20.

A NEW AGENDA FOR MUSEUM INFORMATION SYSTEMS

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> We have emerged from being midgets of knowledge to being giants of information (Huennekens, 1992: 76).

20.1 INTRODUCTION

Museums are massive repositories of complex, heterogeneous and multi-faceted information on materal culture; many museums are aleady creating large computerised archives, storing this information. Yet, if museum information systems are to be used effectively for cultural research and for the dissemination of knowledge to the public, they must overcome the limitations of currently used museum documentation and collection management systems. This can be helped by new developments in information technology, such as object-oriented and semantic information systems, hypermedia, structured text encoding mechanisms and telematics. The redefinition of systems requirements emerges as a critical issue for the diffusion of information technology in museums outside the registrar's department. It should take into account the need for richer modelling of cultural information, so as to avoid data reduction, make museum data more amenable to analytical treatment and support the creation of coherent hyperviews of the information. It should also provide some heuristics for user interfaces better suited for the needs of cultural research and the museum experience. This paper presents a checklist of issues relevant in the definition of this new agenda for museum informatics.

The role of museums is usually defined epigramatically by means of a triad of functions: *collect, preserve* and *disseminate.* The way in which these terms are interpreted in different museums is, however, very diverse, usually clustering around two extreme positions. At one end, there are traditional museums (usually art) that define as their main mission the curation of treasures of great artistic, historical or cultural value. To *collect* for these museums means to acquire new objects. To *preserve* means to ensure the safety and good physical condition of these treasures. To *disseminate*, finally, means primarily the study, scholarly research and exhibition of the objects. The exhibition practice of these museums is dominated by the view that objects can "speak for themselves», and that the experience of the public should not be contaminated by excessive documentation. These are museums made for scholars and for amateurs, seeing themselves as bastions of (typically) archaeological and art historical research.

At the other end, there are museums (mainly ethnographic) which give priority to the educational, public mission. To «collect» for these museums now encompasses the collection of information on objects and object histories.

To «preserve» includes the maintenance of inventories, catalogues and other information sources, considered essential for the understanding of the collections. The function of *disseminating* is given central importance, and is implemented by means of intensive educational and exhibition programmes. In this second type of museums, objects are often displaced from the centre of museological practice, and the limelight is stolen by the interpretive web formed by putting together information on their cultural, historical or artistic context.

Notwithstanding this difference, the collection, management and use of information is a thread that permeates the triad of collecting, preserving and disseminating for both kinds of museums. From the moment an object is accessioned by a museum, information is collected on its history, from its last owner, accompanying documents or other sources, or from its associations with other objects. The archaeological context of objects found in the field is painstakingly recorded, so as to allow their typological and functional classification, and the reconstruction of excavation contexts. The form, function and meaning of museum objects often becomes the battlefield for heated scholarly debate in archaeology, ethnography and the history of art; these battles are the motive force of scholarly progress, and are based on the collection and study of large amounts of information. Curators and conservators submit objects to detailed morphological and scientific examination, and amass large amounts of data. Finally, museologists and museum educators also collect information about visitors' response to exhibits, which in turn feeds back into their communication policy.

Information technology is currently seen as an opportunity for museums to establish effective control over the management of their collections, to assist the process of material culture research, and to improve communication with the visitors. Its use in museums, for inventorying and collection management systems, was legitimised during the last fifteen years, by stressing the practical utility of maintaining object lists and indexes, sharing information resources and providing for an accountability mechanism in administration. All the more, the large amounts of accumulated paper-based and computerised museum information need sorely to be transformed into *knowledge.* In rethinking the use of information systems in museums, one should keep equally in mind the more far-reaching, strategic implications to the way their introduction may affect the way we see both material culture as a domain and museums as active cultural institutions. Indeed, this is the context in which the following items for a new agenda in creating museum information systems should be situated.

20.2 MUSEUM INFORMATION SYSTEMS SHOULD MODEL ADEQUATELY THE COMPLEXITY OF MATERIAL CULTURE

Computers were introduced to museums from the related field of libraries, carrying with them the intellectual traditions of librarianship and information science. Their introduction coincided, no wonder, with the development of

formal documentation and procedural standards, intended to help the maintainance of full and consistent records of art objects, and thus to improve the accountability of museums over the management of their collections (Roberts 1985).

In the course of the 1980s a large number of museums had already introduced microcomputers for documentation, aided by their popularity and low cost and also by the availability of simple database packages for museums, such as Superfile and MODES in the UK and Mobydoc in France. As a rule, data about museum objects were stored in flat file databases, sometimes with repeatable group or limited multifile linking capability. Applications allowed the production of printed inventories and interactive query based on single or multiple criteria.

In large museums, the trend towards mere documentation was supeseded by the appearance of sophisticated collections management systems, which automate standard museum procedures such as object movement, loans processing and conservation. The most advanced systems now used in museums are based on relational or network DBMS and provide comprehensive multi-file query and reporting facilities (Roberts 1993a). The emphasis is often on administrative, rather than scholarly information, which is typically represented in a simplified manner, so as to allow efficient indexing and retrieval of basic data. Consequently, these systems failed so far to gain wide acceptance among curatorial staff and researchers, and, as a rule, are not available for use by museum visitors.

In response to this situation, several initiatives, from single institution systems to international standardisation efforts, have attempted to tackle the complexity of museum information at a conceptual level, and thus provide the ground for systems better suited to a broader range of museum functions. In the course of developing a semantic model of material culture for the Benaki Museum information system (Christoforaki et al., 1992; Dallas, 1992b; Constantopoulos and Doerr, 1993), we came across several aspects of complexity that, on the whole, are not addressed well by existing museum documentation and collection management applications.

20.2a. Specialisation

The Benaki Museum owns a very heterogeneous collection of objects, ranging from figurines, icons and prints to furniture, pots, coins, textiles, costumes and jewellery. While all museum objects share a subset of common traits (e.g., their inventory number, accession date and common object name), specific classes of museum objects need to be assigned additional traits. For example, for objects that can be identified as representations (e.g., dolls, figurines, pictures, photographs) it is necessary to record their figurative subject; correspondence letters from an archival collection have a sender, a dispatch date and one or more addressees; for prints, it is necessary to specify the

names of the engraver and the printer; coinage is characterised by mint information, and so on.

The specialisation-generalisation relationships between classes of museum objects collectively define a class hierarchy. Subclasses inherit the traits of their parent class, and possibly also the value. The traits of specific subclasses are, naturally, important for the definition of objects belonging to them; as a result, it is not possible to capture the essential description of heterogeneous objects just by listing their common attributes.

Besides, specific objects or classes of objects, such as prints displaying a portrait, should be augmented by additional traits from more than one «superclass»: in this example, the name of the sitter. Since material culture can be described on the basis of at least the three essential dimensions of form, function and meaning (or subject), it is common to find classes (or individual objects) belonging to more than one superclasses, by means, respectively, of a multiple specialisation or multiple instantiation relationship.

20.2b. Part aggregation

Another issue, concerning the description of many museum objects, is part aggregation: apart from a global attribute set, adequate description of composite objects such as costumes requires the specification of named object parts (e.g., a vest, shoes, headgear), which should be identified and described in their turn, according to a variable set of pertinent traits. Part aggregation is also common with objects in which parts do not have an administrative identity for the museum: for example, a traditional post-Byzantine head ornament, composed of several buckles, chains, coins and beads, each requiring separate description according to its respective classification within the object class hierarchy.

An adequate account of part aggregation should also preserve relational information about the structural relationships between (physical or conceptual) object parts. For example, the formal description of a painting should account not just for the presence or absence of image parts (subjects, motifs), but also for their relative position in the image field, so that meaningful questions about iconographic structure can be asked (Dallas 1992a).

20.2c. Temporality

Most historical information concerning museum objects, from the objects' creation to changes in ownership and form, is situated within time. Yet, the date of events concerning cultural objects cannot always be determined exactly and is regularly expressed by means of inprecise textual estimates rather than numeric values; often what is known is only that an object was made after a certain date, within a certain time interval (e.g. mid-5th c.BC) or before the creation of another object. Besides, the states which museum objects undergo

have a proper duration, and therefore should be characterised by a time interval rather than point measurement; the bounds of this time interval may also be inexact, in the sense suggested for point measurements above.

20.2d. Spatiality

Space is fundamental to our knowledge of object histories. While the place where an object was made should be differentiated from the place where it was found or last attested to be in use, often the distinction cannot be made in practice, notably due to lacunae in the object's documentation. Besides, often what is available is only the general area of origin of an object rather than its exact provenance.

Places recorded in relation to museum objects are derived from the domain of historical geography. Places, sites, features of natural geography, areas and countries belong not only to the coordinate system typically recorded and analysed by means of Geographic Information Systems (e.g., Lock and Harris, 1992), but also to a symbolic system of geographic inclusion, adjacency or overlapping relationships. Place names introduce a new layer of complexity, since the same name may be attested in use for different geographic entities, and the same entity may be designated by different names, according to chronological period, user or context.

20.2e. Conceptual relationships

Material culture objects often have a conceptual component distinct from their physical description. This is especially true of iconographic themes, represented in figurative art, and of literary works, represented in books and manuscripts; the description of the conceptual entity is independent from its material support, i.e., the museum object on which it occurs.

Besides, museum objects may belong to abstract *composite* objects. For instance, a particular popular garment belonging to a museum collection may belong to the wedding costume of a particular place; it would be useful to know if the museum can reconstitute an artificial wedding costume of that place from existing objects in its collection, even if they do not belong together, given their context of accession.

In the broader domain of describing object histories, the relationship between objects, people, places, events and concepts is generally recognised as an important one, and indeed is explicitly dealt with in current models of museum information such as the CIDOC Data Model and the UK Museums Database Model (Roberts 1993b).

20.2f. Partial and missing data

An attribute value in a data base containing information on cultural objects is often hypothetical or unknown. In the former case, the degree of uncertatinty should be identified, together with the *warrant* on which the information depends. In the latter case, the following types of missing values may be defined (Cheetham and Haigh 1992); the last two concern data base systems that are not in normal form, which, however, are common in practice:

1. The attribute has not been recorded as yet;
2. The attribute was not visible during the examination of the object;
3. The attribute belongs to a part of the object which is now lost; and,
4. The attribute is not applicable to the current object.

The differentiation between these types of missing values is necessary to ensure the correctness of queries using summary functions and for the effective management of data resourcing. It goes without sayng that the absence of a certain trait, e.g. a decorative motif, should be clearly differentiated from the absence of information concerning its value.

20.2g. Subjectivity and context dependency

An important part of museum information, appearing in sources such as documentation records and printed catalogues, does not concern neutral data but rather *beliefs* concerning museum objects, their style and function, and their interrelationships. It is remarkable that even attributes commonly agreed to belong in the minimal inventory record, such as artist, date or provenance could not be called objective facts, but are clearly opinions expressed by scholars on the basis of historical evidence, stylistic analysis or, sometimes, mere flight of fancy.

These opinions may be seen as classifications, connected with the objects' form, style, function and (figurative or symbolic) content. It has been noted that such classifications cannot be handled adequately by traditional data bases, but require a knowledge-based component (Rold 1990). Equally, object names and terminologies cannot be expressed as simple facts, since they depend on cultural context and scholarly tradition. For example, the same item of female costume may have different local names in different village communities; the appropriate local name should be used for each object according to its provenance. Named periods, such as "Iron Age", correspond to different time ranges, depending on the provenance and culture to which an object belongs.

20.2h. Multimedia and textual data

A cultural heritage information system, automated or manual, consists not only of formatted data, but also of large quantities of text, photographic documentation, handwritten notes and, less often, sound and video. While conventional DBMS provide well-tested facilities for the management and retrieval of formatted information, extended machanisms are necessary to allow equal flexibility with textual and multimedia data. Dynamic, stream-based data such as video and sound, which can be of primary importance for the effective precentation of cultural information, introduce yet another layer of complexity.

Alternative strategies are available in order to develop information systems modelling adequately these complexities of the material culture domain. In the case of the Benaki Museum, a cultural documentation system was developed, implementing directly a semantic model of material culture information and storing, in the prototype version, a few dozens of object descriptions and histories, together with textual and pictorial documentation (Dallas, 1992b; Christoforaki et al.. 1992). The application, codenamed MITOS/CLIO, is based on an efficient semantic object-oriented DBMS already tested in another domain, which supports multiple instantiation and multiple specialisation relationships, part aggregation, unlimited level metaclasses, and dynamic schema redefinition (Constantopoulos and Doerr, 1993). The way categories (classes) and their instances (museum objects, other real-world entities) are represented in MITOS/CLIO blurs the distinction between data structure and data content, typical of traditional documentation systems. This allows far greater flexibility and precision in modelling reality, but makes it more difficult to adhere to external standards without losing some of the expressiveness in data representation.

At an inter-institutional level, Bearman suggests that a semantic model of material culture could be used to post-coordinate existing museum information systems, by providing mappings of data elements to standard semantic representations, using some form of text-tagging mechanism (Bearman, 1994). The approach of post-coordinating departmental databases, albeit in the context of formatted data, is already followed in the information system of the National Museums of Denmark (Rold, 1990). This solution should provide a standard mechanism of linking heterogeneous systems, and fits with developments in the field of international standards for the interchange of museum information (Perkins, 1993). It remains to be seen, however, how easy it will be to post-coordinate systems developed according to possibly widely differing data models, and whose «semantics» are implicit in using a software application rather than being explicit in the data structures of the DBMS.

2.3 MUSEUM INFORMATION SYSTEMS SHOULD FULLY UTILISE EXISTING INFORMATION

The systematic collection, organisation and retrieval of information is sometimes considered to be a novel aspect of museum work. Yet the compilation of inventory ledgers is almost synonymous with curatorship since the early days of collecting; the typical organisation of museum collections within hierarchical schemes (on the basis of form, function or contextual evidence on the associations between objects) is clearly an information management operation, since physical arrangement in galleries and stores implicitly forms the primary means of accessing the objects of a collection. The physical arrangement of collections in the archaeological museums of the early 19th century represent, in fact, cultural classifications of artefacts. The concern with the conceptual organisation of the subject domain of material culture, illustrated by the thesauri and terminological reference works of modern cultural documentation, finds early parallels in works such as Cesare Ripa's *Iconologia* and, considerably later, in the literature of evolutionary archaeology of the 19th century.

Going back into the published record of museums of archaeology alone, from Winckelmann to the present, we will appreciate their central role in the advancement of knowledge; in fact, this record is a panorama of the changing nature of archaeology, ranging from the idealist *Altertumswissenschaft* of the 18th century to the philological approach and the great excavations of the 19th, the typological method of the Scandinavian school, the anthropological and psychoanalytical interpretations at the turn of the century, the Morellian elements and the basic forms of Woefflin, and the recent development of processual, post-processual, structuralist and symbolic approaches.

Contrary to some other domains, information collected about museum objects does not decrease in value or utility with time. Whether it concerns the history of the object in the museum's custody or the opinions expressed in the past about the object's creation, use and cultural setting, the information gradually accumulating in fact enhances the intrinsic value of the museum's collections. The numerous publications of museum material, ranging from scholarly catalogues to exhibition guides, monographs, articles and synthetic works, constitute a valuable information resource. At another level, manual records, curator's notes and anecdotal information remain an interesting source of information on museum objects, for curators and others alike.

In a critique of the current state in museum information systems, it has been stressed that «the crucial thing will always be the data. You can't create new exciting constellations or contexts unless the data are available» (Wanning 1993: 31). One cannot fail but wonder with Bearman (personal communication) how much effort is spent within museums in massageing the same item of information into different, successively «better» inventory records, with the supposed benefit of standardisation and the certain drawback of losing both the nuances of meaning intended by the original author and,

often, also the context of the source document. At the same time, the wide realm of paper-based cultural knowledge remains inaccessible to the information system. Instead of adopting a normative approach to standardisation in museum information, which assigns «second class citizen» status to older, textual information, an effort should be made to create the indexing mechanisms which will allow the integration and effective retrieval of such information within the unified museum information system.

Experiments in using natural language querying, supported by full text indexing and an «information weighing» mechanism, gave promising results with two text bases regarding sculpture from Delos and the sanctuary of Delphi respectively (Guimier-Sorbets and Joquet, 1991; Guimier-Sorbets, 1993). The usefulness of a hypertext approach is also obvious in allowing access flexible access to linear long streams of text. Full-scale tagging of document structure should, however, not be underestimated as a complementary access mechanism (Smith, 1992). This would allow the identification of local context for hypertext links and the preservation of semantic relationships that would be lost if the information was transcribed as formatted data. In fact, the adoption of SGML by the Computer Interchange of Museum Information consortium will probably lead to a unified framework for tagging both formatted and free text museum information. Nevertheless, the lack of integration between full text retrieval, hypertext and traditional DBMSs has restricted so far the use of text in automated museum documentation, despite its recognised primacy in traditional, paper-bound documentation and cultural research.

20.4. SCHOLARSHIP AND COMMUNICATION IN MUSEUMS SHOULD BOTH BE SUPPORTED BY A UNIFIED INFORMATION SYSTEM

While the bulk of computerised museum information is buried in traditional DBMS, intended for internal use, the *navigation* paradigm of accessing information is increasingly used to support the educational and public mission of museums. Navigation, it is argued, the capacity of retrieving information by forming chains of associated units rather than by accessing sets of data satisfying some explicit criterion, fits better the way in which visitors are used in experiencing museums. Putting the user in control of the reading process, by allowing him or her to move within the information realm according to their particular interests, is claimed to ensure far better retention of information than «passive» modes of communication. While these claims are yet to be proven within the museum context, it is clear that interactive multimedia - and its more sophisticated variant, hypermedia - are fast becoming a standard new means of communication with the museum visitor (Hoffos, 1992; Perrot, 1993).

The great majority of interactive multimedia exhibits in museums are so far based on stand-alone applications, not linked with an information system. A case in point is the successful exhibit presenting the entire collection on

display at the National Gallery in London, now available also as a CD-ROM. Although the application allows navigation through what appears as dumb hypertext links, considerable amount of processing takes place in the background, so that data and images stored and indexed by a custom data engine could be retrieved efficiently. The data are, in this case, entirely tied to application code, and the updating of information is a batch process, planned to take place every few years (Ellis, 1991).

For most museums already using computers for documentation, the ad hoc development of interactive multimedia applications cannot be justified. Firstly, the collection and structuring of material culture data involves clearly an enormous amount of effort; this, alone, is a good reason why such information should be stored in an information repository, so that it may be reused in all areas of museum practice as necessary (Dallas, 1992b). Secondly, for museums planning more than occasional involvement in interactive multimedia, the use of an information system to manage the data will ensure easier maintenance of existing interactive applications. Thirdly, it will arguably lead to the development of more consistent and predictable hypermedia applications, since the data will be already structured according to an explicit schema. Fourthly, some institutions already store large amounts of pictorial, textual and formatted information in data bases, and the use of this information for multimedia, rather than its collection from scratch, would be highly desirable.

Wanning noted that

> ...the traditional way of registering artefacts is an obstacle in finding new ways of interpretation. ... Without producing new information in a formalised form, we will not be able to disrupt traditional interpretations, not even with the latest technological inventions at our disposal (1993: 31).

In the context of using information technology, this statement is equally valid for curators using an internal documentation system as it is for visitors using an interactive multimedia exhibit. In fact, both scholarship and communication require far richer information depth than is afforded by current museum information systems; while different user intefaces will probably be still necessary, a radical change in the direction of richer information support would benefit both functions.

It may be argued, also, that support for communication with the museum public depends equally on supporting associative access to information, provided by the hypermedia approach, as is support for scholarly research in material culture. Indeed, another criticism against the current generation of collection management systems is that they impose a frame of mind - based on answering fixed pre-defined queries - that is foreign to the predominant mode of material culture research - based on contextual, agglomerative incorporation of facts into knowledge. While the truth is probably somewhere in the middle, the capability of getting easily at related information afforded by museum information systems supporting the navigation paradigm (while not losing the

ability of asking direct questions) should be welcomed by museum curators, researchers and visitors alike.

An evolutionary approach to this need has been followed by the Hypertext Interface for Information (HIFI) project, partly supported by the Esprit programme of the European Commission (Garzotto et al., 1993). HIFI uses a version of the Hypertext Design Model (HDM+) in order to map data from existing multimedia and relational databases on a hypertext front end. The Benaki museum *Gold of Greece* demonstrator for HIFI was developed by Epsilon Software (Greece). While the application provides real-time access to a relational data base representing a virtual exhibition of Greek jewelry through the ages, the user is given the impression of using a hypermedia application, navigating from a jewel to the techniques used for its construction, other jewels employing similar techniques, their provenance, iconographic themes, and so on. Two levels of hypermedia access are provided, one for visitors and one for researchers, the latter dispensing with basic encyclopaedic information (e.g., the definition of techniques or jewel types) but including longer scholarly texts and bibliographic references. Yet, the data are updated directly at the relational database level, the hypertext front-end being read-only (Dallas and Garzotto, 1993).

The current separation of interactive multimedia exhibits from the museum information system proper is due, mostly, to the fact that industrial strength information systems capable for supporting the navigation paradigm (hypertext engines, object-oriented DBMS, knowledge-based systems) and for storing the multimedia data required for interactive exhibits (images, video, sound) have been so far the province of the «bleeding edge», somewhere between the realm of academic research and vapourware. This situation is, however, changing fast. Relational and object-oriented data base management systems already in the market promise full support for multimedia objects. Current thinking in the European Commission sees multimedia data bases as a technology promising «to have a huge market, comparable to the old mainframe market» (European Commission, 1994: 17). The technology should support management of copyright, of capital importance for pictorial information, as well as export facilities to authoring and publishing environments. Museums planning to automate at this stage, or those wishing to include a strong interactive multimedia component in their communication strategy, should take note.

20.5 THE OBJECT LIFE CYCLE REVISITED

Starting from an object's history, material, construction, design and function, Fleming (1974, quoted by Pierce, 1992: 267, 270) identifies four stages in material culture research:

1. Identification, concerned with the factual description of the object;

2. Evaluation, i.e., the elicitation of judgments, based on its comparison with other objects;
3. Cultural analysis, i.e., the use of contextual information to relate the object with its culture; and,
4. Interpretation, i.e., the assignment of significance to the object, based on the values of present cultures.

Three main points, concerning museum information systems, were raised in this paper. Firstly, that they should provide adequate support for the complexity of museum information; secondly, that they should provide access to existing, currently paper-bound information; thirdly, that they should cater equally for scholarly research as for communication with the museum visitor. In fact, what these points amount to is a single statement: museum information systems should cater for no less than the full object life cycle, from identification to interpretation.

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