Introduction to Multimedia in Museums

International Council of Museums (ICOM)

Committee on Documentation (ICOM/CIDOC)

Multimedia Working Group

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Jan H.E. van der Starre

Foreword

The Potential for Multimedia in Museums

The documentation of museum collections has traditionally focused on the creation of comprehensive databases of structured text records, each detailing the salient characteristics of a particular object, specimen or work of art. Designed and implemented with collections management functions in mind, these databases record consistent data about museum collections. Standards development efforts, such as those of the International Council of Museums, Committee on Documentation (ICOM/CIDOC) have modeled the structure of such databases, defined minimum database field structures and recommended terminology to be used. Integration efforts have focused on developing systems which will support a broad range of museum functions, from registration through curatorial activities, to conservation or photographic services.

The ability to capture and store information in formats other than structured text provides new opportunities for the documentation and interpretation of works in museum collections. New kinds of information can be recorded, stored and communicated. Multimedia databases-defined for the purposes of this report as databases which store two or more different types of information-enable the recording of structured text, unstructured text, still images, moving images and sound. All of these data types can be integrated to form a comprehensive archive which offers a more robust picture of the context and meaning embodied in artifacts, held in collections and interpreted by institutions.

Initial efforts to exploit the interpretive potential of multimedia in museums focused on the creation of single-purpose interpretive or educational projects. These may have taken the form of an in-gallery kiosk (offering orientation to an institution or exhibition) or a publication (distributed on videodisc or CD-ROM). The models for these projects came from the world of publications, and their goals reflected those of gallery guides or exhibition catalogues. These first forays into interpretive multimedia exploited its interactive potential to offer a personal view of often complex and "multi-layered" subjects.

These prototypes and first-generation systems produced, almost as a by-product, collections of digital data in forms other than text. The potential to re-use multimedia content (such as digital

images) created for one purpose in another project, however, has prompted the consideration of institutional multimedia databases. These storehouses of text, structured text, sound, and still and moving images form an impressive information resource. The construction of institutional multimedia archives has begun to play a significant role in the documentation strategies of many museums.

Multimedia is Multifaceted

Multimedia is an opportunity for museums. It offers a paradigm for capturing and preserving the multi-faceted information embodied in the objects of our culture. It also offers new capabilities for structuring and communicating knowledge of our collections.

By surrounding objects with a gloss that includes description, representation, interpretation, derivation and appreciation, we can document and communicate the cultural significance of artifacts. Meaning is preserved as well as physical form. A multimedia database can function as an institution's collective memory, gathering and recording all types of information.

Museum multimedia databases are becoming vast storehouses of digital information about the world's cultures, which have the potential to play a significant role in the new information age. As libraries are being converted into digital form and teaching takes place on the networks rather than in classrooms, learning moves from being directed to being exploratory. Museum multimedia databases which offer quality content and depth of meaning are prime resources for network research. By making collections available in digital form, both in-house and through communications networks, museums have a tremendous opportunity to meet their educational mandate, as formulated in the official ICOM definition of a museum:
"A museum is a non-profit making, permanent institution in the service of society and of its development, and open to the public which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment (ICOM Statutes, art. 2)."
Multimedia museum archives become an institutional knowledge-base, providing the raw materials for the creation of new intellectual property. Portions of such a database can form the core of multimedia products which structure the vast amount of information available on a subject, offering layers of interpretation and meaning.

Linked together over networks, museum multimedia databases become a valuable cultural resource. The continent of multimedia information is just now forming in networked information space. Explorers are identifying the natural features of this new landscape. We are learning to tell the mountains from the rivers, the fixed points from the pathways. What is missing are maps. These maps through multimedia cultural information may become the knowledge of the future. Those who can offer meaning through structuring and interpreting complex information will provide the subject-oriented, specialized guides to these new spaces. Museums are ideally suited to play this role.

J. Trant

Chair, ICOM/CIDOC Multimedia Working Group, September 1996

Using Multimedia in Museums

In the summer of 1992, a group of museum professionals at the International Council of Museums (ICOM) triennial meeting in Quebec City, Canada, began an ongoing discussion on the potential for the use of multimedia data in museum documentation. This group became the Multimedia Working Group (CIDOC/MMWG) of the International Documentation Committee of ICOM. Initially, discussion focused on sharing information about pioneering projects which were using new computer-based tools to capture and communicate multimedia information about museum collections. The integration of sound and image data into museum collections databases offered a new opportunity for recording the depth of information about works in museum collections, and interpreting their significance. New interactive multimedia interpretive tools also provided ways of communicating the rich context and meaning embodied by museum artifacts.

In order to illustrate the potential for this new medium, the Working Group outlined this *Introduction to Multimedia in Museums*. Each of the sections was initially drafted by a member of the Working Group (the original authors are listed in the acknowledgments). The draft report was reviewed at the CIDOC Multimedia Working Group meeting in Stavanger, Norway, in July 1995. In Norway, the CIDOC/MMWG confirmed that multimedia played two distinct roles in the museum context. Multimedia is used as a communications tool, interpreting museum artifacts and collections, both within the institution (in the exhibition gallery or orientation kiosk) and through distribution mechanisms (such as published CD-ROMs or multimedia databases accessible through the Internet or the World Wide Web). Multimedia is also being used as a documentation tool, building integrated museum databases that record information about collections. These may be used simply as internal collections management or documentation tools, or they may be made accessible to outside researchers. The themes of multimedia as a communication tool and multimedia as an archival tool echo throughout this report.

Following the Stavanger meeting, Ben Davis was asked to act as General Editor of the *Introduction to Multimedia in Museums* to provide a consistency and integrity to the report as a whole. Working with Jennifer Trant, the chair of the ICOM/CIDOC MMWG (Canada/USA) and an Editorial Committee composed of David Bearman (USA), Jan van der Starre (The Netherlands), and Tine Waning (Denmark), he has revised the structure and organization of the report. The editing and production of the report was completed in collaboration with the Imaging Initiative of the Getty Information Institute (formerly the Getty Art History Information Program). The final editing of the present report was done by Jennifer Trant and Jan van der Starre. Production of the printed version took place in the Netherlands.

"Multimedia" presents the museum visitor with more than formatted data and textual information. It encompasses interactive multimedia, hypermedia, imaging applications, digital video, computer graphics, virtual reality, and computer-controlled interactive displays and participatory exhibitions.

Introduction to Multimedia in Museums examines the integration of computer-based multimedia applications into the traditional activities of the museum, profiling the issues involved in developing and implementing multimedia applications. The review is structured in three broad sections:

I. Using Multimedia in Museums

II. Developing Multimedia Systems
III. Issues in Multimedia.

Introduction to Multimedia in Museums examines the impact of multimedia on the traditional functions of the museum. It begins with an overview of the ways interactive multimedia applications might be used in the museum, followed by specific discussions of Multimedia in Museum Exhibitions, Multimedia in Museum Education, and Multimedia as a Research and Documentation tool.

The second section, "Developing Multimedia Systems," identifies the stages in the development of a multimedia application or product. Beginning with Project Definition, this section introduces issues of Multimedia Technical Formats, Project Management, Interface Design, Information Architectures, and the Stages of Systems Development: prototyping, the design specification, production, testing, and distribution. This section ends with a discussion of the role of evaluation throughout the development process.

The final section of the report, "Issues in Multimedia," introduces two critical questions that must be considered when a multimedia system is developed: Intellectual Property and Funding. The report concludes with an overview of outstanding issues, and points toward the future role for rich museum multimedia archives in the emerging global information network.

Introduction to Multimedia in Museums reveals the potential for multimedia to both preserve and communicate the knowledge embodied in museum collections. Reusable museum multimedia archives, will, however, depend upon a foundation of technical and content standards to ensure the inter-operability of systems and the interchangeability of data. Without a common standards framework, it will not be possible to take full advantage of the potential for integration that communications networks offer.

The International Documentation Committee of the International Council of Museums (ICOM/CIDOC) has a long history of developing documentation standards for museums. CIDOC's Multimedia Working Group (CIDOC/MMWG) has identified two primary concerns for future multimedia standards development within the museum community. The first, documenting multimedia data types, focuses on standards for describing the full range of digital data types, including still images, moving images, sound, and unstructured text. The second, using multimedia as documentation, explores the potential of sound, images, and video as effective means of capturing descriptive and contextual information about museum objects. Developing guidelines and standards in these areas will be key to creating reusable digital multimedia archives for museums.

Section One: Using Multimedia in Museums

1. Multimedia in Museums

Introduction

Visiting a museum is a "multimedia" experience. Since the first written explanatory label was placed in an exhibition gallery, visitors have gathered information both by looking at things and by reading about them. As multimedia is simply a combination of two or more different media, computerized multimedia systems form part of a long tradition of interpretive and explanatory

technologies and techniques that grows from slide shows, text panels, and dioramas.

Multimedia makes use of computers to store, combine, retrieve, and present information from a variety of media, and enables user-defined interactive navigation through these sources. A multimedia database of text, images, and sound can be searched quickly and effectively. The results of the search can be displayed locally or communicated over a network to a user in a remote location. These capabilities open up a wealth of possibilities in all areas of museum activity, including education/interpretation, curatorial research, and documentation.

Characteristics

Strictly defined, multimedia results when two or more digital media are combined to provide information about a subject. These media may be text, drawings, graphics, still photographs, moving images from film or video, and audio. Interactive multimedia enables communication between the multimedia system and its user; the user controls the sequence and presentation of information. This is in contrast to a film, for instance, which is linear and meant to be seen by a passive viewer from start to finish.

Interactive media requires input from its "audience". The user must make choices, ask questions or define search criteria to activate the system, and retrieve information from it. Multimedia is not by definition interactive; it can be presented as a linear performance like a slide show with additional effects. On the other hand, interactive media is not necessarily multimedia; it can be based on a single media such as text. Encyclopedias were never intended to be read from beginning to end, and some new books are constructed as interactive media, where the information presented depends on the readers' choice. Fully integrating multimedia into museum operations requires extending the definition of audience to include museum visitors, researchers, and staff., whether in the museum or working remotely locally, nationally, or globally.

Navigation

Navigation refers to the ways and means through which a user encounters the information in a multimedia program. Interactivity results when a user is permitted to choose his or her own route. Some systems are constructed hierarchically; choices are made from menus until the "bottom" of the system has been reached. Others are constructed following hypertext principles: pieces of information are linked together in a web, and users may browse in the system by activating the links, which may be identified in various ways. Hypertextual navigation best exploits the computer's flexibility in handling large amounts of data and cross references.

Multimedia systems often combine these two organizing principles. A hierarchy may be necessary in order for the user to choose a subject, but the hypertext structure without any hierarchical structure can impair the user's ability to navigate.

Multimedia and Visitors

Multimedia installations in museum galleries can range from a single interactive video-kiosk in a special exhibition to a totally integrated exhibition and information environment supported by technology. When multimedia is featured in an exhibition design or interpretive plan, its target audience can be defined as the visitors to that exhibition.

Exhibitions often include supplementary interpretive material to provide information about

objects, works of art, or artifacts that is not apparent from their visual appearance. This contextual information enables visitors to understand and appreciate more fully what they are seeing. Multimedia interpretive systems can provide a broader range of information about the themes of an exhibition, and enhance visitors' experience.

Within the traditional gallery environment, an object can be exhibited only in a limited context, such as its provenance, or chronological sequence. Multimedia databases provide the opportunity to position a particular work on more than one continuum, enabling comparison, interpretation, and recontextualization.

Limited gallery space often means that museums can exhibit only a small portion of their collections. Multimedia databases make it possible to introduce comparable works, which might not otherwise be seen. Interactive image manipulation capabilities can make it possible for a visitor to compare and contrast objects, and to examine works in detail. While these functionalities may be particularly useful to the specialist researcher, visitor engagement with the material increases when interactive multimedia are introduced.

Multimedia kiosks can also be used to provide visitors with general information about the museum, its building, and the subject it interprets. It may be possible, for example, to print out a floor plan, identifying the location of a particular work. General systems may also include a game or quiz to test visitor knowledge, or provide a place for visitors to comment on their museum experiences.

Narrative Communication

The museum visit can be enhanced by multimedia systems emphasizing narrative content. Similar to advanced computer games or even virtual reality, these systems emphasize the experiential nature of visiting museums (e.g., the Yorvik Viking Center in York). This type of interpretation is not yet common in museums, and it has been criticized for diverting the attention of visitors from original artifacts.

Another means of encouraging involvement in the museum experience is to invite the visitor to use multimedia to play an active role in the exhibition. It may be done by providing the visitor with a identity card, to be used to activate information kiosks in the exhibition. If the card is coded with the visitor's name, it suggests that the computer is conversing with this individual visitor (AT&T's visitor center, New York). The identification of the visitor of the exhibition can also be used to provide him/her with further information, such as lists of relevant literature and a summary of the kiosks the visitor actually used during the visit (Information Age exhibition, National Museum of American History, Smithsonian Institution, Washington, D.C.) Both of these exhibitions deal with information technology, making multimedia a natural interpretational tool.

More often multimedia is introduced in stand-alone kiosks providing more information about and understanding of an exhibition. Simulations like the construction of a sailing ship with hull, equipment, and cargo are used to illustrate concepts such as cause and effect, for example why a big 16th-century vessel sank after only a short sailing. The ship "constructed" by the user can be tested under different simulated wind conditions, in a computer graphics environment (Wasa Museum, Stockholm).

An entire exhibition can provide the basis for a multimedia database. Digital images can be

positioned in three-dimensional "virtual space". Navigation through the exhibition is done on the monitor by pointing right, left, up, or down along the walls, and close-ups of objects can be seen by pointing at them (Galleria Spada, Rome).

Digital Catalogs

Interactive multimedia is excellent as an enhanced exhibition catalog. A database can be constructed containing a complete catalog with basic documentation and images of all objects in the exhibition. Basic information can be combined with background details about maker, genres, subjects, provenance, and techniques. Visitor exploration can focus on any of these categories, and a floor plan printed with the specific objects marked so that the visitor can plan a tour in the gallery (MicroGallery, National Gallery, London).

A nontraditional catalog may tell different stories about the same object. For example, an ethnographic object brought into an European museum in the beginning of the century can be interpreted by a missionary, a businessman, a tourist, and a curator from the object's island of origin. These different points of view illustrate ethical and political issues embodied in artifacts (Birmingham Museum and Art Gallery, England).

Distribution

Outside the museum walls, multimedia is ideal for distribution to a broad range of museum communities (or markets): professional, educational, and consumer. Many museums have already produced digital catalogs (videodiscs or compact discs), and the production of educational material and entertaining publications is growing.

The physical storage media used depends on the intended use of the system, the target group, and the method of distribution. Not many years ago the only electronic media for storing images and film on a large scale were analog videodiscs, which had to be externally linked to databases and programs stored on a computer. With the advent of digital video compression techniques today it is possible to integrate video, graphics, audio, databases, and programs in an all-digital form. Digital media file formats are not standardized, however, and range from a computer's local hard disk to a variety of formats like CD-ROM, CD-I, DV-I, and Photo-CD.

The question of data exchange between museums and the possibilities of joint productions with material from several museums are aspects that require consideration. The media itself are not important, apart from problems with standards, which make it difficult for a producer to choose acceptable and "long-lived" media. The rapid development of new physical media and especially the growth of Internet over the last few years -which showed the inclusion of a growing number of museum services on World Wide Web- emphasizes that more attention should be paid to issues such as user interface, system construction, navigation, and content rather than to technical issues.

Multimedia as Interpreter

It is evident that technology should not be introduced for its own sake but only when it helps to fulfil a clearly defined purpose.

Multimedia is a phenomenon with many variations. Some systems deal with a single topic on a very detailed level, while others are content to address a broad range of topics in less detail. The

success of a multimedia system depends on the user-friendliness of the content as well as the user interface. Both must be tailored to the needs of the user.

Most exhibition systems will be designed more simply than a system distributed to the educational world, where it can be expected that users will spend some time to learn the "language" of the system. Yet there will be no final key to designing user interfaces, as it must be expected that multimedia literacy will grow following the increased use of multimedia in all areas of human activity. Given the speed of current technical development, only one thing is sure: we have seen only a small part of the possibilities multimedia will provide in various situations, and much experimentation is still needed before deciding how it can best be used in museum work.

2. Multimedia in Exhibitions

Introduction

Museums collect and preserve original artifacts (works of art, objects of material culture) and disseminate knowledge about them to the public, mainly by mounting exhibitions. Typically, exhibitions are interpretations of collections or parts thereof. They relate a number of original artifacts or art works with various types of documentation (informational labels, captions, maps, dioramas, etc.) within a spatial organization scheme, in order to provide visitors with a fruitful and pleasing learning experience.

The functions of a museum exhibition can be categorized as:

- social, providing a powerful focus for the construction of social identity for its public
- affective, creating a concrete visual experience that gives esthetic pleasure and which leads to emotional and motivational rewards
- cognitive, providing an environment for self-education, an opportunity for visitors to teach themselves through exposure to the exhibitions.

Questions related to the cognitive function of museum exhibitions include the following:

- Does the structure of the exhibition enhance the artifacts?
- Does it help visitors to appreciate them?
- Can visitors find what they want within the exhibition?
- Is the museum visit a coherent experience, or is it just a collection of unrelated chunks of information?
- Is the exhibition successful in stimulating learning, i.e., the acquisition of new knowledge, concepts, perceptual skills, and attitudes directly attributable to the exhibition experience?
- Can any set of presentation techniques be effective for the wide variety of visitor knowledge, backgrounds, and objectives that characterize museum publics?

Visitor Learning Support

Lacota (Lacota 1976, pp. 245-279) suggests that the cognitive impact of an exhibition may be drastically improved by adopting learning support techniques. Providing a clear conceptual frame of reference for what an exhibition is about, what it has to do with visitors, how it is organized, and what they can expect to learn from it will actually improve visitors' capacity to enjoy the exhibition through discovery and help them to understand what it is they discovered. Multimedia, especially interactive multimedia and hypermedia, presents considerable advantages as an exhibition learning support technology:

- It can deliver a wide variety of heterogeneous information related to the exhibitions, including photographic images, drawings and plans, architectural models, simulations, video clips, music, narrated commentary, textual information (labels, captions, even essays) and database records.

- It may provide visitors with a mechanism to view only the subset of such information that is appropriate to their interests and background, thus catering to different visitor profiles.

The use of multimedia technologies in exhibitions, however, raises the following concerns:

- It may divert visitor attention from the actual artifacts exhibited.

- It may encourage interaction styles not appropriate to the museum setting.

- It may infringe upon the non-technological atmosphere of the exhibition.

- It may alienate those visitors who are not computer literate.

The appropriateness and success of multimedia in an exhibition depends on an understanding of its potential advantages and shortcomings, as is the case with traditional visitor support systems (handouts, informational captions, audio playback units, projection systems, feedback-response devices, etc.). In fact, the conception and design of multimedia applications for exhibitions can be seen from two complementary viewpoints: the contextual viewpoint of the museum exhibition as a whole, and the structural viewpoint of the multimedia application as an object in itself. The former provides a functional context for the latter.

Multimedia in Exhibition Design

Defining the concept of an exhibition entails decisions about its purpose (what the exhibition aims to achieve), content (what objects and/or interpretive concepts are used), structure (linear, based on discovery), target audience (children, local visitors, tourists) and communication approach (object-led, interpretive). Then, in concept development, specific decisions must be made about the storylines, media, and actual exhibits used or objects shown, including the development of multimedia applications to support the exhibition. Some important principles suggest themselves regarding exhibition design:

- A chaotic exhibition, whereby the visitor is not presented with a coherent path of traversal, often leads to information overload or a feeling of getting lost.

- Visual monotony can lead to visitor fatigue; when relatively homogeneous artifacts are presented, this tends to be a considerable problem.

- Prior knowledge of what is contained in a museum exhibition and how it is structured leads to a more satisfactory visitor experience.

However, rather than strictly controlling the learning process, individual museum exhibits provide the information necessary for visitors to apply their own learning skills with greater effectiveness. Visitors enjoy being offered guided tours of an exhibition, especially if they can ask their own questions of the guide and have some choice over the sequence of exhibits visited. Visitors benefit from reading or attending lectures about specific aspects of the theme of an exhibition, both before and after their visit. Affective or sensory arousal, positive or negative, heightens the capacity of visitors for learning. These principles affect the totality of exhibition design, including the educational and other activities used to support exhibitions, such as signage and written documentation. Yet they also identify potential functions for the application of multimedia technology in exhibitions.

Multimedia as Index

Multimedia applications, typically installed in the form of kiosks near the entrance of an exhibition, can provide visitors with an effective way of understanding what an exhibition is about, what parts it comprises, and how it is spatially organized. The purpose of such applications is to improve physical orientation, typically at the beginning of a visit.

For these applications to serve better than the traditional brochure with a brief introduction and plan of the exhibition, such kiosk applications could provide:

- A clear focus on the purpose and scope of the exhibition, possibly in the form of an attractor loop.
- Short introductions to the main parts of the exhibition, illustrating key objects and artifacts and thus arousing visitors' interest.
- Alternative main indexes (e.g., thematic, artist's names, provenance) to the exhibition's content, apart from that determining the physical layout of the exhibition.
- Clear instructions about how to get from the kiosk to the gallery.

The following recommendations may be appropriate for such multimedia index installations:

- While they can offload the work of an information front desk, they should be seen as complementary to human assistance rather than as an alternative.
- They should be designed to allow visitors to retrieve orientation information within a few minutes and should avoid unnecessary detail.
- They should be installed in adequate numbers near the entrance, or, in large exhibitions, in areas where visitors decide on a route to take, with visitor flow as a major consideration.

Multimedia as Visitor Guide

Multimedia technology can complement the function of human guides, audio support, and loop antenna systems in providing learning support to visitors in an exhibition. Applications

functioning as visitor guides may be installed at the entrance of a gallery (accessible after the visit as well), as in the case of the Micro Gallery of the National Gallery in Washington; distributed in a number of access points in the exhibition itself, as in the Networked World exhibition of the Boston Computer Museum; or accessible through devices carried around by visitors, as in the portable CD-ROM system by the Isle of Man museum for visitors to the monuments of the island.

In order to enhance the visitors' experience, these applications can provide:

- Interesting and lucid scripted essays on selected themes, supplemented by relevant and good-quality audio-visual material that improves the understanding of the exhibits themselves.
- A straightforward method of interaction allowing visitors easy access to interesting information that relates to the immediate (physical) exhibition context.
- A carefully selected set of alternative points of view on the exhibition for different segments of the public, possibly personified by appropriate characters, and matched to different levels of background and interests.
- Personalized exhibition plans, which can be printed, suggesting an itinerary through galleries of interest for specific visitors and allowing visitors to know where they are at each point.
- Printed summaries of selected information, including illustrated pages of information to be consulted during a visit.

Some specific problems that may relate to this type of application, depending on its conception and design, are:

- Congestion associated with visitors monopolizing information stations for long periods of time, especially when they are situated near the entrance of the exhibition.
- The unwanted intrusion (in terms of atmosphere) of interactive stations installed within the galleries. For this reason few are likely to support sound.
- The high cost of portable devices designed to be carried around by visitors.

Multimedia as Study Collection

In visitor surveys (Lacota 1976, pp. 245-279) it has been noted that people not only "wanted to see more specimens, but apparently they understood more, learned more and enjoyed it more when there was more to see". In fact, significant applications of multimedia technology, for example in the National Museums of Denmark and the Imperial War Museum, aim to provide visitors with access to material not on display. These applications are a cross between a virtual study collection and an illustrated catalog of the collection, albeit with more powerful information retrieval capabilities and, possibly, better quality images.

The following concerns may be raised about this class of applications:

- In order to be more useful than printed illustrated catalogs, they need to provide excellent

quality images throughout, and well-researched textual captions for the works included.

- Particularly if initially conceived as applications for the museum specialist (Goldstein and Renard 1994, p. 7), they require the adoption of simple user interfaces and appropriate content to be accessible to the public.

- Since research depends on integrated scholarly information on museum collections, they are best implemented as front ends to museum information systems conceived as a whole, rather than as stand-alone applications.

- Discussion should not be limited by the linear catalog format, but exploit associative links to allow full hypertext navigation between artifacts or works of art, people, events, places, and concepts.

- As they aim greatly to increase the visual appreciation of parts of the collections which are otherwise not accessible, they should be enhanced with high quality projection facilities so that groups of visitors can share in experiencing their content.

Multimedia as Explainer

Traditional museum exhibitions are often criticized for not providing visitors with background information and thus preventing them from enriching their understanding of the exhibition. Good museums(traditional and otherwise) attempt to mitigate this problem by publishing educational material and exhibition guides, and by organizing lecture series coordinated with their exhibition program. Multimedia technology, in its role as explainer, has to compete with these complementary forms of interpretation. It may do so most effectively by providing:

- A clear storyline and definition of subject matter, appropriate and necessary to illustrate an essential point about the content of the exhibition.

- An easy-to-use user interface, which does not interfere between visitors and the content of the application and allows visitors to navigate simply and efficiently between different parts of the application.

- An appropriate approach suited to different types of visitors, making it easy to retrieve (directly or indirectly) information relevant to their particular background and interests.

- A good and quiet setting, near but not necessarily next to the relevant exhibits, which will stimulate visitors to think about the content rather than the technology.

- Depending on the nature of the application, facilities for annotating and printing appropriate information.

- Good quality textual, visual, and audio content

Multimedia applications that act as explainers of specific exhibits or gallery themes will exploit different metaphors for organizing content. They may include monograph collections of textual and visual information, hierarchically arranged, such as the Classical art videodiscs installed in the Greek galleries of the Louvre. They could also include role-playing dramatizations, such as the hunting game in the "Life in the Arctic" videodisc that accompanied the exhibition of the same name in the Museum of Mankind in London, and simulations, such as that of a three

species habitat (and many others) in the Exploratorium in San Francisco. Other promising technologies for furthering visitors' understanding include virtual reality and computer graphic reconstruction, construction, and manipulation games (such as archaeological dig simulations), video-on-demand applications with material relevant to specific galleries, and holographic displays.

There are no fixed rules for the applicability of each of these metaphors for explanation of museum exhibitions; the choice of appropriate metaphor should be based on the purpose, content, and intended public of the exhibition. Where consultation of comparative material (visual, textual, etc.) is paramount -for instance, in the case of art history- hypermedia applications are more appropriate. Where the emphasis is on explaining processes used to produce material culture, simulation and role-playing may be more relevant.

If the exhibition is addressed mainly to children, symbols and metaphors more familiar to them could be used to catch their interest: humorous, cartoon-like creatures are used in interactives in the Noorder Dierenpark (Netherlands) in order to teach children about evolution. In all cases, however, the conception and design of multimedia applications should be undertaken as part of the whole exhibition design process rather than as an isolated technical task.

Multimedia as Emotive Trigger

Advances in computer graphics, immersive environments, and virtual reality technology provide the tools for the construction of highly affective sensory experiences. These experiences, which may involve a high degree of interaction, could function as triggers to heighten visitors' interest and involvement in the message of an exhibition. This is done very effectively in the Holocaust Museum and Memorial in Washington, D.C., albeit through simpler means: shocking projected images and narration are used in the exhibition, and the visitor is identified with an individual victim of the Holocaust, whose fate can be traced in the associated database after the visit.

Virtual reality experiences (e.g., fully rendered three-dimensional architectural reconstructions of archaeological sites such as the tomb of Nefertari, commissioned by the Getty Conservation Institute), manipulation games, and role-playing or simulation applications (such as the ship-building application in the Wasa Museum of Stockholm) may be useful as strong emotive triggers. In the "Collectors of South Pacific" videodisc exhibition in the City Museums of Birmingham, visitors are invited to identify with one of four characters and thus develop personal involvement in the subject of the exhibition.

Little evaluation experience, however, exists yet on the effectiveness of multimedia for this purpose. Skeptics question the appropriateness of such an approach, especially for art museums.

Multimedia as Examiner

Museum educators have traditionally used question sheets, quizzes, and revision summaries as well as pre- and post-exhibition questioning (e.g., of the form "What similarity exists between these two artifacts?") to engage visitors' attention. Given its history in computer-based training and other educational applications, multimedia appears well placed to provide a useful and rich way of enhancing the visitors' learning potential, especially after the visit, through the use of similar devices.

Typically, a computer quiz poses questions, elicits responses from the visitor, and presents new

pages of information (according to the programmed learning approach). Possibly a score is given at the end of the "quiz". Little is known of this evaluative approach in the museum context. There are strong arguments against the use of marking as a (negative) incentive for learning, in favour of a more creative, resource-based approach to the acquisition of knowledge.

Multimedia in Existing Exhibitions

The introduction of multimedia applications to an existing exhibition is a pragmatic issue for many museums. This process, however, should be part of a comprehensive approach to exhibition updating, and should address demonstrable shortcomings of the exhibition; it should not be the result of mere availability of resources or technological fashion. Typically, evaluation of an exhibition's impact (through survey, focus group research or other means) may indicate one or more of the following problems, that may be addressed through the use of multimedia exhibitions:

- The purpose and scope of the exhibition (i.e., what it is about) is not apparent to visitors.
- The organizational scheme of the exhibition is not clear (i.e., visitors cannot find what they want easily).
- Visitors are not able to appreciate the multiple contexts of objects exhibited (e.g., functional, symbolic, stylistic, typological), and such a multidimensional understanding is considered appropriate.
- Visitors are not able to retain for a longer period information that they encountered in the exhibition.

These problems may be typical among casual visitors; serious visitors may suffer less. But casual visitors may be under-represented in visitor survey statistics. Multimedia technology may be an appropriate solution, but it should be evaluated against other visitor support systems. Often, successful exhibitions that fulfil their mission to their designated public are better left alone.

Isolation or Integration?

Where is the appropriate place to install multimedia in museums? Arguments for placing multimedia exhibitions separately from the exhibited objects focus on the potential disruption, in terms of visitor flow and mode of interaction created by the presence of technology in the galleries. In general this argument holds true where a small number of interactives are placed in (mostly art) galleries, providing a target for fast-fingered and noisy children and a nuisance to adults trying to have a contemplative viewing experience. On the other hand, the consistent and integrated use of in-gallery interactives in the Haus der Geschichte in Bonn suggests that they can be successful, and non-intrusive multimedia applications can actually enhance the visitor experience, as long as their placement and function within the gallery storyline is planned in advance and is functional.

In general, multimedia are best set in separate areas from the exhibition galleries when:

- They do not relate to the storyline or subject matter of specific exhibits in the galleries.
- They provide access to encyclopaedic material, which could refer to more than one section of the galleries.

- They depend on the creative use of music or narrative through loudspeakers, which would disrupt the atmosphere of the galleries.
- They propose an immersive or strong experience requiring special viewing conditions, such as a virtual reality reconstruction of an ancient site.

Multimedia applications can be useful in-gallery when:

- Their content and metaphor of use relates directly to the storyline or subject matter of a specific gallery.
- Their setting in the gallery does not present problems of visitor flow.
- The social behavior they promote (e.g., talking to each other in a group) does not conflict with that designated for the gallery concerned.

3. Multimedia in Education

Introduction: Ways of Learning

Learning takes place at different levels and in different modes. At its most basic, multimedia can help a user recognize words, terms, and their contextual meaning. Multimedia applications can be designed to support different learning methods and styles. Simple vocabulary trainers for foreign languages or technical terms are the multimedia equivalent of multiple-choice tests for the learning and testing of contextual meaning. They present, identify, and reinforce information.

At the next level, visual perception begins to play a role. Shapes and colors, graphic elements, and movement through space and/or time present information in many different ways. The user is empowered to choose a route through the material or ask questions about the content of still pictures or sequences of moving images. Multimedia computing still offers many unexploited possibilities for this kind of learning, especially in art history.

Interactive learning can also be achieved via role-playing and situational games or communication with other users. For example, multiple users govern a simulated medieval town or discuss a picture with a gallery visitor in another location via the Internet.

Multimedia computing can also be used to pursue the didactic aim of furthering creativity: finding a suitable description of an art object, manipulating scanned pictures, rearranging the pictures in a digital exhibition, or simply grouping colors and shapes, all exercise visual learning and perception.

Brainstorming is one method of gathering spontaneous ideas from a group of users about a topic or question. This method, which is often used during guided tours, can also be used in multimedia computing by means of an interactive exchange of ideas with other users or adding a comment to an existing on-line discussion list.

The synectical method tries to make strange things familiar and familiar things strange. The synectical theory or system of problem-stating and problem solution is based on creative thinking that involves free use of metaphor and analogy in informal interchange. Well-known pictures or objects can thus be made to seem out of the ordinary or put into a totally different context in order to attract the audience's attention to specific stylistic or social sets of rules. Other

examples of this method are programmed conflict situations, mistakes, or provocative questions.

Trial-and-error navigational exploration in multimedia applications facilitate discovery and learning. Users can move freely within a program, make inquiries and comments, or give answers to questions without fear of failure.

Multi-Sensory Learning

One important principle of didactics is the use of several different channels of sensory information at the same time. It is possible to retain about three times as much information with multi-sensory input as with just one channel. It is thought that the retention rate after hearing is on average around 20%, after seeing around 30%, after hearing and seeing together 50%, and after hearing, seeing and touching around 70%. The retention rate, of course, also depends on factors such as motivation, sensitivity, and presentation.

An important element in the use of multimedia computing, especially for a younger audience, is "action". New information is acquired more quickly and easily if linked to something exciting or attractive. Even changing the character of familiar information has an attracting effect. Addressing users by name or encouraging and applauding them have a motivating effect, resulting in an interplay of incentive and award. The same holds true for multimedia applications that directly respond to users entering information.

The display of results or grading in competitions may give incentive to users by awakening ambition. Some programs give a scoreboard of the last or the best competitors. In others a voice says "well done" and gives a personal comment. Other applications are meant to make people curious, offering an amusing response when the mouse is clicked or an on screen feature touched. People are likely to look further for hidden responses in this type of program.

Users' Choices

Multimedia computing has a decisive didactical advantage in comparison with films or slide shows. Users influence the working of a program and may even communicate with other users. They can choose from a menu or shortcut, repeat or prolong ongoing processes. They may even be able to piece together information and present it to other users. Intelligent interactive programs take note of the users' responses, adjust to their success in learning or to their mistakes, and prepare the subsequent learning units accordingly.

Multimedia educational experiences in the museum setting can range from one user working with a multimedia display to several users each working on an individual system but linked by a network to each other and/or to a teacher; the systems could even be located in different museums throughout the world. Using a communication program, a dialogue between two people from different cultures could develop.

In a different scenario a teacher or museum educator could control the individual systems (as in a language laboratory) and pre-select specific decision-making situations. This scenario is suited for courses in which work processes are taught (e.g., restoring an object), for fixed questions (where the answers cannot be reduced to one exact word or figure), for descriptions or re-creations of cultural objects. The more varied the possibilities for interactivity, the more complicated the development of multimedia systems.

Interactivity can be enhanced by the use of simulation and virtual reality (VR). For example, simulating the effects of chemicals on art objects as a result of conservation or environmental influences. VR enables movement within three-dimensional, virtual reconstructions of historical buildings or towns, communicating the conditions of life in earlier times.

Audience and Goals

The target audience for the multimedia application needs to be defined at the outset of the project. A profile of the audience should be developed, considering such factors as age, education, interests, and computer literacy. The individual steps for learning, the volume of information, and its complexity must be adapted to each user or group of users. If a user group consists of people who are intimidated by using computers, a program without too much interactivity may be best. An essential aspect of didactics is to adjust to the learning rhythm of users and to offer them a slower or quicker-paced path through the material.

The aim of the application should be clearly defined. Is it meant to be a training program, a game, a point-of-information kiosk, a medium of communication, a slide show, an interactive film, a virtual reality application? In what way is the audience supposed to benefit? What is the topic supposed to be about? What are its limits? Where will the installation be placed? Is it the principal carrier of information or part of an exhibition or topic? Is it displaying something that could otherwise not be displayed? Does the multimedia installation fit in with the rest of the exhibition?

The right hardware, software, and other additional equipment has to be chosen during the planning phase. An estimate is needed of how many multimedia workstations have to be installed and how many users should be able to work at any unit at the same time. Does the choice of equipment meet the intended aims? Usually equipment and input devices such as touch screens, mice, or keyboards are appropriate for specific installations. It may even become clear that some didactic aims can be achieved much more economically with traditional media such as video or slide shows. Multimedia computing should not simply be used because it is modern or available, but because it responds to a specific teaching goal.

Developing effective multimedia teaching applications requires active and intelligent collaboration between museum educators and multimedia specialists. Only the continuous exchange of ideas and experiences can ensure progress in this interdisciplinary field.

4. Multimedia in Research

Introduction

Multimedia modeling of research processes is used in a variety of disciplines in science, including medicine, biology, engineering, and surface examination. It is possible to envision a suite of multimedia applications for museums that take advantage of this capacity to structure and deliver complex information. These include providing access to full documentation, comparison of objects, restoration and conservation, transport-related topics, and reconstruction.

Access to Full Documentation

For good management and care of collections it is necessary to have a full overview of the content of a collection and its condition. Such a complete overview is not necessary in order to

build multimedia systems for exhibitions and/or educational purposes. For these applications a selection of material is needed. Researchers and managers of collections, however, need to have access to all data, or at least to a nearly comprehensive selection of the information recorded.

Researchers rely more on accuracy and quality of data. For example, a standard VGA image will normally not suffice because it does not allow for zooming in and studying material in detail. These functionalities are necessary for conservation applications, for instance, where a detailed representation of the physical character of an object is essential. Museum professionals need full information to perform the museum's tasks, including publishing collection catalogs, preparing exhibitions, and answering queries. A central multimedia database, which integrates information formerly found in card catalogs and photo libraries, makes these activities more efficient. Depending on the collection (e.g., history of filmmaking, the Jazz Museum) other media as well as text and images, moving images, and sound are needed.

Typically research-oriented applications deal with detailed study of the objects, their composition, and origin/date. A good example of such an application may be found in the article on the analysis of paper texture in Van Dyck's Antwerp Sketchbook (Dessipris 1995). In this research study, digital imaging was used to determine whether all folios in the sketchbook came from the same mold, an investigation that can only be done using computer and computer-related technology. Another type is a system that allows the sampling of three-dimensional images, which makes it possible for users to view objects from all sides, to measure objects accurately, and to visualize the objects for demonstration purposes (Stanke 1995).

Research Processes

Multimedia applications can also be developed that integrate the work of a particular artist or period in a virtual collection. The Rossetti Project at the Institute for Advanced Technology in the Humanities integrates source material in digital form: images of paintings and drawings, images of published texts, and texts marked up in SGML with description and analysis provided by a specialist. Research-focused multimedia publications, such as Luna Imaging's *Frank Lloyd Wright, Presentation* make large amounts of quality information easily available to the scholarly community.

When beginning research, selection of relevant works is often a time-consuming process. Selection may be made by searching a text database, but in many cases similar objects are held in the collection. A final selection can be made only by viewing the objects themselves. Digital images may help in this respect.

In art-history-related research, comparison of paintings and drawings is one of the most essential techniques. The "old fashioned" way is to spread out on a table a large number of photographs of paintings and shuffle them around, placing one next to the other, comparing, contrasting, grouping and ordering as themes emerge. Systems such as the Morelli system (Vaughan 1995), which will form part of the Van Eyck information system, are an enhancement and partial replacement of such manual techniques. Morelli allows users to retrieve from a database of many images those which bear a close resemblance to one selected. Thus the image itself becomes a search argument. It is planned to take this a step further, allowing researchers to select a part of an image and use that as search argument. Other systems allow for texture searching, opening up a range of other possibilities of selecting material.

Other types of image manipulation have assisted scholars in the study and anlysis of works. By

enhancing the contrast between colors, or altering the coloration of an image, it is possible to identify certain compositional details, view the underdrawing in a painting, or identify methods of manufacture. The comparison of images of different works enables the detailed analysis of the different states of a print. Juxtaposing images created under lights of different wavelengths, such as ultraviolet light or X-radiography, can provide further insights into the process of creation.

Restoration and Conservation

Digital imaging is very relevant for conservation purposes, as it enables the detailed analysis of the physical characterstics and composition of a work of art or artifact (McDonnell 1993, Lagerqvist 1995). Imaging is used as a means of documenting results, recording the methods and techniques used. Some systems need not only to do imaging, but also to produce derived graphic representations of objects. Underdrawing research also relies heavily upon computers and computer-related technology. By documenting the underdrawing, and especially when combining it with analyses of paint samples, valuable information is put together that helps both the restorer and the researcher (Russo 1991).

An exciting and relatively new application is discussed in an article on monitoring transportation-related changes in paintings (Muller 1993). Again, a strong relation with conservation and restoration may be detected here. A system is set up to monitor the condition of a painting by taking digital images of the surface of the work and detecting cracks by using line detection algorithms. The images (crack pattern and image itself) are superimposed, thus showing any damage to the surface. By sampling data before and after transportation, differences in the crack pattern may be derived. By using existing expertise on the meaning of various patterns (i.e. cracks in the middle of the painting or on the edges) it can be decided which event caused the further deterioration of the surface.

Multimedia simulations have also been developed that explore the effects of conservation on an object or work of art. The VASARI system at the National Gallery in London has enabled the "virtual restoration" of paintings, through the alternation of the color of particular pigments. As light affects different pigments in specific ways, it is possible to propose alternate levels of intervention in the restoration process, and to view visualizations that restore pigments to "proposed" original colors, without physically altering the work.

Reconstruction

Digital images can be used to reconstruct objects (Iwainsky 1995), photographs (Gschwind 1992), architectural details (Stenvert) or even city centers (Alkhoven). Images of elements can be put together using specially developed software.

Conclusion

Multimedia systems for research mostly concentrate on two media, text and image, often enhanced by specially designed software for manipulation. It is to be expected that similar techniques for moving images and sound will become available, presenting museums with a whole range of tools to be used to fulfill their goals: preserving, documenting, and exhibiting cultural heritage.

5. Project Definition

Introduction

The definition of a multimedia project depends on the content to be created and marketing it to an intended audience. Success requires a clear understanding of goals and objectives for a project. Content must be selected that both supports the thesis and lets it be communicated to the target audience. Technological limits still exist on possible content to include. These are complex factors, which must be balanced within a realistic framework to define a viable multimedia project.

Content Selection Criteria

Multimedia systems combine more than one of the basic modalities of information, such as text, sound, raster image, vector graphics, animation, motion image, and spatial data. The choice of information type to employ in any given program is as important a design decision as the choice of the actual segments or particular content to include.

In principle, a multimedia program will be most interesting if it engages the largest variety of senses and employs a variety of modalities. However, the choice of proportions of text to image, sound, graphics, motion images, and interactive exercises is a design decision: financial, intellectual, and pedagogical considerations will play as significant a role as aesthetic concerns in determining multimedia content.

Financial Considerations

The budget for a multimedia project will limit the amount, quality, and kind of content it may contain. If it is possible to use existing textual, sound, image, graphics, and motion sources, costs will be more reasonable compared to the cost of original production. Costs escalate as more complex data types are introduced into a project, from sound to still photographic images to two- and three-dimensional graphics to motion and animation. Text can be relatively inexpensive, although markup and indexing can substantially increase the cost of using or re-using textual materials.

All interactive exercises will need to be structured, scripted, and authored. This process can often be expensive, as considerable formative evaluation and rewriting is usually required.

Intellectual Level

The intellectual level or age-appropriateness of content must also be considered. Frequently pre-existing content may be geared to a different age or intellectual level than the multimedia product being created; revision may be required before the content can be re-used. It may also be necessary to recreate the text or sound. One of the advantages of interactive multimedia is that there can be a number of different intellectual approaches created in a single product (and a number of different languages as well) depending upon the variety of audiences that are being targeted. Understanding of audience needs and abilities is required to target a product.

Depth of Coverage

An equally important issue in the selection of content is the appropriateness of the depth of coverage in the material selected. The nature of the media on which interactive products are stored is such that considerable quantities of information can be made available. However, design reasons, assumptions about the amount of time that will be spent with the materials, and an assessment of the product's primary uses should guide the selection of content. For example, five-minute segments are often inappropriate in museum settings regardless of how intrinsically interesting they may be. Physical capacities of storage media may also limit the depth of content that can be communicated. If great depth is to be conveyed, some motion sequences that require significant storage space may have to be sacrificed. Similar decisions may be dictated if the primary means of access will be by telecommunications, where available bandwidth is the limiting factor.

A product on more than one disc might allow the inclusion of more information and the ability to sell the product for a higher price. However, accessing information across multiple discs is not easy and would either complicate the development or reduce the functionality of the final product. The CHIN project on Canadian history opted for one disc because searching across all of the textual information was an important objective. This decision was, however, neither easy nor unanimous. Other multi-CD ROM products such as Luna Imaging, Inc.'s Frank Lloyd Wright Archive have focused on comprehensive content, sacrificing ease of use by requiring the switching of discs.

Presentation Requirements

Content selection will be dependent on the systems environment in which it will be used and the length of time the content is expected to be used. If a single product with a short life span (less than three years) is anticipated, then system-dependency will not be a great barrier to selection of content. But if the multimedia content is being created with an anticipated long lifetime, representing information in standard forms becomes a critical consideration. When longevity of information is a concern, it is essential to select a toolset that is both as open as possible (incorporating the greatest degree of standards), under continuous redevelopment, and commercially well positioned.

Finding standards-based solutions for managing multimedia information can be quite complicated, and in some cases impossible, depending on the degree of user control in the interactive application. It is relatively easy to ensure adherence to standards if the functionality associated with objects in the multimedia database is simply viewing them, because viewing tools will tend to support a range of data standards for the datatypes they view. It is far more difficult to ensure that standard approaches are used when higher levels of functionality are desired. Even only viewing data, such as text marked up in SGML which requires a parser, or vector data for a CAD drawing, entails that software "conforms" to the standards used in a variety of sources. Software and systems should be thoroughly tested to ensure that a chosen viewer really does correctly read output and conforms to standards for the data interchange of required dataypes.

At least four additional generic levels of functionality other than viewing can be defined which require even closer attention to interoperability claims:

- "Engaging" tools allowing users to choose how to interact.

- "Editing" tools enabling users to alter the objects.
- "Authoring" tools enabling users to create new content and to link existing objects in strings or webs.
- "Evaluation" tools supporting the recording of paths selected by users, the imposition of automatic branching by the author based on results and prior path selections, and the creation of tests to determine the knowledge gained by users.

None of these functions is supported by standards, so requiring such capabilities will limit the selection of a presentation tool. The tool used may in turn limit the selection of content.

The interdependency between content and the capabilities of the tools used to deliver it means that final content selection and creation still must take place after rather than before decisions about the presentation environment have been made. The good news is that sound decisions will reduce system dependency and provide a longer life for simple data objects. However, the bad news is that given the present state of standardization more complex data objects may not be easily re-usable in future software environments.

Editing Requirements

All content elements that constitute the multimedia presentation must be authored into a product that allows for story-telling or interaction. This authoring environment will enable or limit the ways in which the data can be browsed, searched, navigated, and edited by the product creator and probably by the end-user of the product. Authoring tools will be selected on the basis of the purpose or intention of the product; generically the tools can currently be classified as those suited for entertainment, "infotainment," and pedagogy. All share the features of hypermedia (the linking of objects), but each class includes and excludes functions that are generally considered essential in the others.

Entertainment authoring environments provide a high degree of management for presentation elements involving motion and animation, but have defined and prescribed links activated by selection of specific elements. They generally provide no facilities for browsing or searching, although they may contain functions for testing and performance recall.

"Infotainment" products allow for significant browsing and searching, and enable navigation across webs along defined links. They tend to provide presentation support for less dynamic objects than the entertainment software and do not provide facilities for user logging and performance evaluation.

Pedagogical products support searching, although not necessarily browsing. They support user evaluation and testing and make it possible to create interactive exercises, along with other scripts. They may allow linking of pre-existing objects in new ways, including the type naming of such links and the creation of new objects, especially textual commentaries or citations.

Given the range of such tools, and their specific individual limitations, it is important that content selection be informed by the capabilities of specific authoring environment.

Language

The languages spoken by the target audiences will also influence the presentation of content. For

example, as a Canadian federal government institution, CHIN (Canadian Heritage Information Network) is required to produce products in both official languages, English and French. This decision has several ramifications. Since all material must be translated from one language to the other, the timetable of a project is extended. Since all text and soundtracks must be stored in both languages, the need for storage space is increased significantly. Video and images may also need to be stored twice if they contain language-based information, but that has not yet been the case in products we have seen. Producing a product in more than one language may therefore reduce the amount of material that can be presented. In CHIN's CD-I product, some of the research and prepared material could not be used in the final product because the bilingual requirement was not fully taken into account by the developer in all steps of the project. In subsequent products, the developer chose to have two products, one in each language.

Multilingual products have the advantage of larger target markets. Producing a product in more than one language can also broaden its utility, appealing to those who teach languages, for example.

Delivery Platform

Selecting the target audience also affects technology decisions. If the target audience is schools and the technology available to them is low-end PC and Macintosh with low-quality monitors, the development of a product that is beyond these capabilities should be carefully considered.

Trends in technology and the existing (installed base) and potential market should be carefully monitored. A product is going to take several months to a few years to develop, and technology available to a target audience will advance. There is no point in working on a DOS-based product when Windows or graphical user interfaces are required by the time the product is ready for market. In North America, for example, the distribution of Macintoshes and PCs in elementary schools is approximately 40-60% with significant regional differences. It is therefore important that a product for elementary schools runs on both platforms.

The speed at which technology is adopted by the target markets should also be considered. For example, museums and elementary and secondary schools, for economic reasons, tend to use their technologies longer than industry, universities, or government.

The use of CD-ROM and/or CD-I players in the target audience is also an important factor to consider. This varies greatly internationally. CD-I technology has made inroads in Europe but not yet in North America, where there is strong competition from computer games. Even in Europe the number of CD-I players sold is lower than expected. Of course, if the number of products available to use with a particular technology is small, the technology will not sell. From a production point of view it is hard to justify developing a product for an undersold technology. While products may be developed to promote a particular technology, this is not a role museums have played.

Marketing Factors

Content selection should also be influenced by the intended audience for the application. If there is one lesson to be learned during the development of a multimedia product, it is that a marketing strategy cannot start too early.

Case Study

As an example, CHIN participated in the development of a product aimed at students in Grades 7-10 (age 11-15) of the Canadian school system. The educational level and content, Canadian History, had already been chosen; research materials that had previously been used in another paper and slide-based information formed the backbone of the product. CHIN's goal was to assess a new technology and thus the decision was made to produce a CD-ROM.

The material used in this project could have been presented in many ways. After consultation with the educational community, it was decided that a reference-type product would be created that would enable the user to search, display, print, extract text to a word processing package or editor, and extract images and print them. These capabilities were based on requirements for classroom and teaching use. If the product had been for the home market, the functions may have included more interactivity such as games or quizzes. The printing and extracting capabilities probably would not have been needed. The searching would have been presented in a different, more intuitive way. All decisions were made with the target audience in mind.

The selection of the target audience also affects the media to be chosen. CHIN's Canadian History project included only text and images. The decision was made not to add sound because it was recognized that the product would be used in a classroom by a single student or a small group or in a library where sound would distract other students. Because related video was not available without more research and cost, video was not used, even though it would have improved the product. In some products full video, as opposed to quarter-screen video available on CD-ROM, will be required. In such a case a format such as CD-I might be preferable.

Packaging

There are many decisions to be made about the packaging of a multimedia product. CD-ROMs require labels, package-inserts, boxes, and registration cards. These must include information required for the user to understand the context and content of the product, who was responsible for its production, what hardware it requires, how to install and use it, how to get help, warranty, and registration. Wording should capture the audience's attention and be visually appealing.

The type of packaging required is also important. Often CD-ROMs are packaged in a box of the same size as most software boxes. This allows stores to stock it more easily and makes the product appear more substantial and professional. It also allows space to include further documentation if required. Packaging must also meet other functional needs. If a product is to be distributed by mail, packaging design must take this fact into consideration.

There is, however, debate about adding extra packaging as it increases the cost of production, distribution, and storage. It also adds time to the schedule. The other opposing argument is environmental. Is this type of packaging necessary when public opinion is moving toward cutting down on packaging?

Packaging must be visually appealing while communicating information about the product, its developers, copyright, and technical requirements.This can be a lot of information in a small space, especially if it must be in more than one language. Careful professional design is required.

All materials relating to the product, disc label, insert, packaging, and promotional material should have a similar visual appearance and provide the product with an identity. The materials must be written with the target audience, or a segment of the target audience, in mind. This

includes wording, visual appearance, and focus. For example, one might expect the product to be of interest to other museums as well as the educational community. To market to museums, the promotional material will need to focus on different aspects of the product. Depth of research or subject matter may be the marketing hook for museums, while curriculum suitability would be of interest to the educational community.

If the product has been developed by a partnership, all partners need to agree on the promotional material. This will ensure that their contribution is acknowledged properly and that the resulting product reflects their organization accurately. Promotional strategies and approval processes should be specified in the partnership agreement.

Marketing Mechanisms

Marketing multimedia products is similar to marketing other products. Promotional material on the product can be mailed to standard mailing lists. Mailing lists can also be purchased from associations that cover some or all of the target audience. The statistics for the success of mass untargeted mail-outs are very low, so careful selection of mailing lists is important, especially considering the rising costs of mailing. Keeping track of sales will helpto develop mailing lists for future products.

A press release can announce the product. Newsletter, journal, newspaper, radio or television station interest in the product could lead to free publicity. Even if this does not lead directly to sales, the resulting articles could form part of the promotional material.

Advertisements for the product can be inserted into journals, newsletters, magazines, and newspapers. These should be carefully selected, since advertisements are expensive to design, produce, and publish. The target audience will determine the type of journal in which to advertise. They could include journals of museum associations, professional or educational organizations, as well as those related to the subject of the product and the age group at which it is aimed. Libraries often acquire multimedia products for their collection. Selecting journals targeted at them may well increase sales. Popular computer and multimedia magazines are also a new venue for marketing multimedia products.

Products can be announced on the Internet to listservs or newsgroups. While these must follow the etiquette of the listserv or newsgroup and should not be too commercial or pushy, information about the product and where to get it can be made available inexpensively and quickly to thousands, if not millions, of people, some of whom constitute the target market. Unexpected potential audiences might be in reach. Another way to promote the product is to include information about it on the museum's Gopher or World Wide Web site; this could include sample screens displaying the product's functionality along with ordering information that might promote interest. (Within a short period of time it will be possible to put up an electronic order form on the Internet and have buyers fill it in, pay, and send the order to the museum for delivery.)

Other traditional methods of marketing include talking about the product in a conference presentation. Promotional material can also be included in the conference registration kit of carefully selected conferences. Advertisements can often be placed in conference programs. A more expensive way to market is to demonstrate the product in the exhibition hall at conferences or trade shows.

Products can be submitted for awards given by museum associations, trade shows, and multimedia events. Getting a placement or honorable mention means promotional material and free publicity when the results are promoted by the organization responsible for the award.

A product can also be sent to journals and experts for review. One should bear in mind, however, that a negative review can be very detrimental.

Distributors and Publishers

Often the best way to promote the product, especially if the market is not a traditional one for the museum, is to make arrangements with a distributor or publisher. The advantage to this is that they are familiar with marketing to target audiences. For example, choosing a publisher familiar with the educational market will help to market the multimedia product to schools. They know the educational community and how and when to sell to them. For example, any educational purchases are made in the spring, late summer, and early fall. Experienced publishers and distributors know what approaches to use with their audiences and can time them to purchasing cycles.

Reviewing distribution policy and market plans is essential to ensure that the museum's interests are respected. For example, a distributor could use a hard sell with heavy discounts when what is desired is a professional, low-key approach with consistent pricing for a few years. A contract with a distributor should specify museum for marketing material consistent with museum philosophy.

When selecting the publisher or distributor, several questions should be answered:

- How much of the potential market they will be contracted to cover?
- Will there be an arrangement with them exclusively or with several distributors based on market segments or regions?
- Will they market within only a particular region or internationally?

The terms of a distribution contract may limit a museum's ability to distribute the product themselves. Financial arrangements with distributors and publishers are often costly. It is not uncommon for a distributor to retain between 40 and 70% of the selling price.

Pricing

When establishing the selling price of the multimedia product, the cost of development, production, packaging, marketing, storage of inventory, and mailing or distribution should be considered, together with the selling prices of similar products. After estimating costs, expected sales are projected and a profit margin defined. This could be zero if it is only expected to recover costs.

The decision to recover only out-of-pocket expenses and not "soft costs" such as staff time is also possible. Or the museum could decide only to recover a percentage of the costs, perhaps considering the unrecovered costs as part of the learning experience using this technology or part of the museum marketing costs, since the product could be enhancing the museum's image. The product is, after all, reaching some or all of the museum audience in a different way than temporary or permanent exhibits and other outreach programs. Costs could also be offset by the

project's contribution to the museum's multimedia database. The same multimedia data could then be reused for other products and purposes.

Consideration should be given to two or more pricing levels, including discounts for museums, the educational market, or other not-for-profit organizations.

6. Multimedia Formats

Introduction

The case for standards has been made regularly and frequently in the museum documentation community, and in the broader information management community. Standards enable us to share information effectively and efficiently, without fear of data loss or misinterpretation. They safeguard our investment in information, ensuring predictability and consistency. Guidelines provide shared methodologies and enable collaboration and cooperation through the development of consistent approaches to common problems. Sharing the ways and means of doing things avoids a duplication of effort.

The interconnectivity provided by the Internet and WWW provide further impetus for the development of common approaches to the creation of image databases. In the brief time since the release of NCSA Mosaic, we have seen the potential for the network distribution of visual information about museum collections. Many institutions have begun to make significant portions of their collections available this way. This emerging virtual world provides us with concrete examples of the need for standards for information capture, storage, retrieval and display. To 'put up' museum information on the Web is just the first step.

Common practices and shared standards are the key to creating a quality information resource. So how can the cultural heritage community approach standards in such a revolutionary environment? Are there standards that can be employed when developing systems? Are there areas where standards need to be developed? How can we target the limited resources of the cultural heritage community towards areas where advances in common practice are critical to our successful employment of multimedia technologies?

Different types of media can be represented in different data and technical formats. These may be integrated within one system or application to greater or lesser degrees. Formats apply to elements of systems and to elements of data content as well as to different stages in creating and using multimedia applications. Only some formats are specific to multimedia applications, with many existing already as "monomedia" formats. Many formats may be regarded as applications of standards.

Standards thus may exist for system formats and/or data formats, for production and use of multimedia applications, with some applicable at different stages in the creation process, as well as for the interchange of information. Standards can standardize formats in different ways, within one system or across systems. They may be operational specifications with some being protocols or sets of procedures for communication. These may or may not be accepted formally by official standards organizations. The latter may be national or international or may relate to a particular segment of industry or interest group with differing degrees of authority and acceptability. Official standards often emerge from or build on de facto standards. More rarely standards may exist officially but not have been applied nor become widely acceptable.

Multimedia applications in museums may be used for many different purposes such as temporary exhibition enhancement; guides to collections or buildings, within a gallery or outside a museum; archival or collection management systems; access or retrieval systems,internal or external, perhaps networked; multimedia publications. The particular purpose should influence the choice of systems and formats.

This chapter concentrates on formats and standards related to imaging systems. An updated version of the chapter should contain information on audio and video.

Hardware

Multimedia hardware may include PCs, TV players, electronic books, and other hand-held devices. Elements for input, storage, and output may include scanners, cameras, WORM (write once, read many) discs, CD-ROM, CD-I (compact disc interactive), etc. The following paragraphs discuss some equipment and related formats.

Input

Image capture is the process of employing a device (such as a scanner or digital camera) to create a digital representation of an image that can then be stored and manipulated by a computer. Image capture can take place either directly from a work of art or artifact, or from an existing photographic image of a work. The circumstances of image capture will have a critical effect on image quality, and therefore on the future utility of a digital image. Key decisions to be made in the image capture phase include capture methodology, digital image resolution and image bit-depth. The cultural heritage community has not developed standards or guidelines to govern image capture activities.

Digital or conventional cameras for stills or video, scanners, and computers may provide input. If a high resolution still image is needed, or a blow-up of a detail in an image, then a scanned image is necessary rather than a video image or one from a mobile digital camera. Low-end flatbed scanners are comparatively inexpensive and adequate for black-and-white images, but some may have poor color sensitivity, and do not provide for a good hard copy output from a system if that is a requirement. High-end flat bed scanners are more expensive, and many may provide high-quality images with good colors.

The limitation of both types is that the format to be scanned is normally A-4, although larger scanners exist (but at considerable higher cost). High-resolution, direct negative scanners or fixed digital cameras for large-format negatives are expensive, although images from 35mm film can be produced at a reasonable cost, particularly from Photo CD, which will be adequate for many purposes. Photo CD, however, relies on image capture by a bureau or company operating under license, or in-house requiring an expensive and powerful scanner and workstation, again under license. In all cases the resulting files are big, requiring large storage devices.

Video input, although quick and comparatively cheap to produce, suffers even more from technical limitations for use as full-motion video than for still images. Animation suffers from the same limitations, although it is now much easier to produce using computer technology. Especially moving images require large amounts of computer memory for their storage and manipulation.

Graphics are generally well catered for in their creation in digital form, although considerable

care is needed in conversion from paper form to digital form. Color, and black-and-white, photographic images and graphics may require different scanners appropriate for the different type of image, i.e., color, monochrome, or gray scale.

Bit Depth or Dynamic Range

Bit depth governs the maximum number of colours it is possible for a digital image to represent. While not stated formally, there appears to be a minimal requirement for 24-bit (> 16 million) colour for "quality" images of works of art, i.e. those used for more than reference or identification purposes. This exceeds the 8-bit (256) colour images now routinely distributed on the WWW or made available in many CD- ROM titles. Recent technological developments have focused on 32-bit (or even 36-bit) image capture. These images are then sampled and stored as 24-bit images. Key to a decision regarding an adequate bit depth for images of cultural heritage is a further understanding of image quality.

Resolution

Resolution refers to the number of pixels which make up a digital image, and can be expressed as a ratio such as 1,000 x 2,000 or in terms of dots per inch (dpi). DPI (a term inherited from print technology) is a complex and often confusing concept - used to characterize scanning devices, image files and various display devices. It has also been used to compare the pixel dimensions of a digital image to the dimensions of an original object.

Storage and Distribution

Storage may be in the form of a variety of magnetic, optical or magneto-optical media, analog or digital, mainly computer based. These include videodiscs, CD-ROMs, writable and write-once disks, DAT tapes, Video CD, Photo CD, CD-R, CD-I, DVI, 3DO.

Videodiscs store still and moving video images in analog format. They need the combination of a videodisc player and a computer system to be fully interactive. They have a large image capacity (54,000 to 76,000 per side) and handle motion video well, but the image quality is limited and production costs are high if use is made of videodiscs which have to be produced using a master disc. Writable videodiscs are much cheaper. However, analog master images are of limited value for reuse.

CD-ROM discs have a large storage capacity, especially for text (1/4 million pages A4), although image numbers are limited, but can be of a high quality (2,000 high-resolution color images). Up to 20 hours of recorded speech can be stored, or various combinations of different media. They are read by a computer system only, with a CD-ROM drive or several drives in a jukebox. The speed of access to data is improving, but they are better as a publication and distribution format than for permanent storage as an archive. CD-ROM discs are produced using a master disc. CD-ROM is the most standardized and widely used of optical media. Standards exist for the physical and optical characteristics of optical discs. The major disc sizes have different format standards, with some national and ISO standards in place. The CD-ROM format is ISO 10149 for the recording format, with ISO 9660 for the "logical format," i.e., the file structure. All Photo CD disc formats conform to this. The CD-R (recordable) may be written by the user, although the process is relatively slow and therefore only suitable for limited editions. The new and coming generation of CD-ROM with a storage capacity of 4,7 Gb will probably prove to be a suitable distribution media for large museum productions.

Other optical discs, WORM, and rewritable, have a much larger capacity, and can be accessed quickly, held online on a multiple drive system, or via a jukebox. As they are relatively expensive they are more suited for use by organizations with large data requirements. Rewritable discs also provide a means of readily updating contents. Although WORM CD-ROM discs, known as CD-R (see above) have been developed now, allowing cheaper in-house proofing or small-scale production of CD-ROMs, there are no rewritable ones yet. Many WORM media and drives use proprietary standards. 5.25" WORM format discs have three different incompatible standards. ISO 9171 covers both formats A and B. Larger optical discs have some draft standards.
5.25" and 3.5" rewritable optical discs have ISO standards which are adhered to, but some imaging systems use non standard discs.

The Kodak Photo CD stores color images on standard 12cm compact discs, which can be displayed on a TV screen using a CD player (some available versions play audio and photo discs), or on a VDU through a compatible CD-ROM drive linked to a computer. This must have multi session capability to allow it to read Photo CDs, or CDs that have been written to more than once. It should also be at least double speed (preferably triple speed) to access data with sufficient speed. About 100 35mm images can be stored on a Photo CD at photographic quality, or up to 800 at the equivalent of TV resolution, or 6,000 as low-resolution thumbnail images.

CD-I adds the full range of media capability to audio discs, and is playable on any CD-I player attached to a TV set, with access by questions or menus as with interactive video. As it is a digital medium, the images are archived in a higher resolution than video and than they appear on-screen with present technology. It is a relatively cheap and flexible medium. For CD-I the relevant standard is the so-called Green Book, and enables for better audio and video quality than CD-ROM. However, in terms of market penetration CD-I has not been very successful, and museum should be careful to employ this medium for distribution purposes. It may however keep its role for in-house distribution systems, such as Point of Information systems.

Other output/distribution media are:
DVI is a competing standard to CD-I as it enables storage and playback of visual and audio data digitally. It is basically a compression format for moving images which allows one hour of full-motion video and audio on a CD-ROM to be played back on a computer, but development and distribution costs are high.

Video CD converts VHS-quality video to digital form, to a format agreed on by MPEG. With the addition of a special full-motion video cartridge Video CDs can be played on CD-I and some CD ROM machines.

3DO is a multimedia consumer platform similar to CD-I with improved 3D graphic animation.

HDTV (High Definition TV) -though not really hardware, but more a file specification- currently has three competing formats, analog and digital, giving a higher-resolution display than has previously been possible on a TV screen, about 2000 x 2000 pixels and equivalent to 35mm film quality. HDTV however is still not very present on the market, and there are doubts if it will ever be in its present form.

Alternative output devices are VDUs for soft display, printers for hard copy or desktop publishing systems. Hard copy output requires higher-resolution images than machine-readable output,unless it is acting as a form of note or reminder, when the quality equivalent of a

photocopy may be sufficient. Good-quality printers are expensive. CD-ROM is currently seen as the most favorable format for electronic publishing.

Image File Formats

Content of multimedia applications may include data in combinations of the following formats: still images, graphics, motion video, animation, text, numbers, sound, storyline, and interface. Image files may be put in various standard formats for interchange purposes. These may also be used for editing and storage. The formats explain what encoding system is used to compress the image and how the image information is organized, with additional header information about the image as well. The choice of image file format is critical to the interchangability of image data. If images are not stored in a widely supported format, it will be difficult, if not impossible for images to be interchanged. (It may be possible to transmit the file, but not to display its contents.) If images are to be made available on the WWW, a limited number of image formats (including GIF and JFIF/JPEG) can be supported by current generations of browsers (although this is changing rapidly).

The only standard in this area, Standard Recommended Practice, File Format for Storage and Exchange of Images, applies to the area of document imaging and at the present time, deals only with black and white image data. Subsequent additions are being developed to handle colour and gray-scale images. The file format recommended by this standard is TIFF. Of the file formats outlined below, only JFIF (the file format defined with the JPEG compression standard) can be considered a standard. Other image file formats, some proprietary, have become de facto standards through widespread use.

TIFF (Tagged Image File), originally developed by Aldus Corporation. Version 6.0
TIFF files are widely supported, and can store image data captured with up to 24-bits of colour, compressed with LZW, CCITT Group 3, or Group 4, or JPEG. Issues arise with the widespread variance in the use of the tagged data fields in the TIFF file, and in the range of extensions to the format available.

GIF (Graphics Interchange Format), originally developed by CompuServe Inc.
Widely supported, and originally the only file format which could be used with WWW documents, GIF is limited in its ability to render only 8-bit colour. The file format and accompanying compression algorithm, LZW, have recently been the subject of a licensing dispute, which originally appeared to threaten the use of the format, but in retrospect appears not to have had a significant effect.

JPEG File Interchange Format (JFIF) ISO/IEC 10918-1 and ISO/IEC 10918-2
A widely supported file format developed by the Joint Photographic Experts Group, which stores images encoded using the JPEG compression. Stores images in up to 24-bit colour. Now used to distribute images on the WWW, as it is supported by the most recent versions of the Netscape browser software.

Kodak Photo CD (Image Pac), developed by Eastman Kodak
A proprietary CD-ROM based storage medium, which bundles a series of image resolutions into a single "Image pac". Stores 24-bit colour images, in PhotoYCC format, a method of representing the colour spectrum where the 24 bits of data per pixel are distributed among three color components. The Photo CD format has become popular because of the ease with which it enables existing photographic collections to be converted to digital form.

BMP (Microsoft Windows Bitmap), developed by Microsoft
Microsoft Windows-based format, supporting up to 24-bit colour. Images are most often stored uncompressed, resulting in a larger file size.

PICT (Macintosh Picture), developed by Apple Computer Inc.
Macintosh-based format, supporting up to 24-bit color, and used with JPEG compression.

Still Picture Interchange File Format (SPIFF) ISO/IEC CD 10918-3
A proposal now being developed by Joint Technical Committee 29 of the International Standards Organization and the International Electrotechnical Committee (ISO/IEC JTC 29) "intended to be a generic format that is simple in nature and does not include many of the features found in application specific file formats" Still some years away from implementation.

Image Compression

Stored data may be compressed to reduce the space needed with various formats and standards for image, audio and video compression and decompression for transmission and display.

The two image compression formats in widespread use are JPEG and LZW.

JPEG (Joint Photographic Experts Group) ISO/IEC 10918
A lossy compression format, used in JFIF files. JPEG allows for a choice of the level of compression. Various 'Quality' settings within JPEG compliant applications enable the selection of a best possible compression ratio. Compression ratios of 25:1 are common - somewhere between 10:1 and 40:1 is likely to be acceptable for a 'working image'.

LZW (Lempel-Ziv-Welch)
A lossless compression algorithm used in GIF and TIFF files. LZW offers compression ratios between 50 and 90%. The LZW algorithm was at issue in the recent GIF licensing controversy (see above).

CCITT or Huffman Encoding
Referred to as CCITT Group 3 and Group 4 these compression formats are commonly used for compressing two-colour images, (page images) and are used in fax machines and fax modems. Their uses are limited within the cultural heritage community which tends to require colour imaging.

Emerging compression technologies, based on wavelets and fractals may provide alternatives to JPEG or LZW compression, but these applications are not yet widely available or supported.

Examples of standards for other media are MIDI for audio; MPEG and DVI for video and associated audio. MHEG (Coded Representation of Multimedia and Hypermedia Information Objects ISO CD 13522), from the Multimedia, Hypermedia information coding Expert Group, a draft standard, is the nearest to an overall standard for multimedia, at a high level. Reference needs to be made to various other areas of standards within this, or in addition to this, such as those for various monomedia elements contributing to multimedia. Many of the relevant standards are important to data interchange and are specified by the CIMI Standards Framework.

System Standards

In addition to the various so-called standards for general computer systems, which tend to be set

by the manufacturers and are really proprietary or possibly de facto standards, there are some developments specific to multimedia systems. These include the MPC standard, a base specification for a multimedia PC, and interface standards such as MCI (Media Control Interface), HCI (Human Computer Interface ISO 9241, under development), and API (Application Programming Interface). Some "standards" are beginning to develop for software, and standards for the development of systems, including multimedia systems, which may eventually become ISOs. The IMA (Interactive Multimedia Association) is industry led, producing recommended practices; it is currently working on multimedia system services, data exchange and scripting languages.

Capture and Encoding Standards

For scanning quality control and OCR (Optical Character Recognition) procedures and preparation various national standards exist, such as North American ANSI standards.

ODA (Office Document Architecture) and SGML (Standard Generalized Markup Language, ISO 8879) are standards for describing electronic documents, for document interchange. They can also be used for hypertext, which is often used in multimedia applications. These two standards have been developed to define formats forpresentation of multimedia and hypermedia information, and are also necessary for editing and manipulating, and for facilitating interchange of such data between applications. MHEG (Coded Representation of Multimedia and Hypermedia Information Objects, draft ISO CD13522) is extending the standards for text to include other data and media. Hytime (Hypermedia/Time-Based Document Structuring Language, ISO 10744) extends the markup of single documents using SGML to multiple data objects or documents.

For data compression encoding various standards exist for different media, e.g., JPEG (Joint Photographic Experts Group) for the digital coding of still images, MPEG (Motion Picture Experts Group) for motion picture and associated audio. For data encoding many standards exist which are really de facto standards rather than being formally accepted as standards. These include the file formats mentioned earlier. The widely used TIFF Image File Format is one. However there are different versions of TIFF files which may not be compatible.

7. Multimedia Project Management

Introduction

A project can be defined as a unique process requiring significant effort and resources to reach a definite outcome within time and cost restraints. Good project management reduces the risk of failure and of exceeding time and/or budget. A project requires a plan and consideration of the processes necessary to carry out the plan; together these contribute to the development cycle. Multimedia projects are by their nature interdisciplinary and usually involve a team of people. The management issues are therefore those of working in or with a team and working toward a particular goal, usually a system or product.

There are many theories on project management in general which are relevant to multimedia projects; there are also issues specific to multimedia projects. The basic stages common to theories of project management are:

- Define objectives

- Set up project team
- Agree on a plan, timetable, and deliverables
- Monitor the execution of the project
- Control the process and the outcome
- Review outcome

Risks to Projects

Unfortunately, projects sometimes fail to achieve the desired result. Common reasons for projects failing include:

- Lack of clearly defined objectives and benefits
- Lack of client/user commitment or project "ownership": failure to define success criteria in advance
- Lack of clearly defined project roles
- Failure to accurately estimate the resource required
- Lack of legal/contractual advice on relationships with suppliers
- Adopting a formal project management strategy and development methodology will help avoid these failings.

Objectives

Project objectives must be clearly defined and agreed upon by all involved. Usually the main objective is a final multimedia product or system. Alternative options within this objective should be costed and evaluated, e.g., for a public access system, a curatorial system, or a CD-ROM.

It is necessary to define the audience for the product, the form it will take, and its scope. Objectives may need to refer to the mission or strategic plan of organizations involved, thus putting a specific project in a wider context.

The aim at the first stage may only be to produce costing estimates or a feasibility study rather than a finished product. Other objectives may be more tangible, such as peripheral products to accompany the system, i.e. manuals, catalogs, or other hard copy products, or less tangible, such as to familiarize those involved with the technology.

Each group of participants may define a project's objectives from its respective viewpoint. If these perspectives differ (or may appear to differ), the project's goals should be clarified. The management group, the project team, and the user group may place a different value on achieving certain objectives.

Decisions can be made as to whether to partner with a company that produces multimedia products or to create an in-house multimedia production team. Either option is viable depending

on the commitment of the museum. Currently, many museums are finding it convenient to build content and design teams within the museum but have the actual production done outside the museum under a contractual agreement with a production company that may be involved with aspects of marketing and distribution as well.

Project plan

A plan identifies the processes and stages needed to meet the desired objectives. It should include a timetable with a start and end date and milestones along the way. These will be linked to stages in the production path and should identify deliverables and payment milestones for each stage. Deliverables may be analysis documents, design documents, storyboards, manuals, prototypes, or any media elements such as graphics or video clips. The timetable is likely to have many concurrent strands in a multi-disciplinary multimedia project. It is important for the timetable to be realistic and achievable. Resources needed at each stage and any critical dependencies must be identified. Potential risks to the project should be identified and minimized. The plan should identify who needs to do what and when and ensure that the same people are not expected to be doing everything at once.

A project budget, with details of how it is broken down, can be a separate document but should be linked to the stages and separate elements of the project plan where possible.

The plan then provides the framework for managing a multimedia project, identifying clear points at which reviews can take place to monitor progress and ensure control.

Planning is also necessary for implementation and for any ongoing activity such as training, maintenance and support of a product, or publicity and marketing. A review of the project may be a requirement at some point before and/or after completion. Full-scale post-implementation reviews may take place as long as a year after implementation, particularly with a large or complex system or where a large user base is anticipated. However, it is useful to have some form of final report or review stage soon after completion to ensure that any loose ends are tied up before those involved move on or lose interest. A general evaluation of a project can be useful to all involved in learning for the future.

Project Plan Stages

- Preliminary analysis
- Design concept/document prototype/outline timetable
- Agreement/commission development
- Production plan/detailed timetable/deliverables script/storyboard/data collection and editing/graphic/video/audio authoring testing
- Modifications/user manual, beta version
- Final product training/publicity
- Marketing/support/maintenance/evaluation
- Project milestones/deliverables as agreed

Monitoring

The project should be monitored regularly, at appropriate stages identified in the plan. Actual achievements and costs should be compared against the timetable and the budget. Checking procedures should be agreed on, and reporting needs and consultation procedures identified. Documentation of the project should be separate from documentation of the product and should include detailed breakdowns of the plan with schedules, budgets, and resources for each process or task and their relevant deliverables. Any decisions reached at meetings and any verbal agreements should be documented in writing. These may include revisions to the original plan. Inevitably, unforeseen factors arise or circumstances change during the actual course of a project.

Responsibility and Control

Areas of responsibility should be clearly established from the beginning of a project. Overall responsibility for a project should be assigned to a project manager. He or she may have a reporting role to whoever has commissioned and/or financed the project, often a project board with representation of all interested parties. The project manager must establish targets for phases of planning and production as well as ensure delivery of work from contracted consultants and outside production companies. Regular reports provide opportunities to ensure that the project is on course and to take any necessary action if it is not. Changes to the timetable or costs will usually require approval from funders and senior museum management. Ownership of the project and the outcome must be accepted in order to establish responsibility. The responsibilities of the client, i.e. whoever has commissioned the project, must also be made clear in signing off at each stage or at the conclusion of the project.

Multimedia Projects

Multimedia projects are often a new area for at least some of those involved. Procedures for multimedia development or production have not been codified, as is true in the field of book publishing, for example.

The technology used in multimedia project development is also changing rapidly. This situation tends to result in a considerable reliance on people who are familiar with the technology and aware of what is possible. When this expertise is not available on the project team, it may be necessary to seek the advice of a consultant. It is crucial that the advice offered is the best and most up to date possible. Recommendations should be evaluated in terms of technical flexibility and adaptability or pre-existing constraints. It is also essential that where established procedures for specification, selection, and procurement of hardware and software exist, these are followed. Where, as is often the case, there is more than one technical solution decisions are made in the light of proper cost/benefit analysis. Necessary design and technical specifications should be clearly spelled out at as early a stage as possible.

Multimedia projects are also characterized by the number of different media involved and by the high level of user participation. These both affect the design process and are important considerations in management of the project. User participation should be planned for at all stages of the project. The needs and expectations of the users initially form the basis of the project requirements. User input will also be needed in the design process and for product testing.

Project Teams

A project may involve different groups of people, including a management team (advisory board), a project team, and one or more user groups. Members should be carefully selected to provide the range of skills and experience needed. The management or advisory team could include representatives of the museum executive, curatorial and/or financial departments; some independent technical or quality assurance if this is not provided elsewhere; representatives of any other organizations involved, or sponsors or publishers; and a direct link to the project manager, either in person or through regular reporting to the board.

User groups should have an input, usually via the project manager. The project manager may be a museum technical expert or a curator/manager, if someone with sufficient experience and/or expertise in multimedia projects is available, but is often an external consultant or multimedia specialist. It is important to ensure that client/user roles are not confused with technical roles.

- Project Management Advisory board
  - Museum Executive
  - Financial Advisor
  - Technical Advisor
  - Sponsor/Partner
- Project Management Team
  - Project Manager
  - Curatorial Staff Member(s)
  - User group Representative(s)
- Museum Project Team
  - Curatorial Staff Member
  - Systems Analyst
  - Programmer
  - Art Director
  - Script Writer
  - Sound/Video Specialist
  - Hardware Specialist
  - Photographer

The project team should include skills in a number of areas. These may include art direction, sound and or video production, scriptwriting, program design, curatorial or academic knowledge, and technical knowledge . There is no single configuration for a multimedia project team. The goals of the project and the kind of final product will influence the skills needed. For example, a hardware specialist may be needed to advise on issues specific to siting a public access system outside a museum gallery. A photographer may be needed for a project involving new photography of museum objects or scanning material into a system.

Those with skills established in areas other than multimedia may find that their skills are not

always satisfactorily transferable. Retraining or experience on multimedia projects may overcome this if such individuals are sufficiently open minded and flexible, and this should be a consideration in the selection of the team.

Many issues arise from working with a project team. All members of the team must be made to feel a part of the team, with a shared purpose and a commitment to the project. Such a team will often cut across normal lines of command and departmental or organizational boundaries and can create new loyalties. These will aid team-building and provide motivation to achieve results and should be encouraged by the project manager. The relatively short time span of a project both motivates and focuses it. Participation in group sessions, ideally with all involved being physically, not just virtually, present (at least in the early stages), will help the team building process. Frequent team meetings ensure a unity of approach and avoiding misunderstandings of the requirements and objectives.

Openness to ideas, firm leadership, and decision-making are essential skills for the team leader or project manager. As the key link of the project, the manager must be able to listen to and communicate clearly with team members and the project board or commissioning body and users. This person may often be a consultant employed for the purpose, so it should be possible to ensure they do have these skills.

Content Management Issues

A multimedia project requires many elements to be brought together and integrated. The stages of collecting and selecting multimedia content, coordinating its transfer or delivery, and its editing and verification are time consuming. The curatorial team members with appropriate subject expertise should have overall responsibility for issues of content.

Multimedia requires rethinking the traditional presentation of data. Proposals for ways of organizing data within a multimedia product or system are an essential part of the design process. Multimedia projects may often need, or wish, to make use of data already existing in some form as well as, or as a part of, creating new data sets. The state of the existing data must be carefully considered. Even where existing data is available in a machine-readable form, conversion or input to a new system requires some effort, usually requiring decisions by curatorial staff. Indexing requirements for multimedia may differ from traditional cataloging methods or have additional needs. Authoring, the process of linking information and providing pathways through a system, will often be necessary, particularly when data is reinterpreted in a thematic form. This is a specialist skill and a time-consuming process especially when done, as it ideally should be, in collaboration with curatorial staff.

Even if an off-the-shelf software package is used, a great deal of work will be needed to adapt it to the particular requirements of a project. Multimedia project costs are often mainly staff costs, and it is easy to underestimate the work involved.

Collaboration

Multimedia projects are often collaborative ventures involving several organizations as well as a number of individuals. This kind of collaboration greatly complicates the management of a project. Objectives and priorities are more likely to differ. Issues of control may become problematic, and competitiveness may take over from cooperation. Costs will be higher for travel-time and communication. Face-to-face contact will probably be reduced and

communication will certainly be more difficult. Communication problems are more likely to cause misunderstandings. International collaboration will exacerbate these problems by increasing physical distances and possibly adding language differences. It seems that even recent improvements in communication technology may not entirely eliminate such factors.

The benefits of collaborative projects include sharing workloads and costs over a number of organizations; providing a wider range of specialist knowledge and expertise than is possible within one organization; testing ideas in a wider sphere and allowing a more critical review and better justification of decisions; and providing a larger market for a product. Standards developed are more widely acceptable, increasing the possibility of data exchange and the reuse of data.

There may be political advantages for an organization in encouraging external or international collaboration. It may give a project a higher profile, which may increase funding and sponsorship.

8. Multimedia Design

Introduction

Multimedia integrates different media. The vehicle for this integration is the computer manipulation of bits and bytes, megabytes and gigabytes, representing text, images, sound. The special branch of computer/information science concerned with the different possibilities of contact between man and machine is called as 'Human Computer Interaction' ('HCI').

HCI emerged as an independent discipline because of the continuous evolution of computer technology and the need to understand the point of contact between man and machine. The increasing complexity of systems forced new solutions to reconciling messages in different modalities. The failure of new computer products, due to bad interface design, made the large-scale funding of research projects in the field very important.

In recent years, the number of disciplines preoccupied with designing media integration systems has increased. In general, there has been a shift from engineering towards more psychologically and artistically oriented work. Designing the user interface is typically an interdisciplinary concern.

Integration Development

Key issues of information design can be astracted from the development of the book. Historians of the book have pointed out that it is the crystallization of centuries of experimentation. In the early days of printing technology books inherited several attributes of manuscripts, making them intractable for readers of the period. The typical book of today is a manageable object, conforming to a set of conventions for presenting information. It contains a title page, a foreword, possibly a preface and acknowledgments, and a table of contents. Books have clear cut divisions: chapters, sections and paragraphs. Page-numbering, and in some ephemeral booklets even perforated page-corners enable the reader to plot their relative position in the volume. All cues enable the user of the book to locate specific text and images. In short, the physical object does not distract the reader from its contents. The reader does not have to worry about changing appearances; with relative ease he/she may concentrate on the text and accompanying illustrations. The writer on the other hand does not have to be both text- supplier and a page

composer. Layout questions are left to the graphic designer.

Human-Computer Interaction

Some major transformations have taken place in the history of human-computer interface design. One is the change from a text-based, "conversational" model of interaction between human and machine, towards one in which the user may ultimately become an actor in a (virtual) theatre (Laurel, 1993, pg.33).

In the early days of computer building, the operator of the machine was provided with very mechanical means to interact with the systems. Plugs, switches, real knobs and dials were used to control the processing of data. Later on, text-based command languages were developed and for years human-computer interaction was essentially a matter of typing in strings of text, using keyboard, punchcards, and feeding the machine with these strings in batch mode. The system typically responded with printouts of data on fanfold paper. The use of the cathode ray tube display (CRT), and a more advanced keyboard (with special keys for special functionality) ameliorated the job. The emphasis of computerization was on characteristics of the technology, less so on attributes of the user.

A major breakthrough was the introduction of the Macintosh Graphical User Interface, which was marketed only four years after the introduction of the ASCII text-based IBM/DOS PC in 1981. Using a combination of earlier inventions developed by Xerox but never marketed (windows, mouse, the desktop metaphor) this was the first commercially succesful operating system enabling software developers to use semi-consistent graphical features in their application programs.

The wide-spread use of operating systems and application programs modeled after the Macintosh scheme, implies that the general, "lay" user of computer systems is familiar with the operations of a mouse, scrolling menu bars, rows of buttons or icons representing data, programs, actions etc. The designer of a human-computer interaction may take advantage of these conventions as the starting point for multimedia design and authoring.

Multimedia Authoring

Just as present day wordprocessors have incorporated a range of the standard features of books (including style sheets, index functions, automatic table of content generating routines etc.), most of today's multimedia authoring languages now have tools to implement common navigational features (backtracking mechanisms, history lists, linkmaps, bookmarks, arbitrary jump functionality, etc.). Most current authoring systems have extensive capabilities, from which the application developer may adopt what is necessary to establish specific functionality in his system.

Multimedia applications may be developed for a wide variety of purposes The kind of interaction anticipated may vary from relatively short sessions aimed at the retrieval of specific information from a structured multimedia database, to hypermedia 'storytelling' at the other end of the scale.

A considerable number of components have crystallized. The difficulty for truly interactive multimedia systems is that "a skillful designer must be conversant with all the base media that are combined in a multimedia environment." (Hodges and Sasnett, 1993, pg 39). This implies that the novice or less flexible user of a multimedia system will often be confused by the

complexity of the presentation.

It is to distinguish between the conceptual organization of the information delivered, and the appearance of this organization on the screen. The first presupposes the latter. The cleverest interface designer will not be able to supply the user with a sense of control if the information architecture fails to be lucid. (Hodges and Sasnett, Reading, 1993, pg.47).

There are many levels of design from the general aims and target of an interactive multimedia project to the fine tuning of the user interface, or the definition of the data storage structure. The main question one should address at the very beginning is who is talking to whom, in which communication process? An analysis of the way a museum communicates with its public can be a useful discovery of its communication process which, in turn, can inform future interactive multimedia products.

"Une technique de l'intention," a booklet published in 1992 by Direction des Musées de France, points out four main stages in producing interactive content : analysis, design, realization, assessment and distribution.

Preliminary Analysis Methodology

Depending on the context and the constraints, designers should be able to clarify the interactive multimedia project rationale, to define the program scope, and to set up methods of evaluation by creating a preliminary analysis.

Typical constraints in the design of an interactive multimedia application for museums include:

- media configuration and performance, e.g. designers might have multi-platform development strategy aimed at producing for the publishing market, or a very tailored approach for a specific installation in a museum exhibition,
- the availability of expertise about the subject,
- the accessibility of related multimedia documentation,
- the budget and the deadline.

There are a number of kinds of multimedia products and combinations of products that might be applicable to the project. Some of these are:

- CD ROM presentation
- CD ROM with presentation materials from a database
- CD ROM Presentation with user tools
- CD ROM with presentation materials from a database user tools
- CD ROM with presentation materials from network database
- On-line presentation of an in-house multimedia database
- On-line presentation with data from network database servers

- On-line presentation, user interactive tools
- On-line presentation with data from network database servers, user interactive tools

The look and feel, interface and functionality of existing products should be evaluated. It often helps to make a chart of comparative features of existing products. Looking at these products will reveal the the puzzle that multimedia design and production represents. Production is always governed by the delivery requirements, hardware limitations, storage capacities, and the speed of the programs that present the information. All the existing products analysed will demonstrate the trade-offs the designers had to deal with in order to bring the project to the perceived market. The processor speed, the hard disk storage and access, and memory limitations have all been juggled to create the best application for the investment.

Preliminary Design Document Outline

The preliminary design document is a summary of the intended goals, content, and form that a project will take. It is a simple, concise statement of purpose. It can be illustrated with flowcharts, screen designs, or storyboard sketches of how the project will appear in its final form. This is the document that gets everyone associated with the funding, production, and distribution of the final product excited. Nothing in the document is set in cement, but it should give the reader the feeling that this is good idea with market viability and sincere commitment to make it the best. The preliminary design document outline should include:

- Project Goals
    - Scheduled Release
    - Subject and importance
    - Educational experience
    - Promotional aspects
    - Range of audience
    - Quality of production
- Program Map
    - Flowchart of the project components
    - Storyboards of screens
- Concept
    - Focus of the project
    - Experts
    - Generic Program Structure
    - Inquiry Model
    - General vs. Specific Content
- Program Scenario
    - Introduction

Main Menu

Module Metaphors

User Tools

Key elements in this outline are the flowchart (a diagram that represents modules in boxes linked by lines) which describes the general structure of the interactive multimedia application, and defines the main branching alternatives and the storyboard which is a graphical representation of how the user will perceive the content. The scenario presents all details about each component of the storyboard, relating to the interactive philosophy and the user-interface.

Through the interactive multimedia application the user receives information from the system. This is the visible part of the iceberg of interactivity. In fact interactivity links the user with the author(s) of the content (designers, subject matter experts), and/or some programmed set of functions (database, artificial intelligence) in a communication process. The designers decide how users will navigate through the multimedia content.

Designing an interactive multimedia program involves selecting or generating information as well as representing the structure and the content to the user through the interface. These activities are concurrent, but very closely tied together. A narrative approach to interface design provides a framework that allows the structure and content of the knowledge base to evolve together, while accommodating a variety of contexts defined by the user's needs and interests. This is what Abbe Don explained in 1990: "Within that framework, interface designers can adapt strategies from narrative theory, such as including multiple representations of events and information, or using characters as a means of representing material with an explicitly acknowledged point of view".

Designers should keep in mind what is considered today as the more efficient metaphors and activities to be performed with a computer, among them:

- New forms of inquiry that engage people.
- Object-designing activities (Royal Ontario Museum's "Build a Bird").
- Linear parameter control (interactive time-lines)
- Remote access to documentation and databases

The Preliminary Design Document evolves into the Design Specification that lays out the intended interface design and the functional design. This document becomes the road-map for the production.

Preliminary Design Specification

After the above meetings, deliberations, and Preliminary Design Document it becomes necessary to create a Design Specification that must be reviewed and updated on a regular basis until it can be frozen into a final Production Specification.

The Design Specification outlines materials available to date and how access to them works, objectives related to content- specifics, production process-related events, and technical requirements and experiments necessary to fully determine needs. Functionalities, interface

attributes, platforms required, audience needs, and the target user-environment (where will it be used, what issues need to be considered to fit this environment) and publishing intentions are all included in the Design Specification:

- Preface: Should define terminology used in the specification, describe the nature of illustrations used in the document, and layout how the document will be revised and distributed.

  Section 1: Project Treatment Summary

  Updated version of the original Preliminary Design Document with changes included from deliberations and initial administrative meetings.

  Market Studies: All relevant information about products and projects that are similar with their strengths and weaknesses. A chart is useful.

  Brief descriptions of sections in Design Spec: Layout how the spec works by describing the main Chapter headings: Resources, Metaphors, Application Definition, Design Strategy, Application Description, Work Schedules, Appendix (relationships to future projects, etc.)

- Section 2: Resources

  Describe all equipment necessary to the project, how electronic data will be stored and backed up, all materials by type, location, and if they are in electronic forms (text, stills graphics, animations, audio movies/videos, and other necessary production). This is the preliminary master list of all the resources for the project.

- Section 3: Metaphors

  The section should describe the basic knowledge representation metaphors and the user tool metaphors that are proposed for the application. Is it a visit to a place like a museum where someone will use a notebook to cut and paste information from the museum into their own collection? The basic metaphors in this case are architecture, travel, notebooks, personal collections. Describe why they are appropriate to the content as well as why they are an interesting and exciting approach.

- Section 4: Presentation Application

  Give a general overview of how materials are going to be presented to the user. List the current resources available, describe the delivery requirements; illustrate and describe the look and feel, describe the software modules that will be created in the prototype like the attract screen, the main menu, help facilities, the index, the credits, the glossary.

  Describe the content specific modules (a biography, a gallery, a secret archive, an e-mail post office, etc). Describe how the inter-module linkages will work. How do you get from the main menu to the gallery? Show the preliminary flow chart and storyboards of the project.

- Section 5: User Interactions

Give a preliminary general overview of the goals and concept of how the user interacts with the application. Is it for education, training, or entertainment or some combination. What are the anticipated user questions, learning structure, delivery requirements, look and feel, User tool modules (notebook, timeline, etc.), and educator resources (ancillary material like teacher guides, kits, bibliographies, classroom handouts, tutorials on using materials for lesson plans, etc) should be identified.

- Section 6: Work Schedules and Responsibilities

  This section should layout the preliminary staffing for design and production. It should also discuss how content expertise will interact with the design and production team. Will the content experts work directly with the team or through the project manager? How will the alternatives be facilitated. The Design Specification Schedule (how and when this document will be updated and distributed for comment, and to whom it will be distributed. Has an advisory board for the project been created for instance?

  Preliminary schedule for implementation of the prototyping and final production, testing, and publishing. This can be a spread-sheet print out.

  Copyright issues and responsibilities for acquiring or negotiating rights can be spelled out here.

- Section 7: Authors and Comments

  Brief description of the document authors and how they can be contacted. Remember this is a working document and will be revised right through prototyping until it is frozen and production begins. New reviewers can be added all through this process. As many views of the project as can be obtained without giving away a good idea are desirable. Distribution of the document should be in the control of the project manager.

Prototype

While design specifications are being researched, documented and circulated it is useful to produce a small scale prototype as a proof of concept demonstration, and to determine the process for each media type as well as the production costs. Even if it is not a full scale production, it needs the same kind of human competences: project manager, author(s), writers, editors and indexers, software designer(s), graphic artist(s), programmer(s), technical assistant(s), audio-visual specialists, reviewers and testers. Making a prototype may be a selection tool for the team that eventually will produce the full-scale interactive multimedia application. Prototyping ideally takes the form of three versions and three rounds of evaluation by the technical team, content experts, and naive users:

- Prototype 1: Key features evaluation
- Prototype 2: Key features and problematic secondary features evaluation
- Prototype 3: As much of the application as time and money allows evaluation

Evaluation must be a permanent process from preliminary analysis until delivery, rather than merely a concurrent process during the design phase. Still, the end of the design stage is a crucial point as later in the project it will be very expensive to make major changes. This is why a prototype is sometimes the only way to perceive the 'look and feel' of a written design for interactive multimedia products. What is notably at stake with evaluation is quality, reliability, and the checking of preliminary behavorial and measurable objectives.

An important issue to be dealt with at the design stage is copyright of desired content. Rights to convert materials into electronic form for use in an interactive multimedia application must be explicitly negotiated. As there are few centralized organizations that administer copyright, this can be a complex process. Talking about a real case, Danmarks Radio producer Peter Olaf Looms explained that "it required considerable time and energy on our part, but our experience also showed that problems were rarely insurmountable". It is good practice to draft agreements with contributing partners which stipulate that it is the contributor's responsibility to obtain the necessary authorizations to use reproductions, photographs, etc.

Production Specification

With the final Design Specification and final prototype application completed, reviewed, and approved, the final Production Specification can be written. An appropriate budget and an exact plan can now be done for the production phase, including critical tasks, monitoring and control procedures (e.g. problem reporting and resolution). The project manager should also define the work schedule, the file sharing and organizational procedures, and estimate resources and materials required. All the content components that have to be produced benefit from very precise scripts (from video sequences to voice over). They should be precisely listed, written or documented (e.g. video shots, animation descriptions, book locations). This phase is the most important as it produces a written design specification that enables the programmers to efficiently execute their work. It also provides a shared document that can be updated and changed as necessary, giving all those involved a consistent image of the progress of the project. It also remains as written documentation of the process and execution of the process.

Conclusion

In the multimedia application, spoken or written language and/or dynamic graphic design enable the user to master the data stored in the machine. Mastering means: being able to "get at the record" (Bush, pg. 85-110) with relative ease. The user interface designer fails to do his job well if the user experiences disorientation during his interaction with the machine/system.

The focus in the process of designing a multimedia application is thus on characteristics of the user, characteristics of the machine, and characteristics of the interaction between these components. Multimedia development seems to be towards ever greater inter-dependencies between the contents of a multimedia system and the different layers of the command structure and interaction techniques used.

9. Defining Structures

UNDER CONSTRUCTION

Abstract: The chapter will contain 5 paragraphs, covering the following topics:

- 1. organization of knowledge (information retrieval, nodes and links in hypertext)
- 2. interface design (orientation, metaphors, navigation, agents and guides)
- 3. frameworks and methodologies (Dexter model, Trellis model, HDM+)
- 4. scripting languages (Hypercard, Script-X, Toolbook, HTML, Windows Help/RTF)
- 5. design process (waterfall, hierarchical, prototyping).

Chapter 10. Evaluation

Introduction

Multimedia technology as a relatively new phenomenon is still undergoing development and rapid changes. Despite the miraculous qualities attributed to multimedia by production companies and software developers, there are still many problems related to this technology and many areas that need to be evaluated and investigated further. As the multimedia craze and "technolunacy" (the use of the technology as a means to an end) have started pervading museums, the need for careful re-assessment and examination of the effect of these programs on visitors becomes imperative. For museums, with their usually tight budgets and increased public accountability-especially when funded by public authorities-it is even more important to evaluate the success of any multimedia venture.

Multimedia design and production are labour-intensive and time-consuming. Even when the programming and the technical design are complete, evaluation of multimedia projects can offer valuable information for improving the applications and useful lessons for further development.

Finally, evaluation should be an ongoing process, integrated in the overall function of the museum. It raises questions that affect the whole institution and relate to its role, its function, and the ways in which the museum fulfills its goals.

Problems and Difficulties

Despite the urgent need for evaluation of multimedia applications, published reports of projects are unfortunately very limited in number, and most presentations focus only on positive outcomes. One of the reasons may be that properly designed and conducted evaluation surveys can be a demanding and daunting task, requiring specialized knowledge and expert advice, which not many museums possess or can afford. Furthermore, not many institutions are ready to share unsuccessful experiences and unpredictable or negative results, despite the fact that the application of a relatively new and experimental technology such as multimedia in museums is very likely to be associated with problems and not well- received first efforts.

Museum professionals have been skeptical of the effectiveness of evaluation in general and the methodology and results of several specific visitor surveys. Evaluating the effect of museum exhibitions has been seen by some as a trivializing exercise which cannot record all the subtle and unmeasurable experiences that visitors might have in a gallery. Kenneth Hudson (Hudson

1993, pp. 34-40) believes that visitor surveys "can be helpful, provided that they confine themselves to simple facts which can be processed and classified without too much distortion" (Hudson 1993, p. 35) and goes further to question the usefulness of most of them: "Because I believe that museum-going is such a personal affair and its results so subtle and so unpredictable, I consider that a high proportion of visitor surveys are useless, impertinent and a waste of money" (Hudson 1993, p. 38).

On the other hand, this skeptical attitude is sometimes considered as a hiding place for those who fear unpleasant facts or changes (Shettel 1989, p. 134). Over the last few years, recording of the responses and satisfaction of the public has begun to develop into a proper science, borrowing research techniques and methodology from various disciplines.

Another criticism voiced about museum evaluation studies is that they have often focused on testing cognitive gain and the acquisition of factual information. "Too often, criteria better suited to more formal learning environments have been applied to the museum, and given such an inappropriate comparison, museums have not fared well" (Munley 1986, p. 20). But the museum visit includes a wide range of other experiences and types of learning that are often ignored: social and aesthetic learning, development of new interests, consolidation of previous knowledge, awareness of issues, change of perceptions. Although these are experienced by many visitors in museums, the are usually elusive and difficult to quantify, measure, and record. This demanding task is made even more complex by the diversity and heterogeneity of the museum audience.

Types of Evaluation

Many authors distinguish three main types of evaluation: front-end, formative, and summative.

Front-end analysis refers to the evaluation carried out before an exhibit is developed (exhibit in this chapter indicates the components that form part of an exhibition, from an interactive program to an interpretative label or a museum case). This type of evaluation can gauge the reactions of users to the subject matter of the application and the appropriateness of the computer for communicating the intended messages. Before embarking in interactive multimedia development, think again if this is the most suitable medium for the task in hand and if it couldn't be substituted by more affordable and easy solutions (McLean 1992, p. 4) After observing that visitors at the Hall of Human Biology and Evolution in the American Museum of Natural History in New York engaged with and appreciated the dioramas and artifacts much more than the computer interactives, Ellen Giusti (Giusti 1994b) warns that "when they choose to visit a natural history museum, [visitors] expect educational displays consisting of objects and dioramas. When a natural history museum uses non-traditional media, there had better be a good reason (educationally) for doing so".

Formative evaluation takes place while the program is being developed, and its results help refine and change the application. It can illustrate the appropriateness and intuitiveness of the user-interface and pinpoint problematic areas and programming "bugs". Both steps are vital exercises for the design of multimedia programs, ensuring that even if the final application is not perfect (Giusti 1993b), it is at least better than one that hasn't been tested at all.

It is never too early to test the program and incorporate the final users in the design process. Even handmade paper mock screens and testing with cheap and crude prototypes can offer valuable feedback and suggest changes before it is too late. In most cases even a brief survey

with a small sample, if a large one cannot be administered, will offer a wealth of information.

Summative evaluation tests the effect and impact of the exhibit once it has been completed. This is often the first time that evaluators can test interpretive exhibits and gallery kiosks in greater depth in relation to the surrounding space, examine their role in the exhibition, and explore the dynamics between objects, visitors, and computer interactives.

Evaluation, mainly formative and summative, can help identify who uses the program. Systematic and rigorous evaluation however with a large random sample can give a valid indication of the profile of the users of the computer interactives. This can include demographic characteristics (information about age, gender, nationality, level of education, occupation), as well as other information such as the visitor's interests and computer skills. As is the case with visitor surveys in general, it is important to follow a rigorous sampling methodology in order to acquire results from the sample that can be generalized about most museum visitors. Random sampling ensures that every person in the population (the museum audience in this case) has an equal chance of being selected to complete a questionnaire or offer information.

Museum staff sometimes face surprises with the disparity between the intended audience and the real public of multimedia programs, as was the case with the Musée d'Orsay in Paris. Its Gallery of Dates, where seven consultation stations offer information about the historical context of the period from 1848 to 1914, was designed essentially for cultivated adults, but-as shown form observation, interviews, and questionnaires-was in fact used by a younger audience with a widely varied level of knowledge (Le Coz and Lemessier 1993, pp. 377-83). If the museum keeps records about its general visiting public, it is very useful to compare these with the profile of the multimedia users.

Formative and summative evaluations can also help answer the questions:

- How do they use the program?

Observation, video-recording, and computer logging of the users' interaction can show if the application is used by groups or individuals; the amount spent with the program; the depth of information reached; the choices made; the navigation paths followed.

- What is the relation of the program to the exhibition and the museum?

The findings of the evaluation study can highlight the role and function of the multimedia program in the gallery; the relationship with the real objects displayed; the time spent with the objects compared with the time spent with the program; the effect of the program on the way the exhibition is viewed; the pattern of traffic flow around the museum, etc.

- What is the effect of the program?

This is one of the most interesting and most frequently posed questions: What do users get out of the program? Do they learn anything? What is the impact of these applications? Do they help visitors understand and appreciate the objects better? These questions refer to educational effectiveness, emotional and aesthetic impact, successful communication, and visitor satisfaction. They are also among the most demanding and difficult characteristics to evaluate.

The evaluation of multimedia in museum settings should acknowledge the difficulty of measuring and recording the often elusive reactions to museum exhibits and the personal

meanings that people derive from exhibits. It is best to employ a combination of methodologies to measure the effectiveness of multimedia programs at various levels, relating quantitative with qualitative results.

The most important thing to remember when evaluating museum multimedia programs is that there is no single golden method to be applied. It is usually necessary to combine several methods in order to have a better chance to verify and combine data.

Observation

Observations can be recorded on data collection sheets with the floor plan of the exhibition space or with checklists of specific behavior categories, together with personal notes. A stopwatch can help record time. Video-recording can also provide a wealth of data, although often these might take longer to analyse, thus raising the costs.

Interviewing

This can be open-ended, with the interviewer just discussing freely with visitors. Interviews can be conducted with a group of people or individuals from the real or targeted audience of a program. Open-ended interviewing can be particularly useful for front-end analysis, to test how and what the targeted audience thinks about a topic before starting program development. If an application is intended for specific groups (e.g., a researcher's resource or a schoolchildren's outreach program), discussions with focus groups can be very useful during the planning and development stages. This often helps outline a list of questions for more formal interviewing. Interviews usually provide much useful and meaningful data, but are time-consuming, demanding on the interviewer, and difficult to analyse and categorize.

When testing a prototype, interviewing can take the form of cued and uncued testing. Cued testing involves explaining to users what the program is about and asking them to perform specific tasks or answer questions. It might also entail engaging users in conversation and encouraging them to "think aloud" as they go through the program, while recording their responses. With uncued testing, users are observed unobtrusively using the program and are then asked questions about their experience.

On-screen Questionnaires

Although not very valid on its own for statistical analysis, this is an easy way to record feedback from the users of the program who are encouraged to answer some questions or click on multiple choice answers after using the program. The National Museums of Scotland used electronic questionnaires in their Western Isles National Database Evaluation Exercise (WINDEE) project to record basic information about the users, like their age, sex, and place of residence. With World Wide Web virtual exhibitions and online applications this is often the only way to acquire some information about the users. The Smithsonian Institution's National Museum of American Art in Washington, D.C., used this method with its America Online electronic pages to obtain information about the number of virtual visits, the place of residence and occupation of users, the areas visited, and the features they would like to see.

Comment Books

In a similar way, attractive and clearly laid out printed questionnaires placed next to the

computer station can encourage visitors to leave their impressions and comments about the program. Providing enough pens and visible boxes or assigned points for returning the questionnaire can help increase the number of responses. Again, this method is not statistically valid and doesn't include answers from a representative sample, but it is cheap and easy to carry out and can often give useful information.

User Interaction Logging

This is a reliable way of electronically recording the choices of the users and the path they selected through the program. Once the scripting has been set up, it is an easy and objective way of obtaining a large set of data, which can be analysed statistically. One problem with this method is that with programs in public galleries, it is sometimes difficult to distinguish in the log among the interaction of different users. Also, although it indicates the most popular visitor choices, it does not explain why they were chosen (Shneiderman et al. 1989, pp. 172-82). The results are not very meaningful on their own, but can be very useful when combined, for example, with interviews and observation.

Feedback from real users of museum multimedia programs in their natural environment is very important and usually more useful than laboratory studies. Laboratory testing in controlled situations with users solving tasks defined by the evaluators can be useful in the first testing of the prototype to correct programming errors, but the sooner the system can be tested in its natural environment, the more valid and meaningful the findings.

Checklist of Evaluation Criteria

Identifying appropriate criteria for judgment is vital for every evaluation. These depend on the scope and purpose of the study, the aims of the multimedia program, the objectives set by the development team, and the time and funds available. The following checklist outlines only some of the basic aspects of multimedia applications that can be assessed:

User Interface/ Presentation

- Is the user interface consistent and appropriate to present the subject matter to users?
- If real-world metaphors are used, are these successful?
- If icons are used for the buttons, are these understandable by the users?
- Is the quality of graphics, images, sound, and video adequate?
- Is the text legible? (fonts, sizes, layout, spacing)
- Is the screen design attractive and effective?
- Are the media used integrated successfully?
- Is the level of interactivity appropriate for the intended audience and environment?

Structure/ Navigation

- Is the structure of the various components appropriate to the content? (linear, hierarchical, network, combination)

- Is the application easy to navigate?
- Does it indicate user's position, past moves, and available paths?

Programming

- Are there any programming problems or errors?
- What happens if the users don't use the application the way it was intended?
- Are users forgiven for making mistakes?
- Is there feedback for operations that may take a long time?
- Are users able to exit or restart at any time?
- Is there a "Help" section?
- Is it easily accessible throughout the program?

Content

- Is the amount and depth of information adequate?
- Is the information accurate?
- Is the writing appropriate, correct, and clear?
- Is the presentation designed for different learning styles?
- Are the intended messages communicated effectively?

Integration with Exhibition/Museum

- Does the program complement the exhibition? Does it match the overall feel of the display?
- Does it integrate well with surrounding exhibits?
- Does it motivate users to look at the objects?
- Does it create bottlenecks in traffic flow?
- Can it be used by several people at the same time?
- Ergonomics of installation (height of screen(s), interface devices, kiosk design, lighting, disabled users)

Distribution

- Will the application be compatible with other hardware or future devices?
- Does it follow established standards?

- Can it be distributed for educational or home use?

Overall Impressions

- Does the program provide enjoyment, arouse curiosity and interest?
- Is it easy to use?
- What is its attracting and holding power?
- Does it fulfill its intended purpose? (e.g., does an orientation program help visitors find their way? does a research tool answer the needs of specialists?)

Research Findings

The few published evaluation studies of computer interactives give us some indication of how interactive multimedia applications have been used in museum settings. The users of museum interactives tend in most cases to be young and male (Sharpe 1983; Doering et al. 1989; McManus 1993b, pp. 74-114; Menninger 1991; Morrissey 1991, pp. 109-118; Giusti 1994a). In their study of the use of the "Information Age" exhibit at the National Museum of American History, Allison and Gwaltney (Allison and Gwaltney 1991, pp. 62-73) have also found that visitors over 45 were underrepresented, while the ones under 25 were overrepresented, but their study showed no inequity linked to sex. Few studies seem to contradict this pattern (Hilke et al. 1988, pp. 34-49).

The study of the program "The Caribou Connection" at the National Museum of Natural History in Washington, D.C., recorded both direct and indirect users, the latter being those who observed without participating. The results showed that while over 60% of the direct users of the computer system were male, the indirect users were divided equally between the sexes. Although we need to be careful when interpreting these data and take into account the special characteristics of every case, it seems however that in general the visitors who will voluntarily approach a computer or compete for its use in a busy gallery, are those who are already comfortable and familiar with using the technology (Doering et al. 1993b, pp. 21-24). At present, they are more likely to be young and male. In most cases visitors use the multimedia interactives in groups. Many adults make use of their attractive presentation and educational content to explain and discuss with children issues related to the objects and the exhibition.

As many museum professionals and educators suspect, visitors seem to like the [process] of using the computer (Serrill and Raphling 1992, pp. 181-189) and comment in many surveys on the attractiveness of the medium (see Doering et al. 1989; McManus 1993b; Menniger 1991; Giusti 1994a and Giusti 1993a). Computers are often more popular than any other exhibit in the display (Hilke et al. 1998) and have a strong holding power (McManus 1993b, Menniger 1991). One exception is the Hall of Human Biology and Evolution in the American Museum of Natural History, where visitors seem to appreciate the dioramas and artifacts much more than the computer interactives (Giusti 1994b). These observations cause uneasy feelings in many educators and curators, who fear that state-of-the-art machinery and dazzling programs are going to destroy the atmosphere of specialness of many galleries and steal attention away from the objects.

Interactive programs can indeed have a powerful impact in public exhibitions, isolating the users from the surrounding environment and distracting them from looking at the displays. On the

other hand, research so far on the use of computers in the galleries suggests that they actually complement and increase the enjoyment of the exhibits (see Menninger 1991; Morrisey 1991; Allison and Gwaltney 1991; Hilke et al. 1988; Wanning 1991; Worts 1990, and Mellor 1993). When thoughtfully designed and carefully positioned, interactive systems seem to function as supplements and enhancements of exhibitions, instead of replacing objects.

The above studies report that after having used interactives interpreting the museum's collections, visitors spent more time viewing the galleries. Allison and Gwaltney observed that visitors are clearly still spending most of their time looking at the traditional displays in the exhibition. "The availability of interactives does not diminish interest in seeing artifacts or period settings. In Information Age at least, the time visitors spend with interactives seems to increase the normal amount of time they would have spent in the gallery if the interactives were not present" (Allison and Gwaltney 1991, p. 70). Although time spent viewing the exhibits is not always an accurate measure of learning or attention, it has been used in numerous studies of museum audiences as it is an easily measurable factor which suggests increased interest and can be an indication of exhibit effectiveness.

The presence of interactive multimedia in most galleries has had a strong influence, but it seems to be a positive one, creating a lively and positive atmosphere and increasing the interest in the subject. Evaluators in many cases tried switching the machines off for certain periods and observed the differences in visitors' behavior. In the Art Gallery of Ontario when the computers were on there were more animated conversations, visitors were pointing to works of art and calling friends to look at details (Worts 1990). In the "Laser at 25" travelling exhibition "visitors read, questioned, and discussed exhibit topics more frequently when the computer was on. Surprisingly, there were more reading and looking behaviors not only at the computer but also for visitors to all parts of the exhibition" (Hilke et al. 1988, p. 48). Interestingly, in the same exhibition, but also at the evaluation of the interactive videodisc program "Birds in Trouble in Michigan" at the Michigan State University Museum, non- computer users spent more time in the gallery than when the computer was off (Morrisey 1991). Modelling after the behavior of other visitors is probably an important factor in this situation.

The observation of the use of museum interactives and the pattern of exploration showed that visitors appreciate the initiative and flexibility that these programs offer. Users prefer to have more complete control over their choices, rather than explore in a linear fashion (Diamond et al. 1989), while they often created unique paths through the program (Morrisey 1991). The evaluation of the "Electronic Newspaper" program in the American National Museum of Natural History showed that the things visitors learned and remembered more vividly were the more active, discovery-based parts of the program (Giusti 1994a). Developers of multimedia interactives should therefore, not forget to make full use of the powerful interactive elements of these programs.

Several studies included cognitive tests to investigate what people learn from multimedia interactives. Knowledge acquisition is a common evaluation criterion, although it is worth remembering that the museum visit is different from the classroom experience: it often includes many different types of learning, not related with the acquisition of factual information, and is difficult to measure and record. The evaluation studies of the Getty Museum videodiscs on Greek vases and on illuminated manuscripts tested cognitive gain by comparing the answers to a quiz of the users of the interactive program with those of a control group which had only visited the gallery without viewing the program. The results indicated that the score of the users of the interactives was significantly higher (Menninger 1991 and Herman 1986). In the studies of the

"Caribou Connection" and the "Electronic Newspaper," at least two-thirds of those interviewed mentioned that they had learned something specific (Doering et al. 1989 and Giusti 1994a).

The visitor study of Birmingham Museums' "Gallery 33" also offered some interesting indications about the impact of computer interactives. The permanent exhibition about cultural relativism, entitled "Gallery 33: A Meeting Ground of Cultures," was organized by the Archaeology and Ethnography Department and includes the interactive video "Collectors in the South Pacific". This raises issues such as the act of collecting, Western influence in the South Pacific, and the return of cultural property. Although the study pointed out that the majority of visitors did not associate the interactive videodisc with the adjacent exhibit with which the designers had intended it to be paired, it also reported that the program "had aroused (visitors) to think of matters related to the collection of artefacts which had never occurred to them previously" (McManus 1993b, p. 79). Almost one-third of those interviewed said that the interactive video had influenced their views on the repatriation of artefacts and on museums (McManus 1993b). The interactive videos in Gallery 33 seem to have been influential in stimulating qualitative learning (Jones 1993).

The summative evaluation of Gallery 33, one of the most extensive carried out,included an exit questionnaire, a tracking study of visitor use of the gallery, an analysis of the memories of the gallery based on a postal survey, a questionnaire to test the reactions to the interactive video, a statistical analysis of the hit counts and choices in the program, a study of school's use of the interactive video, and an analysis of visitors' written comments. It was possible to track down a number of visitors about seven months after their visit to the exhibition, thanks to the addresses that they were encouraged to leave at the visitors' book. From those who responded about what they remembered from their visit to the gallery, it was evident that the range and depth of memories from the exhibition was remarkable. The study showed that the interaction with the multimedia programs had clearly been a memorable experience for the visitors. From the total of memories related to objects or things, the largest proportion (one-quarter) was related to the interactive videos (McManus 1993a, p. 60).

Conclusion

It seems that museum interactives are used mainly by young males, who visit the exhibition in groups. The applications are often the most popular, visitors use them for a long time, enjoy the novelty of the technology, and have a memorable experience. The use and presence of the computers affects the way they behave in the museum, often encouraging them to stay longer and pay closer attention to the objects and exhibition themes. In some cases, the program raises new issues and encourages visitors to challenge, their perceptions.

Further research, experimentation, and communication will be necessary to confirm these findings and increase our knowledge and understanding of the use of multimedia in museums.

Front-end analysis and formative evaluation, even when informal and of small scale, can offer valuable information to the developers of multimedia interactives and help design successful and effective exhibits. "A computer interactive that is prototyped and formatively tested will not necessarily be perfect, but it is guaranteed to be better than one that has not been tested at all" (Raphling 1994, p. 45).

It is difficult to find among the museum community a uniform answer to the question of what constitutes a successful exhibit, and consequently measure its effectiveness. Attracting a large

portion of the audience; contributing to visitors' entertainment and enjoyment; facilitating learning; stimulating curiosity and interest; raising issues; or encouraging self-exploration, whatever objectives the team has set, one can only find out if they have actually been achieved by studying the visitors. The effort and resources expended in observation, interviews, and analysis should be seen as an investment which will increase understanding, enable the museum to improve its exhibitions, and offer valuable insights for future ventures.

Today information technology and telecommunications are becoming increasingly important; we live in a media- and computer-rich world. In this setting, museums are expected to explore the particular features and novel possibilities of multimedia and to investigate and invent effective ways of applying them. Continuous testing with the users, consideration of the audience needs, and further research can help museums take full advantage and make optimal use of this medium.

Section Three: Issues in Multimedia

Chapter 11. Funding

Introduction

Funding of multimedia projects may be less difficult than finding money for ongoing and traditional museum activities such as the organization of exhibitions, or the acquisition of special objects, etc. Multimedia still has the aura of being new, exciting, and fashionable. Of course, in a few years this will pass, but for the time being many organizations and individuals look at multimedia in this way. This has the effect that money may be obtained from sources that aim at high public exposure.

Internal and External Funding

Although in many cases funds for a multimedia project may have to be found outside the museum, the first approach should be to find at least part of the required funds internally. This stage should never be skipped for two reasons: sufficient or almost sufficient funding may be found in the regular budget, perhaps because of some windfall or because museum policy may support new media projects. Plans for a project may originate in one department of the museum, e.g., the educational department; success, however, requires full organizational commitment, through museum senior management. Once committed to the project they may be extremely helpful in finding money possibly committing. Another reason why institutional financial support should be sought is that many external funding bodies requires a proportional commitment by the organization to the project. It is common for only a percentage of the actual costs to be financed by external sources. When considering the solicitation of outside funding, it is important to consult the ICOM Code of Professional Ethics, Article 2.9, which states that commercial support and sponsorship may raise ethical issues. The museum must ensure that its standards and objectives are not compromised by a corporate or with a commercial partner. Control over the content of the application and its presentation should remain with the museum or subject experts.

What May Be Funded

Fundraising is most likely to be successful if a project is well defined and finite. Support for

ongoing programs is more difficult to obtain, as expressed by Charles Meyers of the J. Paul Getty Trust (*ICOM News* 1994, p. 112. Funding programs may involve many years of assistance and could be regarded as a lasting obligation and burden. This reluctance to finance programs is in line with the requirement that a museum itself should show commitment and thus should be capable of continuing a program once initial costs are covered by external funding. Funding bodies prefer investments rather than operational costs. In every project separate "fundable" parts should be identified. These include:

- hardware and software
- project staff
- data input
- feasibility study
- reproduction rights

A separate funding source may be found for discrete parts of a project. However, a production with six sponsors is less attractive to the sponsors than one with three: the less sponsors the more exposure.

Project Description

To obtain funds for a project or a program a clear description is necessary. Such a description has three main functions:

- It clarifies and solidifies the goals of the project. The description may be regarded also as a control mechanism for checking that all elements in a project are covered.
- It is essential for communicating the scope and content for the proposed application to potential sponsors.
- It is a controlling aid after completion of the project, helping the developers and the funding bodies to decide whether the original goals were reached.

There are two types of project descriptions:

- a short overview of the main goals and targets, with an indication of the required budget, and a time frame
- a detailed description with specific time lines, budget, break-down of activities, etc.

Project Proposal Elements

A project proposal written for fund aising purposes uses many of the elements of a Design Specification, but is generally less technical. These elements include:

1. *Name of the project*. It helps to have a meaningful and/or attractive name and/or acronym. Research programs paid for by the European Commission bear such names as: RAMA, Van Eyck, Elise, Mobile, One. These projects are easily remembered by their names.

2. *General targets and goals*. A description of what the project is about, together with a rationale, clearly stating why the project is needed, and how (in general terms) these needs could be fulfilled.

3. *Target audience*. It is very important to specify who will use the actual product. For external sponsors it is of vital importance, as it defines the exposure they are looking for.

4. *Methodology of the project.* Based on the general targets and goals, a more specific description of activities should be presented, such as gathering of information, selection of developers, acquisition of hardware, etc.

5. *System description*. A description of the actual product to be made: how people will use it, how they will navigate, what information (type and content) they will see/hear, etc. Screen images are useful as illustrations.

6. *Partners in the project*. List all partners by name and quote their qualifications for participation and their role in the project. If not all partners are selected yet, only list qualifications needed and roles to be played.

7. *Timeline*. Indicate length of the project, and specify when first results can be shown. A sponsoring organization may want a review point not long after the start of a project. Furthermore, give a short overview of start and end dates of various main activities within the project.

8. *Budget*. In the short project description only the cost of the main items should appear, unspecified. However, in order to be able to do that one has to have already a more detailed break down of the costs. To save time, only "guesstimates" can be used, plus a percentage for contingencies. Check the figures with colleagues to make sure that there is no over- or underbudgeting. Some organizations omit the regular staffing costs because staff members are already in the service of the institute. However, all staffing costs should be included. In the final budget these costs may be marked as "not to be sponsored," thus showing the willingness of the organization to contribute to the project. Of course, this is only justifiable if the work on the project is an extension of the staff members' normal work. Finally, indicate if any profits/income may be generated from the final product.

Identifying Potential Sponsors

The key to successful fundraising is identifying the "fit" between a sponsor's goals and a project's objectives. There are three types of funding/sponsoring bodies: public, private non-commercial, and commercial. Public bodies include (inter)national, regional or local authorities, such as UNESCO, the European Commission, Ministries, Regional and Town Councils. In some countries responsibility for funding is delegated to more or less independent government-supported foundations or services. These organizations in general will de-emphasize public exposure and emphasize more conformity with general policies and objectives. Private non-commercial organizations such as Scientific and Cultural Foundations, Research Institutes, National or Regional Lotteries will in particular emphasize conformity with their mission and in general not care about high exposure. A problem with many such organizations is that funding is sometimes restricted to national, regional or local projects. Cross- boundary projects are sometimes difficult to fund. Receiving money from foreign sources is extremely difficult in

some countries, as tax laws are prohibitive. Commercial organizations are more free in awarding grants, but will care about exposure. Funding, after all, is in most cases part of their public relations activities. Sponsors must perceive a clear benefit to participating in a project. The attractiveness and the cultural effects of the project/product may be defined in terms of the mission or goals of both the sponsoring organization and the originator/museum. The value of sponsoring a project should be articulated. Finding the right source is a time-consuming and difficult task. In many countries commercial organizations are active in this field, and may assist the museum in finding a suitable sponsor. Also sourcebooks exist which list mainly public or non-commercial private funds. Another good source is your personal network, the colleagues in other museums. Choosing from likely candidates is difficult. A frequently listed organization may be a promising target but they already may be bombarded by requests such as yours, which makes your chances small. On the other hand, an infrequently listed source may be poor, difficult to work with, or completely out of line. The most successful fundraising activities are focussed efforts. Specific sources are identified that have an expressed interest in the project area. A Project Description outlines the benefits for both partners.

12. Intellectual Property Rights

Introduction

Using cultural materials in interactive multimedia requires acknowledgement and/or negotiation of new intellectual property rights. As cultural information has no geographical borders, legislation and agreements must be developed in the international social and legal context. The differences in national copyright law are currently a barrier to the development and distribution of multimedia products.

What is worth copying, is probably worth protecting.

In most cases, museums want to distribute images and text related to their collections as part of their educational mission of making their collections physically and intellectually accessible. Nevertheless, they are concerned that, in order to maintain the aesthetic integrity of the original work of art they should exercise control over the dissemination and quality of this material. Licensing rights and reproduction fees are also an important economic asset to most museums. Every museum will have to develop policies and expertise in the implications of digital publishing (joint ventures, going it alone etc.), just as they have done with print, slides, film and video.

The Nature of Copyright

Copyright protects certain rights inherent in a creative work.

The copyright owner has the right to maintain the integrity of the work and protect it from piracy: to control reproduction, adaptation, distribution, public performance and public display of a work and to control the creation of derivative works. Widespread lack of understanding of the subject leads to emphasis on copyright protection rather than sensible and necessary exploitation of copyright. There is no required registration of copyright, no registration system and no central clearinghouse for information as to who owns or who can clear rights in relation to a particular work or performance.

Who are the authors/creators (copyright holders) of the digital form? This has become an even

more complex question with the development of interactive multimedia now comprised of authors of text and image: writers, museums databases, artists and the estates of deceased artists, photographers and the estates of deceased photographers; museums as owners or controllers of photographic records of works; "subsidiary rights holders" including music, film, video; software authors; compilers of a new resource. Copyright may also attach to the actual digital scanning of an image.

The Museum as Owner

To what extent does a museum own the works it shows? A museum has to consider the copyright and moral rights attached not only to the works held in the museum collections, but also to material of others that may be used in collection management systems and in other information systems or sources. In general terms, the copyright and moral rights attaching to a work of art (including photographs) belong to the "author" or "creator" for the duration of his/her life or their lives and to his/her heirs for a period after their death. Many works in museum collections will be out of authors'/artists' copyright and in the public domain. The museum (or other owner) may control physical access to the work but does not usually own intellectual property rights. The copyright attaching to any photograph of the work of art likewise belongs to the photographer unless the photographer is an employee of the organization for which the photograph has been taken (e.g. the museum) or unless there is an agreement transferring copyright to the organization in question.

The control of access to the work of art may obviously represent a financial asset to the museum or other owner. It can also be seen as part of the museum's responsibility to preserve, authenticate and accurately represent material in their collections. This involves not only copyright but also moral rights: to protect the integrity of the images and the identification of the author/artist. It would be conducive to good working relationships for museums to take the initiative on the subject of rights agreements at the time of new acquisitions entering the collection or new photographic records being commissioned, possibly utilizing standard forms of rights agreement. This becomes even more critical when the museum may subsequently wish to disseminate images via a network, whether for collection management, research or public access.

Museum as User of Copyright Material

Most museums are both providers and users of copyright material. Copyright protection arises when a work is "fixed" in any tangible medium of expression. Therefore use of a work without identifying the copyright owner (or his/her agent) and obtaining a license from them may result in copyright infringement. As a general rule, it is safe to assume that any right not expressly granted is reserved by the copyright owner and that one does not have the right. All relevant rights should be expressly stated in a rights license. Multimedia and other applications of "new media technology" is not clearly covered in many traditional rights agreements.

Intellectual Property Laws

Historically there have been two different European approaches to intellectual property rights. On the one hand are those countries for whom the concept of author's rights put emphasis on protecting the moral rights of the creator: the right to claim authorship, to insist on the integrity of the work and to prevent false attribution of the work (e.g. in France, where these rights are not assignable and continue in perpetuity). On the other hand are those countries who emphasized

copyright law focussing on exploitation (e.g. Great Britain and the USA).

Copyright legislation in Great Britain and the USA now encompasses moral rights but implementation is still not universal and the extent of moral rights protection varies from country to country. Other legal issues may be taken into consideration such as privacy rights and publicity rights in the USA. One or both of the Berne Convention for the Protection of Literary and Artistic Works and the Universal Copyright Convention have been signed by most countries, world-wide (but not fully implemented in all aspects by all signatories) as has the Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting. These conventions lay down only minimum terms of protection of the rights to which they refer, leaving the contracting States free to grant longer terms.

New Regulation Initiatives

The Commission of the European Communities addressed the problems of harmonization of copyright legislation within the European Union (EU) in a Green Paper in 1988 leading to legislation harmonizing the terms of protection of Copyright and certain related rights which has now been approved by theEuropean Parliament for implementation in July 1995. While this represents a considerable step forward, these are minimal, only applying to the legislation of EU member countries (although many EFTA EEA countries will probably harmonize with the EU) and there are still many exceptions to the norm.

Name	authors	performers / recordings
Berne Convention	50 years after death	25 years from making
Rome convention	20 years from performance/fixation	20 years from performance/fixation
EU harmonization	70 years after death	50 years from performance
USA	50 years after death 75 years from publication	75 years from publication
Japan	50 years after death	30 years from performance/fixation

The 70 year EU harmonization will mean that some artists whose work is already out of copyright will come back into copyright. The EU Directive does not apply to works of non-EU origin, from countries that offer a shorter period of protection (e.g. the USA, life plus 50 years after death of the artist), where the protection will be for the shorter period. Copyright Protection of computer programs was the first example of harmonization in the field of copyright within the EC (1991), followed by Rental and Lending Right in 1992, and copyright related to satellite broadcasting and cable re-transmission in 1993. The EU has also published a draft Directive for harmonization of the legal protection of Databases, but has, so far, done very little on moral rights.

The administration of rights in the music industry (as compared with the visual arts) is much more developed - but highly complex. Attempts are currently being made to find workable solutions for music rights, in the new situations arising from the development of interactive multimedia, including encouraging moves towards one- stop copyright clearance. Linear media in the film and TV sectors are also highly complex and questions arise as to how interactive a use has to be before it becomes non-linear.

Digital Uncertainties

Traditional (analog) media were segmented and had their own terminology and economics. While the content elements of digital multimedia do not bring up new legal problems, the combination and uses of them do. The term "multimedia" can not only apply to text, images and music on hardisk, CD-ROM, CD-I etc., but also to networked resources, video on demand and other interactive services. Questions to be answered are:

Is multimedia a collaborative work (where the authors' rights belong to the different creators and have to be transferred by contract to the producer) or a collective work (where, from the outset, the rights belong to the publisher)?

If multimedia were to be legally considered as a databank, this would raise other sets of rights problems, under existing national legislations and proposed EU harmonization that is currently being discussed.

Does the inclusion of a work in a multimedia resource constitute a new form of exploitation or is it the adaptation of a pre-existing work ? Many existing contracts have provision for the assignment of unknown methods of exploitation but most do not include rights of adaptation. Ancillary rights in existing contracts do not cover new media subsequently introduced.

Digital forms also introduce many new complications - in relation to aspects such as image manipulation, downloading to disc or hard copy printout, networking etc. Reproducing a copyright protected work in electronic form is considered a restricted act, but in many EU and other countries the status under copyright law of temporary (transient) electronic storage of protected works (i.e. in RAM memory) during acts of loading, transmission or screen display is currently being debated. With the rapid rate of technology development it is going to be necessary to regularly update agreements.

Multimedia is ravenous for content and, realistically, we have to start valuing the price of the various elements of content on a new basis.

Image Scanning and Image Security

Who should digitize - the museum or the developer/publisher ? Ideally all scans, whoever makes them, should have integral header identification and information including author/creator of the object or work of art, title, date, owner, copyright owner. Security of digitized images from unauthorized use and piracy (which is a major economic problem in videotape and digital audio publishing), is made more problematic by the rapid development of networking, and is being explored by the development of a variety of technical devices. These include encryption systems and visible or invisible watermarking of images. CITED for instance (Copyright in Transmitted Electronic Documents) has been developed under the EU ESPRIT II program and represents a comprehensive system of controls as to access and degrees of use of material within on-line and also CD- based multimedia resources, including audit trails - according to the password status of the particular user.

Recent Administrative Developments

The law follows, often much later, technical development. Most of present copyright law does not adequately reflect current (and likely future) developments in digital publishing. Some people now feel that copyright will not be able to cope with digital developments in IT and will

eventually be replaced by contract law or by copyright-on-demand arrangements. In 1993-94 the CIAGP (Conseil International des Auteurs des Arts Graphiques et Plastiques et des Photographes), made up of artists rights societies in many countries, drew up draft proposals for agreements on digital imaging and interactive multimedia.

These proposals are currently being considered by its parent body CISAC (Conféderation Internationale des Sociétés d'Auteurs et Compositeurs) and will hopefully be available in 1995. Although they are unlikely to include recommended tariffs, they could and should provide a basis for an important step forward, providing the individual Societies can, between themselves, agree on the terms and basis of implementation. The German Publishers Association has produced a Guide to the Negotiation of License Agreements for the Utilization of Published Works in On-line Databases (September 1993).

International conferences on Interactive Multimedia and on museums and Information technology increasingly feature sessions on the topic of Intellectual Property Rights and their implications but there is still no sign of a basis for international proposals for model agreements. There have been a number of initiatives by consortia of museums in the USA, setting out to establish and protect the position of museums. Similarly there are initiatives by consortia of Photographers in the USA.

The Coalition for Networked Information, Washington DC, produced an interesting research report on Rights for Electronic Access and Delivery of Information (READI) Project, September 1992. This has been followed by the deliberations and a preliminary report in July 1994 of the USA Working Group on Intellectual Property Rights of the National Information Infrastructure (NII) Task Force, which highlight the problem that sources of valuable intellectual property are not being made available over the networks because of the absence of reasonable assurance that intellectual property rights will be respected. The Multimedia Subcommittee of the Copyright Council of Japan's Agency for Cultural Affairs considered the establishment of a centralized organization for copyright information in a preliminary report in 1993. In 1994, the Multimedia Committee of the Japan's Institute of Intellectual Property (MITI) proposed a Digital Information Centre, a collective administrative centre at which information on copyrighted works could be readily accessible and clearance approval efficiently obtained.

Also in Japan, Copymart is a contract-based model for the collective licensing of copyright, which would comprise two databases - the "copyright market" (CRM), where rights holders can file their copyright information including a brief description of works and sale or license agreements and the "copy market", (COM) where copies of works are distributed to customers upon request and payment. In the USA, there is a proposal for a Multimedia Clearinghouse, with copyright owners participating on a voluntary basis. Photo Library Agencies in the UK and the US are working with CD-ROM and on-line networking, providing clients with images that are copyright cleared for the purposes declared on-line by the client followed by the payment of the appropriate fee by the client.

The World Intellectual Property Organization (WIPO) is studying the establishment of an international system of assigning, on request, identifying numbers to certain categories of literary and artistic works and to phonograms. These identifying numbers may also be used for the electronic (particularly digital) means applied to control the extent of use and, possibly, to identify the protected material used.

The French agency for protection of Programs (APP) has developed such an international

identification system for software at the request of WIPO. Significant among recent specialist conferences was Legal Aspects of Multimedia and GIS organized in Lisbon, October 1994 by the Legal Advisory Board (LAB), DGXIII of the European Commission. This included the presentation of drafts of several wide-ranging and, in some respects, controversial papers commissioned but not yet (January 1995) and now published by the Commission. Given that the clearing of intellectual property rights is currently complicated, time consuming and therefore costly, there is an urgent need for simple, understandable licensing and model contracts on the part of the providers to encourage and facilitate integrity on the part of the users.

Fair Dealing and Fair Use

In many countries, copyright legislation allows for a number of defined exemptions on the principle that copyright should not hinder the acquisition of knowledge (eg. Fair Dealing in the UK, Fair Use in the USA). These exemptions relate to research for private study, review or criticism, reporting of current events. This has increasingly proved to be a problem, for example in relation to education and slide libraries. With the rapid development of digital imaging and networking it is now becoming a major issue as to whether Fair dealing / Fair Use is a valid concept in a digital environment, particularly in relation to educational use. This will have to be resolved in order to create confidence and willingness on the part of all interested parties, whether by means of development of intellectual property rights legislation or by licensing. The Museum Education Site Licensing Project, with Getty AHIP support, is one example of an initiative to define, through experiment and working practice, a basis of agreement that can ensure the availability of large collections of digitized museum images and information to all levels of the education sector.

It is advisable for the producer to conduct a legal audit of the rights involved and establish a clear chain of title before undertaking any multimedia publishing. Initially, this should involve existing agreements with the producer's own staff. A surprising proportion of both publishers and museums do not have the necessary legal framework to embark on multimedia. A checklist could include:

- Copyright and Moral Rights Factors: the extent of permissions in relation to:

    - geographical rights

    - language rights

    - duration exclusive/non-exclusive requirement for provision of audit trails.

- User licenses: the number and nature of site licenses for viewing only or more extended usages.There are copyright implications in:

    - loading text and images into a resource

    - calling up/displaying on screen

    - printing/copying for study and private use

    - duplicating or manipulating images

    - on-site retail publishing (museums, libraries etc.)

- down-loading text and/or images to disc or videotape

- transmitting

- networking

- rental provision of digitized image files or color separations for

- publishing

- In scanning images, artists, museums and other image "owners" have to determine their policy as to:

  - what material they provide (transparencies, digitized scans etc.)

  - on what basis they let others originate photographic material and who owns the rights

  - on what basis they agree to others undertaking scanning and ownership of the resultant scans

  - on what basis they license (e.g. non-exclusive)

  - for what period of time (e.g. subject to resource being published within a specified period for a specified number of years for a period determined by maintaining of a specified level of royalty payment)

  - what control they wish to exercise over image quality and design of the resource

- In regard to digital text:

  - what data and other text material they provide

  - any limitations on the joining with other text or images from other sources.

- In regard to usage:

  - museum public information

  - research

  - general public, retail museum management

  - education

  - on-site publishing,

  - libraries

- Platforms :

  - specifying of type(s) of platform licensed (e.g. CD-ROM, CD-I,etc.)

  - networking (inter-museum, Internet etc.)

- cable transmission

- Distribution arrangements and payments:

  - publishers and/or distributors

  - outright fee and/or royalty basis

Next Steps

In a 1994 paper Jorgen Blomquist, Head of the Copyright Section, World Intellectual Property Organization (WIPO), stated "it is fair to say that digital technology is not just another technological evolution, it is a revolution; technology will not wait for us ; we are deploying all possible efforts to achieve a good, updated international framework, proper measures to facilitate the administration of rights in the face of new distribution and communication systems, efficient means to fight against piracy."

13. Data Interchange and Telecommunications

Data representation

Multimedia in museums will rely on data interchange and telecommunications protocol and standards. In 1993, CIMI (Computer Interchange of Museum Information) concluded that underlying data representation standards such as those quoted below should be followed by museums regardless of the interchange application.

These main underlying standards are:

- ASCII for text
- CCITT Group 3 and 4 facsimile
- JPEG (Joint Photographic Expert Group)
- CGM (Computer Graphics Metafile)
- TIFF (Tagged Image File Format)
- BMP (Windows BitMaP) for graphics and still images
- MPEG (Moving Picture Expert Group) for video
- CD Audio for audio
- MHEG (Multimedia Hypermedia Expert Group) for composite object.

CIMI recognizes, however, that while the framework may seem definitive on this issue, concrete recommendations are often difficult to formulate because standards, especially in the area of video compression, are undergoing rapid development and implementations are lagging behind the adoption of new standards.

Data Structure

CIMI identified three approaches to interchange of database records for construction of shared catalogues:

- ISO 2709 (Information Interchange)
- ISO 8824 (ASN.1 © Abstract Syntax Notation One) and its Basic Encoding Rules (ISO 8825)
- ISO 8879 (SGML Standard Generalized Mark-up Language)

Standard Definition Description ISO 8824 and ISO 8825 is flexible technical language for specifying data structures. Together with its Basic Encoding Rules, it provides a means of specifying, encoding and decoding messages to be transmitted. The semantics are very general (Boolean, string, number). Mappings are defined by the user.

ISO 2709 is representative of bibliographic and information (textual, descriptive data) interchange formats. It is specifically intended for communication between data processing systems. It is a content independent specification of fielded (tagged) text for data exchange.

A record contains both data for transmission and information about the data, its structure, and organization for the data processing system to use. SGML/ ISO 8879 is designed to describe how text should be formatted, printed, processed, or represented in a system-independent way (formatting and presentation capabilities are very basic [see Data Presentation]). With its associated standard Hytime (Hypermedia/TIME-based document structuring language ISO 10744) these are methods to denote the structure of free, tagged, or formatted text and to link these with associated images and sounds.

ISO 8879 is defined in two parts : a Prologue and a Document instance. The prologue contains the SGML declaration (specifies facts about character set, delimiter codes, and length of identifiers) and a document type declaration (DTD, description of the entities of the document). The document instance is the content.

After analysis, CIMI concluded that each set of standards had strengths and weaknesses:

- ASN.1 is the preferred OSI language for representing other protocols and standards. For example, ISO 8879 SGML uses ASN.1 for encoding the formats. While ASN.1 can be used to encode data that is formatted for interchange according to other standards such as SGML/SDIF, it is also possible to use it directly for both formatting and encoding.
- Use of ISO 2709 has declined over the last few years especially because the adoption of MARC (Machine Readable Cataloguing) for bibliographic use. Numerous bibliographic but also non-bibliographic MARC formats are in use in over 20 countries, and a bridge (UNIMARC) has been implemented between them. The scope of bibliographic items includes books, computer files, maps, music, visual materials.
- Use of SGML is interesting for most object descriptions, particularly if it involves use of extended text in fields in which the contents of that text should be identified or if it involves text associated with graphics, images, sounds, or multimedia, or if the ultimate purpose of the interchange involves paper or electronic publishing.

Data Access

The suite of technical standards for search and retrieval which were developed as NISO Z39.50 and have since been adopted as ISO 10162/10163, are considered the most widely accepted method for searching remote systems running diverse software.

It is important to distinguish between information retrieval functions of ISO 10162/63 and the database management functions of Structured Query Language (SQL) and Remote Database Access (RDA) extensions to SQL specified as ISO 9579 RDA. ISO 10162/63 is preferred for information retrieval services where knowledge, or data in context is wanted. For example ISO 10162/63 allows searches for concepts like "Author" or "Title" to be conducted independently of the way data is represented internally in the application, or whether it is stored as a flat file or relational table. In contrast to that, SQL and RDA extensions are designed for performing database management services such as updating, archiving, or moving databases, for query of relational tables, or for distributed database applications.

Data Presentation

Beyond the data structure definition, formatting and data presentation have to be defined. For instance, formatting and presentation are not handled by SGML in a single context (they are in fact, but with very basic capabilities). So additional standards have been defined to support the control of the way documents are represented to the recipients in document interchange : DSSSL (Document Style Semantics and Specification Language ISO 10179) for formatting documents and SPDL (Standardized Page Description Language) for page description, for instance. But they have yet to be broadly implemented in commercial software.

Nonetheless, tools are available to process SGML documents into electronic or printed output complete with user-definable formatting. Integrated tools allow changes to structure, content, or formatting at any point in the production process. The SGML set of standards seems to be the more widely accepted. Nonetheless, another standard exists in parallel that is more dedicated to office application: ODA (Office Document Architecture, ISO 8613).

Security

The basic strategies for protecting communicated information are the physical security, the authentification, and the encryption. Physical security concentrates on the control of access to networks, computers, or sectors of storage media such as hard disks. This security is not the subject of this chapter. Readers are referred to the literature on LANs, WANs, and MANs.

ANSI defined standards for authentification such as ANSI X9.9 and X9.17. They are mainly used in banking environment.

Algorithms have been designed for encryption : the two most widely recognized are DES (Data Encryption Standard) and RSA (Rivest, Shamir and Adelman). Recently software for "watermarking" images has come on the market.

Billing and Statistics

Billing for access to data and statistics of actual use are closely linked : billing can be carried out from statistics. The minimum necessary data to calculate the statistics are:

- the identification of the incoming log (transaction ID, type of user)
- the current date and time
- the starting time and the ending time of the connection
- the identification of the query (number of results, type of the content: text, image, video, sound; size of the data transferred)

Data on all users are preferably stored in monthly statistical files, for which privacy is ensured.

Telecommunications

OSI or Open Systems Interconnection is a model defined by ISO (International Standard Organization). Its aim is to enable different computers from different vendors to communicate and exchange data transparently. The model relates to Local Area Networks (LAN), Metropolitan Area Networks (MAN), and Wide Area Networks (WAN). It includes 7 layers or (more exactly) 6 protocol layers and a physical interface as shown in the figure here below.

- Layer 7 : Application data processing (file transfer, consultation)
- Layer 6 : Presentation data representation (coding,syntax, etc.)
- Layer 5 : Session manages and synchronizes the dialogues (e.g., password verification)
- Layer 4 : Transport assurance of reliable and transparent data transport communication
- Layer 3 : Network routing through switching nodes
- Layer 2 : Data link data transfer including correction of binary errors
- Layer 1 : Physical definition of the physical interface between network and terminal.

Standards

The OSI model is a full set of standards each concerning one of (or part of) the layers. In the following paragraphs the most important standards for respectively LAN, MAN, and WAN will be discussed.

LANs (Local Area Network)

Ethernet or CSMA-CD (Carrier Sense Multiple Access Collision Detection): Ethernet is a standard for LAN. The specification is laid down in IEEE 802.3 or ISO 8802.3. It corresponds to layer 1 and part of layer 2 of the OSI model.

- Layer 2 : Data link LLC (LogicalLink Control) MAC (Medium Access Control) : CSMA-CD Ethernet
- Layer 1 : Physical Cable in bus Ethernet

The physical medium most widely in use is either coaxial cable (10 base 5, 10 base 2), or unshielded twisted pair (10 base T) or optical fiber organized in bus. The theoretical transfer rate

is 10 Mbits/s, but the actual rate is approximately 3 Mbits/s. This is due to the protocol CSMA-CD. Before sending a signal or bit stream, a station listens to the network and only sends if the network is free. However, sometimes collisions take place when two or more stations send at the same time. These stations then have to re-send, which takes time. Henceforth the low actual transfer rate.

Enhancements are being realized in order to make Ethernet deterministic and to assure a higher actual transfer rate to the effect that Ethernet may be used for real time applications. In particular the deterministic algorithm DCR (Deterministic Collision Resolution) offers approximately 8 Mbits/s actual transfer rate.

In addition, an Ethernet 100Mbits/s standard is currently under development. Hewlett-Packard and 3Com are the main players in this new development.

Token ring is also a standard for LAN. The specification is laid down in IEEE 802.5 or ISO 8802.5. It corresponds to layer 1 and part of layer 2 of the OSI model.

- Layer 2 : Data link LLC (Logical Link Control) MAC (Medium Access Control) : Token Token ring
- Layer 1 : Physical Cable in ring

The physical medium currently in use is either coaxial cable (10 base 5, 10 base 2), or unshielded twisted pair (10 base T) or optical fiber organized in ring.

The theoretical rate is 16 Mbits/s. Access is deterministic : a token runs from a station to another on the ring and transmits the data. The RAMA project has chosen token ring for video play.

MAN (Metropolitan Area Network)

FDDI (Fibre Distributed Data Interface) is standardized as ISO 9314. It corresponds to layer 1 and part of the layer 2 of the OSI model.

- Layer 2 : Data link LLC (Logical Link Control) MAC (Medium Access Control) : Timed Token FDDI
- Layer 1 : Physical Cable in double ring FDDI

FDDI was originally designed to work with optical fibre. Therefore it was insensitive to electro-magnetic interferences. The main drawback was the high price of optical fibre and the necessary adapter. However, it also can work with STP (Shielded Twisted Pair) or UTP (Unshielded Twisted Pair). The theoretical transfer rate is 100 MBits/s. Access resembles token ring with the principle of the timed token. The topology in a double ring offers a better security however. In practice FDDI is mainly used to link LANs (Ethernet, token ring). Thus it is known as a high-speed backbone network.

WAN (Wide Area Network)

IN WAN's use can be made of various technologies and protocols, such as X25, ISDN, ATM and TCP/IP, which are not mutually exclusive.

X25

The Packet Switching Networks (CCITT X25) protocol refers only to the layers 1 to 3 of the OSI model. It is mainly used within the framework of a WAN (Wide Area Network).

- Layer 3 : Network Establishment of connection, management of data transfer and release of connection
- Layer 2 : Data link H.D.L.C protocol (High Level Data Link Control) assures data transfer without binary errors. It corrects errors and controls the data flow
- Layer 1 : Physical The interface is defined by X21 protocol and the medium is usually a leased telephone line (public network)

ISDN (Integrated Services Digital Network)

ISDN definition is based on 3 main pillars: digital connectivity from end to end high quality network universal and transparent access. ISDN offers two modalities to connect users: BRI (Basic Rate Interface) or BRA (Basic Rate Access) which provides two B channels (Bearer) and one D channel (Data). The B channels can carry any form of digitized information (data, voice, image and video), while the D channel is primarily intended to carry packet signalling information. The other modality is the PRI (Primary Rate Interface) or PRA (Primary Rate Access) which provides up to 30 B channels and one D channel.

The transfer rate per B channel is 64 Kbits/s. The transfer rate of the D channel is 16 Kbits/s for the BRA and 2 Mbits/s for the PRA. ISDN supports both circuit switching transmission (public telephone network) and packet switching transmission (X25).

A set of services is supported by ISDN:

- CLIP: Calling Line Identification Presentation,
- CLIR: Calling Line Identification Restriction,
- DDI: Direct Dialling In,
- MSN: Multiple Subscriber Number,
- TP:Terminal Portability,
- AOC: Advise Of Charge,
- CFB: Call Forwarding Busy,
- CFNR: Call Forwarding No Reply
- CFU: Call Forwarding Unconditional,
- CH: Call Hold
- COLP: COnnected Line identification,
- COLR: COnnected Line identification Restriction,

- CUG: Closer User Group,
- CW: Call Waiting,
- SUB: SUBaddressing,
- UUS: User User Signalling,

Each PNO (Public Network Organization, in most instances still the National PTT) offers a National ISDN with a specific version of the D protocol and therefore a specific set of services of which the complete list is quoted above. Unfortunately the current versions of ISDN are not fully compatible. An International ISDN exists : it is the result of the interconnection of the various national ISDNs but it has been realized with a proprietary protocol D version called code 7 TUP (Telephone User Part) and does not offer the services listed above. Nevertheless an Euro-ISDN will be a standard for ISDN in Europe and is available.

ATM (Asynchronous Transfer Mode)

ATM is chosen by the ITU-T (formerly CCITT) as standard for the next generation of WAN. In fact this technology can be applied to WAN as well as to LAN. For instance, IP (Internet protocol) will "work" on top of ATM and FDDI and will be connected to ATM. ATM in future will be used as backbone network. ATM is a compromise between the simplicity of circuit switching mode (e.g., ISDN) and the flexibility of the packet switching mode (e.g., X25) and is a so-called Cell Relay technique. The cells are much smaller than with X25 and of fixed size, hence the speed of transmission.

Adaptation layer (AAL): Segmentation and re-assembly of cells. ATM layer Generation and extraction of the cell header and control of the multiplex/demultiplex of cells

Physical layer: The media can be either shielded or unshielded Twisted Pair or Optical fiber. The transfer rate starts at 25 MBits/s to 155 MBits/s for Twisted Pair and up to several GBits/s for optical fibre.

Internet TCP/IP (Transmission Control Protocol/Internet Protocol)

TCP/IP can be represented in layers like in the OSI model but it does not respect this standard as it was defined before the OSI model. TCP/IP is almost always referred to as a unique form because TCP and IP represent two different layers of protocol. In comparison with the OSI model, IP corresponds to layer 3 (Network) and TCP corresponds to layer 4 (Transport). Thus it can be used either in LAN or WAN environment according to the lower layer used in conjunction with it.

Applications:

- Assurance of data processing (file transfer, mail)
- TCP (Transmission Control Protocol)
- Assurance of reliable data transport in a connected mode
- UDP (User Datagram Protocol): Data transport without control in disconnected mode.

- IP (Internet Protocol): Fragmentation and re-assembly of datagrams (basic item in IP) and routing of these datagrams.

In LAN environment, TCP/IP is often used with Ethernet. In WAN, TCP/IP is often used with X25 or Frame relay in lower layers. In higher layers, protocols such as FTAM (File Transfer, Access and Management) for file transfer, X400 for messaging and X500 for Directory services are also used in conjunction with TCP/IP. TCP/IP often includes at least the three standardized upper layer protocols: Telnet, File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP).

The RAMA structure for instance is built into layers in the top of TCP/IP. RAMA accepts any LAN with winsockets facilities and any WAN protocols which encapsulate TCP/IP.

Public and Private Network

X25

The X25 standard met a real success in data transfer. In the beginning public networks were developed such as Telenet in the USA, NPSS in Great Britain, Datapak in Scandinavia, and Transpac in France. But beyond a certain threshold it became interesting for important companies to buy and manage their own networks in order to save money.

ISDN

Most Public Network Operators offer National ISDN and are connected to International ISDN. Examples are AT&T and MCI in the USA, BT and MERCURY in Great Britain, ITJ and KDD in Japan, and France Telecom in France.

Until recently ISDN did not meet the expected success. One of the reasons was certainly the lack of full compatibility between the different National ISDN. Organizations such as ETSI (European Telecommunication Standards Institute) have been working on the harmonization of standards to the effect that Euro-ISDN is more widely implemented and will meet wide acceptance in the years to come.

ATM

ATM has reached the maturity necessary to shift from "laboratory experiments" to "field deployment". Manufacturers are releasing commercial ATM products, users are installing first ATM LANs and Network Operators are realizing public ATM networks. In particular, 15 Public Network Operators have developed an ATM pilot in Europe, which after an appropriate consolidation phase probably will evolve to commercial operation.

Internet (TCP/IP)

Internet is an interconnection of hundreds of networks running the TCP/IP protocols to the effect that users of any of the networks can use the network services provided by TCP/IP to reach users on any other networks. Internet started as ARPANET (Defense Advanced Research Project Agency NETwork) in the USA, but now includes such networks as NSFNET (National Science Foundation NETwork) in USA, SuperJANET (Joint Academic Network), RENATER (National Network for Technology, Teaching and Research) in France, EBONE (European IP backBONE)

and hundreds of others.

Pricing Volume vs. Connection Time

The communication over Internet is free of charge. Contrary to that communication over other networks is invoiced. The mechanisms for pricing are various, even with one tellecom provider. France Telecom for instance invoices its ISDN service according to the distance and the duration of the connection whereas it invoices its X25 service mainly according on the basis of data volume and in a lesser way according to duration of the connection.

14. Conclusion

"The recent proliferation of non-literate forms of communication like television and of electronic systems of storing and retrieving information may teach the historian to put his books and documents into perspective."

M.T. Clanchy, From Memory to Written Record: England 1066-1307, p. 8.

This chapter is still under construction. Comments are invited

Bibliography

Reference comments

The literature of multimedia is quite vast and growing rapidly. The portion devoted to multimedia in museums is considerably smaller, has a distinct Anglo-American bias, and has rarely had the benefit of peer review, nevertheless parts of it are very valuable. The literature which deals with multimedia technology and the market for multimedia products becomes outdated very rapidly; almost nothing over a couple of years old has any value except as history. However, the discussions of museum applications that treat design issues, audience concerns, organizational strategies, and socio-legal issues are often still useful after many years.

The most important source of papers specifically devoted to interactive multimedia in museums have appeared in the three volumes of Proceedings of the International Conference on Hypermedia and Interactivity in Museums (1991, 1993, 1995) and in the Proceedings of the Electronic Visual Arts (EVA) conferences (1990-1996). Together the volumes contain over 400 articles on the technical, socio-cultural, and museum design issues as seen by leading developers in the museum community and leading researchers worldwide. [ICHIM Proceedings are available from Archives & Museum Informatics, 5501 Walnut St. #203, Pittsburgh, PA 15232 USA; EVA Proceedings are available from VASARI Enterprises, Alexander House, 50 Station Rd., Aldershot, Hants GU11 1BG, UK].

Worldwide only a handful of short monographs have been completely devoted to the topic and few are very current. The technical report by Stephanie Koester, "Interactivity in American Museums" contains a bibliography on museum multimedia which is quite complete up to its publication in 1993. "Studies in Multimedia: State-of-the-Art Solutions in Multimedia and Hypertext " (Susan Stone and Michael Buckland eds.) includes a number of articles on museum multimedia not published elsewhere.

There are no journals exclusively devoted to interactivity, multimedia or image databases in

museums, but several journal have published reports on multimedia projects beyond the journalistic level. These include: *Archives and Museum Informatics: Cultural Heritage Informatics Quarterly* (from Kluwer Academic Publishers, P.O.Box 322, 3300 AH Dordrecht, The Netherlands; in North America use: P.O.Box 358, Accord Station, Hingham MA 02018), *Museum News* (from the American Association of Museums, 1225 Eye St., NW, Washington DC 20005, USA), *Visual Resources* (ISSN 0197-3762, Subscriptions from International Publishers distributor), *The International Journal of Museum Management and Curatorship* (ISSN 0260-4779, Subscriptions: Elsevier Science Ltd., The Boulevard, Lanford Lane Kidlington, Oxford OX5 1GB UK), *Curator* (ISSN 0011-3069, Subscriptions for North & South America: Curator Subscription Service, P.O.Box 3000, Denville NJ, 07834,USA;Elsewhere: 3 Henrietta St., London WC2E 8LU UK) and *SPECTRA*, (ISSN 1042-3729; MCN, 8720 Georgia Ave., Suite 501, Silver Spring, MD 20910 USA).

News from the multimedia field in general is published in dozens of journals, but the most useful of the inside the industry newsletters continues to be the *Multimedia Monitor*(ISSN 1071-0698; from Future Systems, P.O.Box 26, Falls Church, VA 22040-0026 USA). A basic resource for those seeking software, consulting, publishers or other service providers is the *Multimedia Yearbook*, an annual from Interactive Media Publications (UK phone +44-171-490-1185/fax +44-171-490-4706; US distributor Pemberton Press phone and fax +1-203-761-1466). The yearbook also features several hundred pages of industry updates in each annual volume.

A database of projects and products of museum multimedia is maintained by the International Visual Arts Information Network (IVAIN) in conjunction with the International Documentation Committee of the International Council of Museums (ICOM-CIDOC). The database is available online (and may soon appear on the WWW), and as a bi-annual printed product ISSN 0961-9259, from IVAIN, Suffolk College, Rope Walk, Ipswich IP4 1LT UK). The ICOM-CIDOC Multimedia Working Group, originators of this publication (Jan van der Starre, c/o RKD, PO Box 90418, 2509 LK The Hague, Netherlands), andthe ICOM AudioVisual Committee AVICOM also have information on on- going projects and can make referrals.

Imaging, which is only one component of multimedia in museums but clearly a critical one, is best dealt with in the Getty Information Institute pamphlet, by Howard Besser and Jennifer Trant, entitled Introduction to Imaging. While addressing issues at an introductory level, this brief report identifies the full range of concerns and provides valuable advice about how and where to resolve them

With the exception of design issues, many of the critical parameters of museum multimedia are changing rapidly. Legal frameworks are under review and revision in almost every country and at an international level. The publishing industry is working out means for distributing products using fixed media and networked access and both technologies are in dramatic flux. The market for public consumption of interactive multimedia is so young that few patterns are discernible. While much has been written on all the state of play in all these areas, including references in this review would be a disfavor as they are rapidly dated.

Often the best advice in these rapidly changing areas will be found through participation listservs and by investigating those resources on www sites that have dates on them. Among the lists with the heaviest participation (which does not assure reliability but at least means others will have heard the advice) are:

- Museum-L (the generalist list serve for museum professionals)

- CIDOC-L (the list serve of the ICOM Committee on Documentation)
- H-Net (Humanities On-line maintains dozens of lists focused on humanities disciplines)
- Museum-ed (for museum educators)
- Musweb-L (for museum webmasters and others interested in WWW issues)
- IMM-L (the general list for interactive multimedia discussions, not museum specific)

In addition, both for their content and for ideas about how to present museums on-line, anyone interested in multimedia in museums will want to explore many museum World Wide Web sites. The starting point for any such journey is the list-of-sites at the virtual library - museums maintained by Jonathan Bowen [www.comlab.ox.ac.uk/archive/other/museums/example.html] as it has versions in many languages and mirrors in many countries. For museum professional advice, visit the Canadian Heritage Information Network site [www.chin.gc.ca/] in French or English. For information on activities of the Getty Trust and related cultural information issues, including the Introduction to Imaging booklet, and the archives of the Museum Educational Site Licensing Project, visit the Getty Information Institute [www.ahip.getty.edu/mesl]. Most national ministries responsible for museums and higher education also maintain sites that will have useful information - don't forget to use these resources.

Most first world countries have also conducted national investigations of multimedia in the past few years and can be expected to continue to do so. These rarely have any special relevance to museums, but are helpful for orienting readers to issues of national policy and funding. Similarly, the European Union has conducted both general investigations and much funded research [www.echo2.lu]. The latter is often directly related to museum multimedia and has been well reported in the EVA Proceedings over the years.

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