Museum Informatics and Information Infrastructures Supporting Collaboration across Intra-Museum Boundaries

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Abstract

This paper examines the development of an information infrastructure involving collaborative technologies at the Spurlock Museum, a museum of world history and culture at the University of Illinois. It details a socio-technological system that was designed to pack and re-locate 45,000 artifacts across campus to a new museum facility. It addresses the question of how the information infrastructure of the Spurlock promotes collaboration among the various departments at the museum working on this move and encourages the sharing of common data resources across internal museum boundaries.

Introduction

A new and very important area of study for information professionals working in museum environments today focuses on the structure and use of information. The extensive use of new media in museums has resulted in an upsurge in data generation and analysis (Jones-Garmil, 1997; Thomas & Mintz, 1998). However, studies are just beginning to be performed on the impact that this phenomenon is having on museum infrastructures and social systems (Rayward, 1998). The specific aspect that this paper discusses is the implementation and use of an information infrastructure at the Spurlock Museum at the University of Illinois to facilitate the inventory and packing needed for the re-location of the museum's entire collection of 45,000 artifacts to a brand-new facility currently under construction. In addition, we will examine the influence this infrastructure has had on the way the museum professionals at the Spurlock collaborate in their daily tasks.

Information Infrastructures and the Spurlock Museum

The development of information infrastructures represents an area of study of vital interest to information scientists. Many characteristics of information infrastructures have been identified and analyzed; information infrastructures have been recognized as organic structures that evolve along with the organization or society they support, defining it as much as they are defined by it (Star and Ruhleder, 1996). They tend to become such an inherent part of any organization that they cannot be separated from the environments in which they reside; therefore any study of information infrastructures must examine them from multiple perspectives, including both social and technological systems, in order to consider all possible interpretations (Bowker, 1996).

Since 1997, we have been analyzing the implementation of information infrastructures at the Spurlock Museum, a museum of world history and culture at the University of Illinois; this is a work in progress. We are currently investigating how such infrastructures allow museum professionals to collaborate and share data across boundaries within a single museum in order to accomplish a common goal. Currently, the energies of the entire staff of the Spurlock Museum are focused on the task of preparing the museum's collections for the move to a new museum facility, set to open in the year 2001. Each department within the museum naturally has different responsibilities in relation to this goal, yet they all make use of common sets of data about the museum's collections, exhibits, facilities, and so on. By examining how individuals in different departments within the Spurlock Museum share common data to accomplish distinct tasks which contribute to achieving the common goal of moving the museum, we hope to gain a better understanding of how information infrastructures support collaboration within diverse museum environments.

In 1996, the Spurlock Museum received approval at long last from the University of Illinois to construct a brand-new museum facility to replace the museum's current home in the attic of a ninety-year-old building. At this point in time, the museum staff embarked on a massive project to completely re-organize the infrastructure of the museum, redesigning the museum's internal processes so that they focused totally on one goal: the move (Marty, 1999). New technological systems had to be purchased and introduced into the museum. A dedicated database system was installed, designed from scratch specifically to support the new project. Large numbers of undergraduate student workers were hired and trained

for artifact processing and computerized data entry. Arrangements were made with specialists around the university to assist in the exhibit design process. Procedures and systems had to be developed to pack and safely transport the museum's collection of 45,000 artifacts. Moreover, all data generated through these procedures had to be organized and made available through database systems and over the Internet to all participants, whether they worked inside or outside of the museum itself.

The development of this new information infrastructure was influenced by two things: the needs of the museum's social system and the capabilities of the museum's technological system. The new infrastructure had to support such social processes as a complete re-inventory of the museum's collections, the packing and tracking of 45,000 artifacts, and the design of brand-new exhibits and galleries. At the same time, the development of the museum's relational database systems provided the skeletal support upon which the infrastructure could grow, thereby shaping the overall organization of the infrastructure. Once established, however, the infrastructure itself in turn helped define both the social and technological systems in the museum. A specific infrastructure now existed, where none existed before, specifically designed to encourage collaboration through relational database systems. This infrastructure told the many groups and participants involved in the move how to interact, how to collaborate, and how to perform their tasks. As we shall see, the information infrastructure itself has shaped the society of museum professionals working within the Spurlock Museum.

The Organization of the Spurlock Museum

Before beginning our discussion of the museum professionals at the Spurlock and the Spurlock's new information infrastructure, we offer here a brief definition of terms, listing the various Spurlock Museum departments, their roles and responsibilities as they relate to the subject of this paper.

Administration
Administrative duties at the Spurlock are handled by two full-time employees, the museum Director and Business Manager. The Business Manager is assisted by one or two part-time student workers.

Registration
At the Spurlock, the primary responsibilities of the Registration department are those of data analy-

sis and data entry. Two full-time employees, the Registrar and Assistant Registrar, supported by approximately a dozen part-time student workers, control the complete re-inventory of the museum's artifact collections (as well as handling the day-to-day tasks of maintaining ledgers and files, communicating with donors, managing new acquisitions, etc.).

Collections
With the museum closed to the public, the primary duties of the Collections Management department at the Spurlock are to pack, transport, and ensure the safety of the museum's artifacts during the move to the new facility. This department is headed by two full-time employees, the Collections Manager and Assistant Collections Manager, and employs approximately a dozen part-time student workers.

Curatorship
Curatorial responsibilities at the Spurlock Museum are handled by teams of external curators from affiliated academic departments elsewhere in the University. These external curators work with museum staff members in researching the museum's artifact collections and helping plan the new galleries.

Exhibit Design
A team of outside exhibit designers have been hired to work with the museum staff to design and construct the exhibits to be installed at the new facility. Most of their work is done off-site.

Information Technology
The information systems in use at the Spurlock are managed by the Director of Information Technology, assisted by three part-time student employees.

Education
The staff of the education department, which consists of the Director of Education, Assistant Director of Education, and a handful of part-time student employees, are responsible for designing educational programs for the new facility, working with the exhibit designers in planning the new galleries, and developing outreach programs to keep the museum active in the local community even while closed to the public.

Within this context, the primary goal of the museum's information infrastructure is to facilitate communication among these departments in order to ensure as smooth a transition to the new facility as possible.

The Infrastructure of the Packing Process

Rather than present a necessarily superficial overview the entire infrastructure of the Spurlock Museum, we have decided to present a detailed analysis of one aspect of the Spurlock's new information infrastructure: the procedures currently implemented for packing each artifact for transport to the new museum facility. This process is very complex and requires the involvement of virtually every department in the museum, although the primary participating departments are Registration and Collections. The nature of the task requires database systems that encourage collaboration among the participants and facilitate the dissemination of relevant data across divisions within the museum. Therefore, the packing process is itself an excellent microcosm within the museum to study in order to better understand the influence of the information infrastructure on the museum's socio-technological systems.

To move the museum, every single artifact in the museum's collection has to be pulled off display or out of storage and individually processed. Although the actual packing of the artifacts is performed by the Collections staff, a variety of steps must be undertaken by other departments in the museum before each artifact can be packed and sealed. The role of the information infrastructure is to ensure that each participant in the process has access to the data they need when they need it. Moreover, it ensures that the many steps involved in the process are taken in the appropriate order, keeping the process moving forward in a smooth fashion. Thus, the system itself acts as a guide to collaboration, keeping track of the needs and responsibilities of each department involved in packing the museum's collections. We will here examine these needs and responsibilities in turn, department by department.

Registration

The need for each artifact to be individually handled offers tremendous opportunities to the museum staff, and especially to the Registration department, since they have the chance to accomplish a complete re-inventory of the museum's collections (the last attempt at a full inventory having been performed in 1973). Thus, before any artifact can be packed, it is brought into the Registration department for processing by the Registrar and her staff. Registration of artifacts during this re-inventory process is divided into two categories: *in situ* registration and long-term registration.

First, *in situ* registration refers to those activities that must be performed with the artifact present. This includes such activities as measuring, weighing, color identification (the Spurlock uses the Munsell color identification system), and material analysis. In addition, a record for this artifact must be created in the museum's database systems, basic data entry must be performed, proper nomenclature entered, as well as such data as geographic, cultural, and temporal designations. Moreover, any problems of artifact identification (illegible accession numbers, inconsistencies between data records and old ledger files, etc.) are cleared up at this stage in the process. By the end of this stage of the re-inventory process, each artifact will have been clearly identified and duly recorded in the museum's databases.

Second, long-term registration includes those registration activities which can continue without access to the artifact itself (i.e. after the artifact has been packed). The undergraduate students working for the museum spend much of their time going through the accession ledgers, old card files, label copy, archives, and scholar's records finding information related to the artifact and entering it into the system. This information, including such things as related artifacts in other museums and bibliographies listing works where this artifact has been referenced, is then made available through the databases and on-line, where it has proven very valuable to the museum's curators and other individuals working with these records.

Digital Imaging (Information Technology)

The staff of the Information Technology department is taking advantage of the packing process to build a digital image repository containing at least one digital representation of each artifact in the museum's collections. The creation of this database of digital images, available on-line, is an important element of the Spurlock's educational mission, and one that cannot be accomplished once the artifacts have been packed. Therefore, once the Registration department has completed its part of the process but before the artifact is turned over to the Collections department for packing, each artifact is taken to one of two photography stations, where it is photographed (both slides and digital camera images are taken). The digital images (either from scanned slides or directly from the digital camera) are entered into museum's images database, which is relationally linked to the museum's on-line databases. Thus, digital images become available for the curators, exhibit designers, and educators to use in their tasks.

Curatorship

While artifacts are being re-inventoried and packed, the curators planning the new galleries are in the process of finalizing which artifacts in the museum's collections will be on display in the new galleries. It is essential that this decision be made, if at all possible, before the artifact in question is packed. This is because artifacts that will be on display in the new museum are being packed separately from those artifacts that will stay in storage; for those artifacts, the box in which they are packed is intended to be their permanent home in the new facility. Therefore, difficulties arise when objects intended for display are mistakenly packed with objects to be placed in storage (multiple objects are quite often packed in the same box). There are already several cases where boxes will have to be opened in the new facility, a single artifact removed, then the box resealed and replaced in storage with one item missing, simply because an artifact that was intended for storage has had its status changed to display after it was packed. By insisting that the curators finalize lists of artifacts to be placed on display as quickly as possible, the Collections Manager is attempting to minimize the number of such problems. Moreover, the Collections staff is trying to keep artifacts slated for display in the new facility unpacked and available for study by curators, educators, and exhibit designers as long as possible. Thus, the seemingly simple decision of whether an artifact is marked for display or storage has a tremendous impact on the packing procedure.

Education

The staff of the education department is currently developing a series of on-line educational outreach projects intended to take information about key museum artifacts from the museum to the schools even while the current museum is closed to the public. As they work with various specialists designing the projects, they often need access to artifacts before they are packed for research as well as for such special needs as 3D imaging. As with the curators above, the education staff has to work closely with the Collections department to ensure that all required information is available before the artifact is wrapped and sealed.

Exhibit Design

Likewise, the exhibit designers working with the museum staff needs long-term access to those artifacts to be displayed in the new facility. Such artifacts must be handled, mounts considered, rotation schedules discussed, conservation needs assessed, etc. None of this can be done after the artifact is packed.

In order to ensure, as best as possible, that these many concurrent activities occur before the artifact is packed, the Spurlock's information infrastructure tracks the progress of these activities through relational database systems. A series of 'pre-pack checks' are automatically calculated by the computer systems: has the artifact been appropriately re-inventoried, have measurements and weights been entered, is a digital photograph available through the system, have curators finalized decisions about which artifacts should go on display, have educators completed projects requiring physical access to artifacts, and so on. Only once all these 'pre-pack checks' have been confirmed is the artifact marked 'ready to pack' in the primary artifacts database. Note that the final decision as to which artifacts are indeed 'ready to pack' is made in the Registration department, where the Registrar not only double-checks all the pre-pack conditions but has the ability to override the automatic pre-pack checks and force an artifact to either remain in the pre-pack process or jump ahead to the packing process.

As artifacts are marked as 'ready to pack', inventory sheets are generated from the databases and posted either on display cases or storage shelves. These sheets tell the Collections staff which artifacts are ready to be packed. The Collections staff pulls the appropriate artifacts and takes them to the packing stations. A final physical inventory is performed along the way to ensure that the inventory list generated by the computers does indeed match the artifacts being packed that day. Inconsistencies are reported to the Registrar and such artifacts re-enter the Registration department for those problems to be resolved.

Collections

Finally, at this stage, the artifact to be packed enters the Collections packing area, where it is now no longer available to Registration, Education, the curators, etc. Before the artifact is packed, a detailed condition report is filled out on the artifact and entered into the museum's electronic condition reporting database. It is essential that such reports be completed so that a permanent record exists of each artifact's condition immediately prior to packing, so that when a given box is unpacked in the future it is at once apparent whether the condition any artifacts has changed. Once the condition analysis has been completed, the artifact is packed and packing list is generated, listing all artifacts in that given box. One copy of this list is packed with the box itself; a second copy is sent to Registration where the packing data is entered into the museum's packing database system (which

tracks each box, its contents, its location, its handling needs, etc.). From the packing database, box labels, listing the accession numbers of the artifacts packed within the box, are generated and affixed to the box. The box is then moved to a temporary location to await the move to the new facility.

The role of the museum's information infrastructure in this process is to ensure that each department in the museum has accomplished its tasks and has access to relevant data regarding the packing process. Even though each department is working on different tasks in different areas of the museum, the Spurlock's information systems attempt to break these barriers and promote collaboration across boundaries within the museum itself. We turn now to a brief discussion of the individual elements of the system which encourage such collaborative activities.

Collaboration across Boundaries

It is our belief that that which allows such collaboration among the various museum departments involves the use of data elements that can be viewed from multiple perspectives and used in multiple ways yet still retain a degree of integrity, identity, and consistency. In information science, such an element is called a *boundary object*. Boundary objects are defined as *objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites* (Star, 1989; cf. Engestrom, 1990). The use of boundary objects in the museum environment has been studied before, notably at Berkeley's Museum of Vertebrate Zoology (Star & Griesemer, 1989). We believe that we can apply the concept of boundary objects to the semi-directed collaboration observed in the Spurlock Museum.

One straightforward example of a boundary object at work in the Spurlock Museum is that of the artifact record itself. This record, which is available on site from the museum's internal database systems or externally over the Internet from the museum's web site, provides identical data to each observer, yet different users will approach this data in different ways. What the curator expects to see in the record, what the registrar expects should be entered in it, what the exhibit designer expects to learn from reading it, all vary based on the needs of the participants. Yet the very fact that they are working on the same record encourages collaboration not only in achieving the goal of moving the museum but also in improving the quality of individual artifact data records.

A more complicated example, and one related to the packing procedures described above, can be found in the *condition summary,* a brief, one paragraph description of an artifact's current condition generated when the detailed condition report is filled out in the condition reporting database system. This condition summary is referenced by the museum professionals far more frequently than the detailed condition report, due to its size and conciseness. However, each department within the museum that makes use of the condition summary approaches this same piece of data from a different perspective; the data within the record is able to mold itself to the needs of the observing group

Collections

For the Collections Manager, the condition summary serves three purposes. First, it offers a quick glimpse into the stability of the artifact, providing necessary clues for how the artifact should be packed to best ensure the artifacts safety. Second, it provides a concise record of the artifact's condition at the time of packing which can be compared to the artifact's condition when it is unpacked to observe any changes in the artifact's condition. Third, it tells the Collections staff which artifacts will require conservation work, either before they placed on display or within a reasonable amount of time after they are placed in storage.

Curatorship

From the perspective of the curators, the condition summary tells at a glance whether or not this particular artifact can be placed on display. The condition of many artifacts may be too unstable to allow the artifact to be safely displayed or too deteriorated to make the piece exhibit worthy.

Registration

The museum's Registrar must often include the artifact's current condition in reports to the Director, to acquisition committees, etc. The condition summary provides a simple way to incorporate a statement regarding the artifact's condition into any other task. Moreover, the museum's infrastructure uses relational database systems in which the condition reporting database is relationally linked to the Registration system, so that for any artifact and for any report, the artifact's current condition summary can be imported at the touch of a button.

Exhibit Design

The exhibit designers find it necessary to consult the condition summary statement regularly, especially for mounting and installation concerns. The condition of a particular piece of pottery, for example, may necessitate it being placed on its side

rather than being stood upright. Easy access to this brief condition statement is provided to the exhibit designers, who typically work off-site, over the Internet through the museum's web site.

Thus, one piece of abstract data can acquire multiple meanings when viewed from different perspectives. In the process, however, that data element does not lose its integrity nor its purpose in the overall process of facilitating the move to the new museum. In this manner, we have the opportunity to observe how the information infrastructure supports the overall functioning of the museum staff, including multiple museum departments, even from the point of view of one individual data record.

Conclusions

Our interest in this on-going study is to better our understanding of how the Spurlock's information infrastructure provides the Spurlock's museum professionals with a holistic approach to artifact data. Prior to the implementation of this infrastructure, museum staff members did not share data in such a collaborative fashion and certainly did not have a common pool of data resources at their disposal. Over the past two years, we have discovered that all museum departments can benefit from having access to common data records, even though this data may be used in a different fashions in different departments when shared across the museum's internal boundaries. We plan to continue our analysis of the impact this infrastructure has had and will have on the social system in the museum itself. In conclusion, we wish to emphasize the importance of conducting more studies of how data management systems affect collaboration among and between departments within and without of museum organizations. In this respect, the museum world continues to lag behind the library and information science community.

References

Bowker, G. "The history of information infrastructures: the case of the international classification of diseases", in *Information Processing and Management*, 32 (1), 49-61, 1996.

Engestrom, Y. "When is a tool? Multiple meanings of artifacts in human activity", In *Learning, Working, and Imagining*. Helsinki: Orienta-Konsutit Oy, 171-195. 1990.

Jones-Garmil, K. (Ed.) *The wired museum: emerging technologies and changing paradigms.* Washington DC: American Association of Museums, 1997.

Marty, P. "Museum informatics and collaborative technologies", in *Journal of the American Society for Information Science*, 50 (12), in press, 1999.

Rayward, W. B. "Electronic information and the functional integration of libraries, museums and archives",. in E. Higgs (Ed.), *History and Electronic Artefacts*. (pp. 207-224). Oxford: Oxford University Press, 1998.

Star, S. L. "The structure of ill-structured solutions: boundary objects and heterogeneous distributed problem solving", in *Readings in Distributed Artificial Intelligence*. Menlo Park, CA: Morgan Kaufmann, 1989.

Star, S. L. & Griesemer, J. R. "Institutional ecology, translations, and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology", in. *Social Studies of Science*, 19 (1989), 387-420, 1989.

Star, S. L. & Ruhleder, K. "Steps toward an ecology of infrastructure: design and access for large information spaces" in. *Information Systems Research*, 7 (1), 111-134, 1996.

Thomas, S. & Mintz, A. (Eds.) *The virtual and the real: media in the museum.* Washington: The American Association of Museums, 1998.