall Digital Library Distribution and Access framework is essential for its widespread adoption and ease of use.

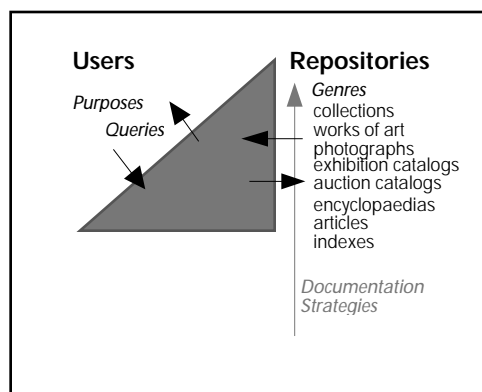
The Distribution and Access team represents two distributors of the AMICO Library and two subscribing universities. Willy Cromwell-Kessler, an experienced systems librarian, will coordinate staff of the Research Libraries Group (RLG) with extensive experience integrating data from diverse primary materials repositories and in providing access both through open protocols. Brian Boigon, a multimedia designer and Executive Producer of the Art Museum Network (AMN – a program of the Association of Art Museum Directors) specializes in presenting museum information in ways appealing to the general public. Denise Troll of Carnegie Mellon University (CMU) and Michael Robertson of Rochester Institute of Technology (RIT) are information professionals with long experience making resources available on their campuses, and developing tools and methodologies to increase their utility and assess their usefulness.

IV.E.1 Public Web Site

A public version of the AMICO Library, containing thumbnails and limited data, will be offered by the Art Museum Network (AMN). AMN will study the impact of this publicly available resource on access, by collecting public catalog user data where possible from log analysis and self-reporting; analyzing usage patterns; tracking “click-throughs” to the licensed resource and tracking “click-throughs” to the members web sites. AMN will also explore different pathways into the AMICO Library, by developing links between the AMICO Library and ExCalendar, an international exhibition information system. Results will inform our study of the economic and social impacts of AMICO, and the assessment of member costs and benefits.

IV.E.2 Hybrid Models for Licensed Distribution

At its “simplest,” Distribution and Access involves querying a catalog, receiving a result, and retrieving relevant data. Effective distribution systems also include technical means for user authentication and usage data collection, for serving remote search clients, for delivering various sizes of data packages (including very large image files), and enabling feedback. Given existing information throughput for Internet delivery, systems implemented in the near-term will exploit a hybrid of local and remote access/delivery. CMU will explore hybrid distribution, applying its experience with the distribution and management of electronic journals created by digitizing printed pages.



The crux of the distribution and management of digitized art and artifacts is the storage and retrieval of high resolution images. In the TULIP project with Elsevier Science Publishers (ended 1995), Elsevier initially tried to FTP gigabytes of digitized journal pages to project participants, but turned to CD-ROM distribution because FTP was too slow and the Internet too unstable. In a project with University Microfilms International (UMI), CMU developed software to manage and deliver to the desktop journal images archived in eight CD ROM jukeboxes. Integrated solutions are high priorities for digital library users and developers (Croft 1995). CMU will develop a distributed architecture for the AMICO Library that includes software to manage a local cache (10 GB) of digitized art and artifacts and associated metadata. Carnegie Mellon users will search, view thumbnails and low resolution images at the remote AMICO Library at RLG. High resolution images requested by users, will be cached locally to provide secure (authenticated) access and reduce the turn-around time between request and delivery (multiple requests for the same image do not require resubmission to RLG). This will reduce storage demands on users and permit monitoring of the use of high resolution images that associates usage with local user demographics and reasons for needing higher resolution.

The first year of the project CMU and will RLG to develop requirements and a technical specification for the

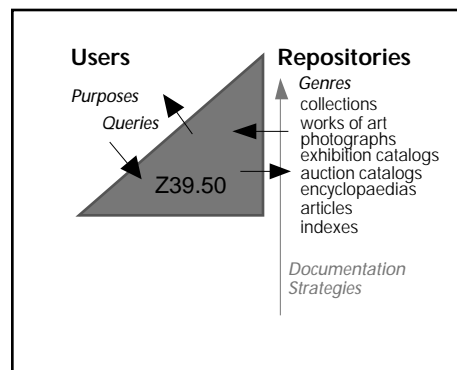
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distributed architecture. The system, including the cache management and usage monitoring software, will be implemented and tested year two. Architecture, performance, and image usage. will be evaluated and reported in year three.

IV.E.3 Using Z39.50 for Access

The first step in putting the AMICO Library in the context of the Digital Library is enabling queries from other systems. ANSI/NISO Z39.50 (ISO 23950) is an open communications protocol designed to support retrieval and searching of heterogeneous resources. While proven with respect to bibliographic and textual resources, Z39.50 has not been tested with large repositories of image and multimedia, or with museum rather than bibliographic targets. The museum attribute set developed by CIMI has only been implemented in a limited test (CHIO), and the pros and cons of a museum-specific attribute set vs. the use of a widely supported attribute set (BIB1) have not been assessed.

Working together RIT and RLG (a major sponsor of the CIMI effort) will implement Z39.50 access to the AMICO Library, investigating how best to apply the BIB1 attribute set to museum data and comparing that to an implementation of the CIMI attribute set. RIT will also test a number of Z39.50 clients, including one developed in collaboration with Xerox Corporation (with the capability to manipulate multiple images), the Blue Angel Technologies MetaStar gateway used in the CIMI testbed, and possibly OCLC's SiteSearch/ WebZ. Z39.50 will also play a pivotal role in managing locally mounted portions of the AMICO Library. RIT will be mounting some of the AMICO Library locally, and this subset will become one of the test Z39.50 targets. CMU also plans to use OCLC's WebZ client to access the AMICO Library in year 3. RIT will assess the extent to which institutions with Z39.50 access actually use integrated searching of multiple resources, how this affects users, and compare Z39.50 access to direct access to the AMICO Library.



IV.F Enhancement/Integration

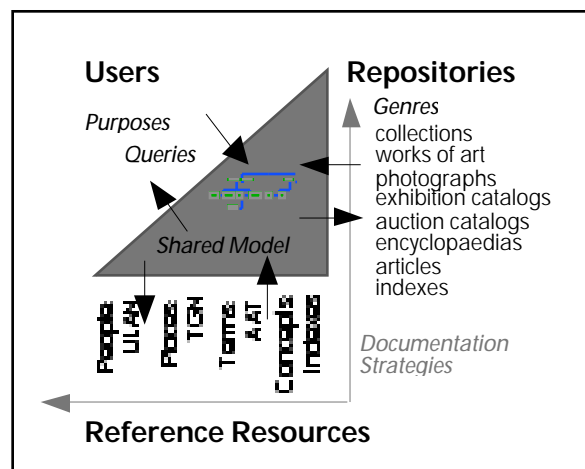
Strategies for enhancing and integrating content from many institutions and making it accessible to a broad range of users include enhancing data (by inserting terms from thesauri and other vocabularies in records) and enhancing access (by diverting a query through secondary research tools). Each of these strategies has a role to play in a hybrid distribution system, and all are relevant to any digital library. Visual digital libraries raise additional issues since metadata describing an image (in our case a work of art) is necessarily subjective and may not support users with different points-of-view.

The Data Enhancement and Integration team comprises Patricia Barnett (Frick), Willy Cromwell-Kessler (RLG), Jeremy Macdonald (Grove) and Steve Dietz (WAC). All have extensive experience in the development and implementation of cultural heritage information systems, and in the access and use of diverse genres of art documentation. Barnett was involved in the construction of the *Art and Architecture Thesaurus* (AAT) and co-authored its *Guide to Indexing* (Peterson/Barnett 1993). The Frick has also contributed substantially to the *Union List of Artists Names* (ULAN), through its *Dictionary of Spanish Artists' names*. RLG distributes the AAT, ULAN and the *Thesaurus of Geographic Names* (TGN) – three art related reference resources from the Getty Information Institute that have been made available to AMICO – along with many other online art documentation resources. Dietz was involved in the development of the CIMI Access Points and has experience in integrating museum multimedia resources. Macdonald manages the online delivery of the *Grove Dictionary of Art*.

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IV.F.1 Enhanced Searching

Users approach a digital resource with their own language and purposes for inquiry. Neither the terminology they employ nor their goals will necessarily be known to the creator of relevant documentation. Simple searches, which compare character strings or words to the values recorded in documentation, often fail because repositories have historical investments in cataloging practices that do not reflect these new users points-of view. (Duff 1998). Even if retrospective documentation was undertaken, a single “authority” would be unreasonable (Michard 1998) However, search systems can be designed to enable integrated access to diverse resources, as the GII prototype AKA system illustrates, by clustering terminology that relates to common concepts, and exploiting the inter-relationships *between* concepts found in thesauri.



At its simplest, this functionally represents the ‘explosion’ of a query term into synonymous forms prior to a search: a user query for *silver*, may actually be for any flatware regardless of material. Even more sophisticated tools would use the semantic structures of the resources and take account of attribute relations. For example, “Silver” as an object type, is distinct from “silver” as a Material in the *Art and Architecture Thesaurus*. All of these concepts offer different information navigation pathways than the individuals named “Silver” in the *Union List of Artists Names*, or the places named “Silver” in the *Thesaurus of Geographic Place names*. Greater knowledge of user assumptions could support even more powerful information access and navigation (Bearman 1994, Bearman/Peterson 1991).

Disambiguating users’ concepts in the absence of the classic reference interview requires their placement within a transparent but apparent conceptual framework both available to the user and governing the response of the search system. Exploiting meaningful relationships could aid in the identification of the appropriate resources in a rapidly growing, heterogeneous dataset. Working with users, AMICO will prototype solutions. RLG and RIT will explore searching through an intermediate vocabulary or thesaurus via Z39.50. RLG will also develop web-based methods that employ vocabularies (AAT, ULAN, TGN) to enhance access to the AMICO Library. The result will be generalized tools that match user query language with tertiary reference data in system-assisted expansion of queries against distributed humanities resources.

IV.F.2 Enhancement strategies

AMICO will continue and extend the systematic data enhancement it implemented in 1998. During the construction of the testbed Library, we developed routines to parse data in free-text fields (e.g.; Date Text) and insert equivalencies in the appropriate index fields. Preliminary studies show that ~60% AMICO Library terms are represented in controlled vocabulary sources if matching is done on a literal – character string – level. However, more sophisticated matching routines are possible, that compare culture, birth and death dates as well as name, to establish equivalencies between the values in documentation in the AMICO Library and the concepts in vocabulary resources. Once equivalencies have been established, AMICO will employ two strategies for recording them: 1 writing a “preferred form” of a term back into an AMICO catalog record (not altering the data contributed by the member, but recording the more widely recognized form as an alternate) and/or 2. updating the vocabulary resources, with cooperation from the GII, by identifying new terms in documentation sources and developing automated means to contribute them to the vocabulary resources.

With RLG, AMICO will also explore capturing the actual queries of end-users and identify the concrete terms by which they are searching. Feedback of *actual user terminology* will directly influence strategies for adding data values to the AMICO Library, and augmenting the vocabulary resources.

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IV.F.2.1 Integration strategies

Building on the common knowledge models, developed during Data Capture, AMICO, RLG and the Frick will work with the *Grove* to specify means to integrate primary, secondary and tertiary materials with the AMICO Library. The partners will prototype various navigational tools linking diverse genres of sources. AMICO and the *Grove* will exploit their common data model to enable subscribers to both the AMICO Library and the *Grove* online to navigate between these resources on as many levels as possible. RLG explore tools to integrate the AMICO Library with the Getty Provenance Index, BHA, SCIPPIO, the Avery Index, and other imagebases. Making the differing terms and conditions of use associated with each part of these integrated resources is critical; AMICO's General Counsel, Michael Shapiro, will work with the *Grove*, RLG and users to define and test appropriate mechanisms.

IV.G Use and Student Involvement

We build digital libraries to enable and augment use by traditional, new and remote users, and to provide improved access to materials in ways not previously enabled. Users of a digital library come from more disciplines, different levels in the educational system, and with many different purposes than those of traditional specialist art libraries. The AMICO Library will be available for research, teaching and learning to all faculty, researchers and students affiliated with subscribing institutions. While access and integration strategies enable new users to find resources relevant to their enquiry, special tools, interfaces and environments designed specifically to support educational objectives, are also required make the best use of visual digital resources.

Significant barriers to Web-based art education seem to be not technological but psychological and social in nature, as we have transplanted existing interaction models to the new medium. Mary Schmidt, an art historian, teacher and fellow in the Studio for Creative Inquiry at CMU, and Slavoljub Milekic, a Neuropsychologist at Hampshire College (HC) will take the lead in developing visual collaboration environments to support teaching and learning with images. Milekic will build on work in K-12 and museum settings and Schmidt will develop previous courses where she has taught using digital images. Identifying and evaluating the tools with the greatest benefit in universities (art historical and general humanities disciplines) and museum education, will engage all project participants. Steve Dietz, curator of *Beyond Interface* (an exhibit of on-line art) and an architect of the "Integrated Arts Information Access" (IAIA) project will articulate museum educators' requirements, and coordinate museum feedback. Patricia Barnett (Frick) and Henry Pisciotta (CMU) will work with teams in their respective libraries to support users of new digital humanities resources. Together with RLG interface designers, the team will develop tools and interfaces that enable creative use of the AMICO Library. Resulting tools will be made available to AMICO members and subscribers for testing, and evaluation, and if successful, to be used with the AMICO Library.

IV.G.1.1 Tools

Developments will focus on the following three areas: a) pedagogical tools specific to the digital medium; b) enhancing and augmenting existing social and educational practices by adapting them to digital medium; and c) creating visual interfaces that support manipulation, exploration, exchange and modification of images and data.

Pedagogical tools: Many tools for teaching with digital images, such as Slide Search developed by the University of Maryland in MESL project, replicate the traditional, art historical, side-by-side 35mm slide presentation. Other ways to present visual information and to orient users in a visual space have been developed for small scale datasets by Schmidt and Milekic as instructors, and will be tested in the large, AMICO Library with a broader range of teachers as users.

Web-based Computer Supported Collaborative Learning (Koschman 1996) will be enabled through environments which support a variety of educational interactions like peer review, tele-mentorships, groupwork, and cognitive apprenticeships. The arts are a prototypical ill-structured knowledge domain (Spiro, 1991) where the benefits of collaborative knowledge building/acquisition are most pronounced. Examples of such tools exist for text-based environments but are required to support interactions in a visual realm.

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Browser interfaces are still primarily text, button-, menu- and hyperlink-based. Building on designs for intuitive, direct manipulation-based interface environments for children and the general public (Milekic, 1997), new, visual interfaces will be linked to the AMICO Library, to allow on-line manipulation, exploration, exchange, and modification of visual data. For example, visual interfaces could allow exploration of the very parameters the artist manipulated during the creation of the work of art (composition; light; proportion; execution style; and orientation), enhance insights into various aspects of the artifact (key-hole exploration; dis-assembly of the work of art; selective & diffuse masking; matching of different artifacts), or exploration and ordering of visual collections by direct manipulation ('throwing' gallery; navigation through categorical spaces).

IV.G.1.2 Student Involvement: Hampshire College

Hampshire College is an alternative college with an 'inquiry based' learning pedagogy; many on-campus activities become educational student projects. To graduate Hampshire students take a "Division III" examination which is often on a higher level than a masters thesis. Student projects from Milekic's courses "The Psychology of the Human/Computer Interface" (Fall '96) and "Innovative interfaces and digital environments" (Spring '98) have received grant funding and been presented at the Smithsonian Institution during the annual NCIIA Conference. A Milekic student is working on collaborative educational interfaces and will adapt them to Web-based tools. "Far Reach: Technology and Alternative Educational Practices", a 1997-98 course, developed and evaluated tools used for another Internet-based collaborative course at Hampshire. Students who attended both of the courses served at the same time as experimenters and subjects! A similar model will be used with AMICO library interface development. Virtual participation and tele-mentorships will be sought from all project participants, and the teaching methods, tools and results shared widely.

IV.G.1.3 Student Involvement: Carnegie Mellon University

CMU is more typical of the faculty and student use expected on subscribing university campuses. Carnegie Mellon Libraries will be working closely with Mary Schmidt and other interested faculty to integrate the AMICO Library content into curricula, presentations, and research. They will document the range of tasks required to accomplish their work (or at least facilitate it) using digital libraries, and the range of contexts in which they perform these tasks, (including the technology available to them) and in which they use (and manipulate) the contents of digital libraries. Training and user support will be offered that focuses on accessing and using the AMICO Library. The campus center for Technology Enhanced Learning also has skilled staff, equipment and tools to support integration of AMICO Library content into curricula, presentations, etc. Students will become familiar with the use of digital library content in the classroom (where images are projected), through course assignments, and in some cases, through their work in the Library.

IV.H Evaluation

A large scale digital library devoted to best practices and new models requires quantitative and qualitative data about users and uses to measure success. Collecting such data requires collaboration between subscribing educational institutions, the distributors providing access, and the museums providing content. The subscribers can report characteristics of users, the distributor can capture what was sought and found in each use session, and the data creators can analyze the digital content and the original work. The AMICO Library and its user community provides a rich environment in which to study the users and the uses of multimedia humanities documentation and enable an assessment of the impact of the changes introduced as a consequence of this project.

The Evaluation Team includes Beth Sandore, University of Illinois, Urbana-Champaign (UIUC), Denise Troll (CMU) and Slavoljub Milekic (HC). Sandore led the evaluation of the MESL project; Milekic's development methodologies involve iterative prototyping and user observation; and Troll brings skills in analyzing user transaction logs. RLG will collaborate capture user and use data, acquire user feedback, and use results to enhance access. The team will study: 1. Who uses the AMICO Library and why; 2. User needs for teaching and research and the systems architectures to support them and 3. Means for user feedback and dialogue with AMICO members. Each study will incorporate user-centered evaluation. They will characterize users and types of uses (frequency of use, types of images used; how often they consult file metadata; and

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what kinds of access and system functionality they use or need). Specific questions will contribute to understanding the impact of art in a digital format on delivery and retrieval mechanisms, museum meta-data, instruction and research, and the overall social, organizational, and technical environment within the university.

IV.H.1 Quantitative Use Measurement: a broad sample

Beth Sandore (UIUC) will conduct two two-wave surveys (one for instructors and one for students) in years one and three of the project. The survey will be administered at 15 AMICO institutions, and, as a control, two institutions that do not intend to subscribe to the AMICO Library within the three-year period. The first wave survey, in year one, gathers baseline information on users (demographics, technology background), use of visual resources, and attitudes toward using digital images in instruction and research. The second wave (year three) gathers similar information on users, their use of visual resources, and their attitudes toward using digital images. The results for identical questions posed in years one and three will be compared, and significant differences noted and analyzed. Preliminary results of the first year baseline survey will be reported at the beginning of year two. Final results of the year three survey and comparative analysis will be reported at the close of the project.

During year two of the study, focus group interviews will be carried out at several of the AMICO institutions with instructors and with users to ascertain more specifically the uses of the AMICO Library, as well as to gather user feedback on the AMICO Library search engine and interface functionality. The results of the focus group interviews would be reported at the end of year two.

- Student surveys: 15 institutions, 100 surveys each, 2 waves (yr. 1&3): Total 3000 surveys
- Instructor surveys: 15 institutions, 7 instructors each; 2 waves (yrs.1&3): Total 210 instructors.
- The "control group": could contain up to 250 participants, both instructors and students.

IV.H.2 Finer Grained Measures at CMU

CMU Libraries will implement access through a web page that presents information on the rights granted to AMICO users and prompts for users' campus Kerberos ID and password. The encrypted ID, Kerberos domain, and IP address of the user will be logged for usage analysis, "behind the scenes" (unknown to the user). CMU will capture comprehensive usage data, converting ID and domain information in the transaction logs into user demographics. Unique user numbers will be assigned, passed to RLG for use in their transaction logs, associating (local) user demographics with (remote) session behavior.

IV.H.3 Human Factors Research at CMU

CMU Libraries will also conduct focus groups and user surveys of user interfaces to the RLG delivery, the public AMICO web site, and the locally cached AMICO Library. This will identify areas for improvement in AMICO design and functionality, including integration with other software tools, which may generalize to other digital libraries. In year one, CMU will conduct user protocols with RLG's AMICO Library web interface and the public AMICO Library web interface. Twenty subjects will participate in the study (six graduate students, six undergraduate students, four faculty and four library staff). A report will be submitted early in year two. The second year of the project, the researcher will work with CMU developers on the design, functionality and testing of the local WebZ interface to the RLG AMICO Library, including the integration of cache management software and messages. User protocols and surveys of RLG's AMICO Library web interface will be repeated in the third year, and the same measures used to evaluate the local WebZ interface. A final research report will be submitted at the end of the third year, where possible comparing the results of the third-year study with the first-year study. CMU methods will be made available for use at other AMICO sites.

IV.I Economic and Social Models

Concrete, replicable, measurements of economic factors in the creation, enhancement, distribution, access and use of digital libraries are crucial to sustainable digital resources. Throughout the project, formal, focused, research will be conducted on the social, legal, organizational and economic relationships required to support AMICO. This team will be led by Michael Shapiro, General Counsel to AMICO. Former General Counsel to the National Endowment of the Humanities, past director of Museum Studies at George Washington University, and an international trade and intellectual property lawyer, Shapiro will be joined by Dakin Hart, Fine Arts Museums of San Francisco (FASF), architect of "The Thinker" web site, the

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first full museum collection on the Web, and economist Anne Stone (Rand Corporation), a specialist in policy research in the arts and higher education.

IV.I.1 Costs and Benefits

Member institutions are bearing the costs of creating digital documentation of their collections *and* paying annual membership dues to AMICO. They are asking subscribers for an equivalent licensing fee to pay for the value added compilation of the Library. Projections show that the AMICO model can work over the long-term if accepted by as few as 10% of U.S. universities, public libraries and school districts. But we need to know more about the costs and benefits of participating in AMICO. A comprehensive analysis which characterizes and quantifies the costs and benefits of AMICO participation will be conducted to help inform decision-making.

IV.I.1.1 Identify underlying economic principles

AMICO will explore the concepts of public goods, networked externalities, natural monopoly and economies of scale. *Public goods*: Digital museum documentation possess the two characteristics of "public goods:" it is nontrivial (once produced, it can be made available to any number of consumers at no additional cost) and nonexclusive (people can use the good without having to pay for it). Public goods will not be provided at optimal levels (optimal for society) if the market is left on its own. One way to address this type of "market failure" is for AMICO to utilize licenses to transform nonexclusive goods into exclusive goods, but under what terms?. *Networked externalities*: How much value does bringing documentation together add? How much value is added by integrating AMICO's library with other resources? *Natural monopoly*: Under what conditions would society be better served by the development of a centralized system for distributing its cultural heritage? *Economies of scale*: If AMICO can demonstrate "increasing returns to scale," it has an economic rationale for increasing membership. At what rate will AMICO's unit costs decline/increase as it adds members?

IV.I.1.2 Evaluate alternative pricing structures

Three pricing options exist for AMICO: *Non-uniform pricing* (where prices vary with the level of consumption), *Ramsey pricing* (in which prices maximize social welfare, subject to a break even constraint), and *subsidy-free pricing* (in which AMICO breaks even and each university pays a fee to cover the incremental cost of serving it). Public utilities, which provide a basic infrastructure and deliver a product where universal standards are important, are a model. AMICO – in its largest incarnation with hundreds of museum members and licensed sites – can be seen as a standard infrastructure for delivering arts and cultural information to the public. With such "infrastructure industries" there are special production and distribution issues that call for a particular pricing approach.

V. Deliverables

AMICO will enable access by million of students, faculty and researchers, while demonstrating a sustainable model for creation, distribution, and educational use of a museum multimedia. We will develop, implement, and evaluate best practices for capture, distribution, and use of a large multimedia humanities library. Specifically, this demonstration project will result in:

V.A Tools for new social relations in digital library publishing/distribution systems.

- Model contracts for relations between content providers and copyright holders, content providers and the consortium, the consortium and distributors, the distributors and subscribers.
- Tested licenses for educational users from universities, through K-12 and public libraries.

V.B Best practices employed in capturing a digital library with more than 250GB of data

- Published and implemented best practice guidelines for image capture and display for the range of visual genres in museums. Evaluate the benefits to museums and users and assess costs.
- Published and implemented best practice guidelines for digital representation of a range of primary, secondary, and tertiary texts about museum objects, assessed with end-users.
- Published knowledge model of art documentation (an SGML DTD) and implemented in the *Grove Dictionary of Art* and the AMICO Library and offered to other publishers.

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V.C Tools for Distribution, Access, Enhancement, Integration, and Use

- A large scale test of extended Dublin Core functionality and its integration with library catalogs.
- Tested clients and attribute sets for Z39.50 access to large libraries of museum resources.
- Integration of the Getty Information Institute vocabularies and thesauri (AAT, ULAN and TGN) into digital libraries and their retrieval systems.
- Analysis of the issues involved in combining central and local distribution of digital libraries.
- Tools to capture user/use data with both local and remote server authentication.
- Methods for large data set downloads to enable local mounting of data, and best practices for downloading image files of various sizes over the current Internet.
- Innovative interfaces for visual digital libraries. Tested mechanisms for user collaboration. Methods to support user feedback to subscribers, service providers, and content providers.

V.D Evaluation reports

- Rigorous, large scale, quantitative data on educational uses of a digital library resource.
- Fine grained data on the impact of making social, technical and economic adjustments.
- Quantitative and qualitative data on the digital library user population and its needs over time.
- Detailed analysis of costs/benefits for creators, compilers, distributors, subscribers and users.