

Kim H. Veltman

New Roles for Libraries in the Digital Age

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1. Introduction

A revolution is underway. It is inevitably linked with computers, with Internet, Intranet and now Extranet. Much of this is fueled by hype to the extent that one might need to revise the saying from Scripture: many are claimed, but few are chosen (to work). There are many extremes. Some see these developments as a new panacea, acting as technophiles driven to techno-lust. Some have gained fame by decrying the so-called Silicon snake oil¹, while others raise questions whether we can ever afford the process.

With respect to libraries some predict that digitizing collections will make them obsolete. This paper takes a different view. It begins with some anecdotal ball park figures to provide some idea of the magnitude of the changes at hand. A main thrust of the paper outlines ways in which new electronic media can open up new roles for libraries and new relations to museums and education. It challenges an assumption popular in political circles that libraries and museums should be entirely privatized and would be more efficient if they were run as businesses. Some fundamental differences between culture and business are analysed. Some dangers and possibilities are explored.

1000 bytes	=	1 kilobyte
1000 kilobytes	=	1 megabyte
1000 megabytes	=	1 gigabyte
1000 gigabytes	=	1 terabyte
1000 terabytes	=	1 petabyte
1000 petabytes	=	1 petabyte

Figure 1. Basic terms of size in electronic storage.

2. Ball Park Figures

A few simple statistics² provided by Linda Kempster may help to give some idea of the magnitude of the phenomenon. Most of us are familiar with the basic terms of electronic storage (fig.1). It is useful to relate these seemingly abstract concepts to more concrete facts. One megabyte of disk space equals approximately .0423 of a tree worth of paper. One gigabyte equals 42.3 trees worth of paper. One terabyte equals 42,300 trees worth of paper. To take a slightly different measuring stick, there are roughly 499 megabytes in a file cabinet full of paper. It takes 2.1 terabytes or 4,286 file cabinets to fill one football field. It is estimated that in 1996 there are presently 250,000 terabytes of information on-line, or 11,904 football fields full of file cabinets. By 2000, i.e. within four years, it is estimated that the amount of on-line data will increase to 600 petabytes which is the equivalent of 28,569,600 football fields full of file cabinets. We are told, however, that this on-line material will only represent five percent of the actual material which has been scanned. Hence, within four years there will be 12,000 petabytes in digital form which amounts to roughly 571,392,000 football fields of file cabinets or 507,600,000,000 trees worth of paper (fig. 2).

Digital Amount	Physical Amount
1 megabyte	.0423 tree
1 gigabyte	42.3 trees
1 terabyte	42,300 trees
499 megabytes	1 file cabinet
2.1 terabytes	4286 file cabinets
2.1 terabytes	1 football field of file cabinets
250.000 terabytes	11,904 file cabinets
600 petabytes	28,569,600 file cabinets
12000 petabytes	571,392,000 file cabinets

Figure 2. Some basic relations between bytes, trees, file cabinets and football fields full of file cabinets.

Storage Method	Capacity
Magnetic hard disk	375 megabytes per square inch
Hologram	125 gigabytes per cubic inch
Sugar cube	125 gigabytes per cubic centimeter
10 micron ion etching	50 terabytes per cubic inch
3 micron ion etching	190 terabytes per cubic inch

Figure 3. Some new technologies and their storage capacity per cubic inch.

Storage capacities are expanding enormously. In 1950, IBM's Rama C tape contained 4.4 megabytes and they were able to store 50 of such tapes together. At that time 220 megabytes represented the frontiers. Thirty six years later, many of today's desktops are beginning with a gigabyte, i.e. more than four times that capacity and two gigabyte discs are quite common. Such progress has not quite kept pace with the hype. It is sobering to remember that full motion video in uncompressed form requires 1 gigabyte per minute and that the 83 minutes of *Snow White* digitized in full colour amount to 15 terabytes of space. Fortunately new technologies are underway. Holograms, sugar cube storage and ion etching offer a range of new possibilities. Some basic statistics concerning their capacities are listed in figure 3.

3. Libraries

These developments are transforming our libraries in some obvious ways: cataloguing practice, on-line file cards and catalogues, interlibrary loan, and full text retrieval. They are also changing the roles of a library.

Cataloguing

In the past there were basic cataloguing rules such as Anglo-American or the Prussian Instructions which were then interpreted differently by each local library in cataloguing its own collection. Typically a scholarly institution such as the British Library would provide detailed records noting peculiarities in the individual copy, while a small public library might opt for a minimal description of a given book. Some sense of this variety is provided by the RLIN system which allows libraries to provide alternative entries if they wish. The advent of on-line catalogues has, however, introduced a quite different trend. Once a book has been catalogued by a national or major library most other libraries simply adopt that format rather than providing their own independent entry for that book or title. This has the great advantage of establishing a sense of uniformity and standardisation across the system. A drawback is that many individual variants of books are lost in the process.

On-Line File Cards and Catalogues

This automation process has affected users as much as cataloguers. By the 1970's it became the fashion to automate library cards. The University of Toronto Library Automated System (UTLAS) effectively became one of the first automated National

Union Catalogues and now has approximately 65 gigabytes of data. In Washington, the Library of Congress established a Machine Readable Card (MARC) format. This was adopted by the Research Libraries Information Network (RLIN), now known as the Research Libraries Group (RLG), which, in the past few years, has expanded the scope of the MARC format to include archival materials, art (paintings, architecture) and museum objects. RLG has over 100 million records. Significantly the RLG network now includes a number of the major European research libraries and is adding over a million titles from Europe each year. The MARC format is also used by the OnLine Computer Library Catalogue (OCLC, a network linking universities mainly in the United States), which now has over 30 million records online. In the United States, there are also regional networks such as the Washington Library Network (WLG) on the west coast and those linking multi-campus universities notably California (the MELVYL System) and Colorado (CARL).

In addition, the Library of Congress has championed the use of a protocol for the interchange of electronic information (Z 39.50) a standard which has been adopted by over 200 libraries mainly in the United States and Europe for their World Wide Web sites. This protocol has had a considerable impact on the museum world through organizations such as Computer Interchange of Museum Information (CIMI). While criticized by some for its limitations in terms of high programming, Z 39.50 is destined to become more important because IBM and others` have been working on GIS extensions to this basic format.

In Europe, two alternative approaches are emerging: one fee based, the other to provide universal Online Public Access Catalogues (OPACS). In Britain, for example, a fee based system originating from the British Library (BLAISE) dominates the scene. In France, a project for a national PanCatalogue is underway which will require a subscription. The Netherlands and sections of Northern Germany are connected by the Pica System which is subscription based. Meanwhile, other parts of Germany such as Bavaria have their regional catalogues accessible free of charge on the World Wide Web (www). This is also the case with countries such as Austria and Norway which have an on-line national catalogue freely available today. Sweden will soon be added to this list. In addition there are hundreds of libraries on line via telnet at present, many of which are planning to switch to www. At the European level there is an initiative to create a Gateway to European National Libraries (GABRIEL). The European Commission is supporting a number of initiatives which support these developments, notably the ONE project which aims to provide a common interface for all the major European libraries.

At the world level the G7 countries have also included libraries as one of their eleven pilot projects, namely, number 4: Bibliotheca Universalis. Thus far, this project headed by France has focussed on standardising author names in the national libraries of Britain, France, Belgium, Spain and Portugal. Meanwhile, Japan has its own approach to the electronic libraries project and has been developing a prototype which includes High Definition Tele-Vision (HDTV). Major corporations are also entering the field. IBM's Digital Library Project offers a comprehensive approach to these problems. Xerox, through its research facilities in Grenoble is developing an alternative set of solutions.

The consequences of this automation in file cards are already enormous, although it will take years, perhaps decades before the full impact thereof is felt. In the past one was restricted largely to the contents of the library in which one happened to work. The spread of published library catalogues changed this somewhat but ironically these were typically only available in the greatest libraries where there was already a great range of books. The evolution of electronic catalogues which are standardized means that one can now check the locations of a book from the comfortable location of one's computer terminal in one's office, at a library or at home. One can search for copies around the world while sitting at one's desk.

Access to on-line library catalogues is but one dimension of this process. National book catalogues and publishers catalogues such as *Books in Print* are also becoming available in electronic form. So users can interchangeably search for books and explore whether they wish to buy them for their own collections.

Interlibrary Loan

In the past it took up to a year to order a book by interlibrary loan. As the networks expand, interlibrary loan is increasingly being automated such that a user can enter their identification number and order a book from their desktop.

Full Text Retrieval

Most of us are aware that full text versions of major works such as the *Bible*, Dante's *Divine Comedy* or the *Works* of Shakespeare are already available on-line. Initiatives such as the Gutenberg Project aim to make the major writings of western culture freely accessible in electronic form. Less well known are the growing electronic repertoires. In France, there is the database of French classics which has a mirror site in Chicago. In Britain, there is the Oxford Text Archive which is linked with the Text Encoding Initiative (TEI). In the United States a Coalition for Networked Information is speaking of entering ten million books in full texts.

While some view such projects as futuristic, the Bibliothèque Nationale de la France is presently engaged in scanning in 400,000 books in full text versions. IBM, through its Digital Libraries Project, has scanned in 10 million images at the EDO Museum in Tokyo, is scanning in 50,000 manuscripts at the Luther Library in Wittemberg and, thanks to funding from Rio di Janeiro, has begun scanning in the full texts of the 150,000 manuscripts at the Vatican Library. At present there are only eight test sites in the world for this particular project, including one in Canada, namely, the Perspective Unit. Even so glimpses of where this is leading are already available. The Royal Libraries in the Hague and Stockholm have each made 100 pages of illustrated manuscripts available. The Vatican Library has made several hundred pages available through an on-line exhibition at the Library of Congress while the the Bibliothèque de France has made available 1000 pages of illustrated manuscripts on-line. The French examples are particularly striking because they illustrate the potentials of tracing thematic

developments such as papal visits or royal coronations over time. Such potentials will be greatly enhanced as they are co-ordinated with electronic versions of specialized classification systems such as Iconclass or the Art and Architectural Thesaurus.

Roles of Libraries

Eventually all books now in manuscript and printed form will be translated into electronic form and made available on-line. This process is analogous to that which took place after Gutenberg introduced printing to the West, when everything had to be translated from written to printed form. That process took nearly two centuries. No one knows how long the electronic equivalent will take: much shorter or even longer? In a sense it does not matter. Already now and increasingly in the future the roles of libraries are changing as a consequence of these developments.

In the past libraries were places for storing books but it was primarily their role as places for reading books which gained attention. In addition great libraries served as an important meeting place for scholars. A drawback was that scholars had to travel long distances to reach a major library and spend considerable resources while they lived in the city in which the library was located. One of the motivations behind IBM's Digital Libraries Project is to save scholars the cost of travel and accommodation by providing them with manuscripts and published rare books on demand. If this model were pushed to the limit, then libraries might in future be reduced to specialized storage houses.

There are several reasons why libraries are likely to remain important in spite of or perhaps because of digitiation. Firstly, some aspects of books and manuscripts cannot be conveyed through electronic versions or even facsimiles, such as the manner in which a book is bound; its feel, whether it is well worn or almost untouched. While such aspects can theoretically be replicated in holographic or three-dimensional laser images, historians of the book and publishing will need continued access to the originals.

Second, although it is foreseen that there will be universal access to the Internet in developed countries, it is generally assumed that this will entail relatively slow speed connections. The notion of ATM at everyone's desktop is still a long way off and may not happen at all. Meanwhile, experts have suggested that ATM or analogous high speed connections will evolve in the context of service centres³.

Given the traditional role of libraries as focal points for their communities, they are ideally suited to take on the role of such service centres. While it may be impractical to connect every home with ATM, it is perfectly feasible to connect all the major libraries and even the lesser libraries throughout the country. Figure 4 provides some idea of the scope of such an enterprise. Linking 5060 institutions in a province with high speed connections is simple compared to the challenge of trying to provide over 10 million

Number	Kind of Library
410 ¹	Public

¹ With 1100 points of presence.

75	University
3700	Elementary School
775	Secondary School
c.100	Private School
5060	Total

Figure 4. Approximate number of libraries in the province of Ontario.

individuals with a direct high-speed connection. Connections within the institutions might in turn be at different speeds. Public and university libraries might be at OC12 speed, whereas schools might be linked at T1 speed.

The manuscripts and rare books which are presently being scanned in, are typically 30-50 megabytes per page. Paintings range from 50-100 megabytes at the low level to 1.4 gigabytes per square meter at the high level. On regular modems these would be entirely unwieldy. On the other hand, reading rooms with high-speed connections would make consultation of such works entirely feasible. Lecture rooms with high speed connections would make feasible new kinds of on-line lectures. Such facilities would in turn serve to revitalize the role of libraries as a focal point in the community. Students in schools could go their local public and/or university libraries in order to consult not only books but also the latest high level technologies.

For example, companies such as Infobyte (Rome) are using virtual reality to reconstruct major historical sites such as the entire Vatican complex. Thus far this includes only Saint Peter's Basilica, a version of the historical Basilica, and most of the *Stanze* of Raphael. There are plans to include the Sistine Chapel, Vatican Library and the Vatican Museums. As noted earlier IBM is scanning in the full text of the manuscripts of the Vatican Library. Hence it will be possible to walk through the Vatican in virtual reality, find a particular book and then consult the contents of that book.

In future, other possibilities are feasible. The present arrangement of the library is recent. The position of the collection has changed over the centuries. Using the old catalogues and other documentary evidence, it is possible to reconstruct the former states of the Vatican library and museums. Potential visitors could then experience the historical development of this and other famous libraries in a simulation of time travel. To achieve this will require a great deal of scholarly study and interpretation. As the technologies become available it would therefore make sense to integrate such reconstructions within the school curriculum with the high level versions being done at universities. This will result in a whole new corpus of materials to collect, archive and to display, for which libraries are naturally suited. Among the new activities for libraries in the future can be to showcase such reconstructions in a high speed networked environment such that readers can make cross-cultural comparisons on-line, while at the same time having access in electronic form to more traditional forms of documentation, notably, books, manuscripts and archival materials.

In the past, libraries were much more than collections of books. A major collection such as that of the Duke of Lower Saxony (Herzog August Bibliothek, Wolfenbüttel) contained books, prints, paintings and scientific instruments. Over time there was an increasing specialization whereby each type of object found its way into separate institutions, libraries for books only, drawing cabinets for drawings, art galleries for paintings and history of science museums for scientific instruments. In the process it has frequently been forgotten that all of these seemingly disparate objects are reflections of a single culture. The advent of networked systems introduces new possibilities for re-integrating these disparate strands. This raises new roles for libraries as venues for integrating the resources of other institutions such as museums and offering special resources for education and training.

4. Meta –Data

Recently there has been increasing attention to the term, *meta-data*, which is often used as if it were a panacea, frequently by persons who have little idea precisely what the term means. In its simplest form, meta-data is data about data, a way of describing the containers or the general headings of the contents rather than a list of all the contents as such. Some of the interim measures listed above could be seen as efforts in this direction.

More specifically there are a number of serious efforts within the library world. The Library of Congress is heading work on the Z.39.50 protocol, designed to give inter-platform accessibility to library materials. This is being adopted by the Gateway to European National Libraries (GABRIEL) and the Computer Interchange of Museum Information (CIMI) group.

A number of meta-data projects are underway. For instance, the Defence Advanced Projects Agency (DARPA), in co-ordination with the National Science Foundation (NSF), NASA and Stanford University are working on meta-data in conjunction with digital library projects. DARPA itself is working on Knowledge Query Markup Language (KQML) and Knowledge Interchange Format (KIF). The Online Computer Library Centre (OCLC) has led a series of developments in library meta-data (Dublin Core, Warwick Framework). In essence these projects have chosen a core subset of the fields in library catalogues and propose to use these as meta-data headers for access to the complete records. An alternative strategy is being developed by the Institut für Terminologie und angewandte Wissensforschung (Berlin). They foresee translating the various library schemes such as the Anglo-American Cataloging Rules and the Preussische Regeln into templates using Standardized General Markup Language (SGML). This approach will allow interoperability among the different systems without the need for duplicate information through meta-data headers.

Each of the above initiatives is laudable and useful in its own right. They will all contribute to easier access to materials and to efficiencies in that users can sometimes rely on overviews, excerpts and abbreviations rather than needing to consult the whole database in the first instance. But all of these remain short term solutions in that they do not solve questions of how one determines variant names, places etc. Meanwhile some

members of the computer industry continue to argue that the troubles surrounding the Internet are merely a passing phase; that although connectivity and search engines and were initially too slow, as soon as these hindrances are resolved, all will be well. While rhetorically attractive, such reassurances are not convincing for several reasons.

First, there is a simple question of efficiency. A local database may have only local names. The name for which one is searching may only exist in specialized databases. Going to a typical database does not guarantee finding the name. Going to all databases just to identify the name is highly inefficient. The same problem applies to subjects, places, different chronological systems etc. It applies also to different media. If I am looking for one particular medium such as video then it makes sense to look at sites with video, but not all sites in the world. Searches to find anything, anywhere, anytime should not require searching everything, everywhere, every time. As the number of on-line materials grows apace with the number of users, the inefficiencies of this approach will become ever greater.

A second reason is more fundamental. Even if computer power were infinite and one could search everything, everywhere, every time, this would not solve the problems at hand. Names of persons and places typically have variants. If I search for only one variant the computer can only give me material on that variant. If, for example, I ask for information about the city of *Liège*, the computer can at best be expected to find all references to *Liège*. It has no way of knowing that this city is called *Luik* in Dutch, *Lüttich* in German and *Liegi* in Italian. This is theoretically merely a matter of translation. But if every place name has to be run through each of the 6,500 languages of the world each time a query is made, it would be an enormous burden to the system. And it would still not solve the problem of historical variants. For instance, *Florence* is known as *Firenze* in modern Italian but was typically written as *Fiorenza* in the Renaissance. It would be much more practical if every advanced search for a place name went through a standard list of names with all accepted variants. Such a standardised list acting as a universal gazetteer needs to be centralised.

The same basic principle applies to variant names of authors, artists etc. If I have only one standard name, the computer finds that name but it can never hope to find all the variants. Sometimes these variants will be somewhat predictable. Hence the name *Michel de France*, will sometimes be listed under *de France*, sometimes under *France*, *Michel de*. In other cases the variants are more mysterious. Jean Pélerin, for instance, is known as Viator, which is a Latin equivalent of his name, but other variants include Le Viateur, and Peregrinus. No simple translation nor even a fuzzy logic programme can be expected to come up with all the actual variants of names. Needed is a central repository to ensure that these variants can be found efficiently. In the case of artists names, for instance, Thieme-Becker's *Allgemeine Künstler Lexikon* offers a useful starting point, as do the great library catalogues (e.g. National Union Catalogue, British Library and Bibliothèque Nationale). These lists need to be collated to produce one authority list with all known variants, much in the way that the Getty found it needed in the case of its (in house) Union List of Names (ULAN). The problem applies also to subjects,⁴ as anyone who has tried to find things in foreign versions of *Yellow Pages*, will know. In Toronto, for

example, a person wishing to know about train schedules will find nothing under *Trains*, but needs to look under *Railroads*. A person looking for a paid female companion will find nothing under *Geisha*, *Call Girl* or *Prostitute*, but will find 41 pages under the heading *Escort Service*.

Hence a fully distributed model for housing collections may be extremely attractive because it means that museums, galleries and other cultural institutions can remain in control of the databases and information pertaining to their own collections. The disadvantage is that there are already hundreds and there will soon be tens of thousands of individual repositories and if every user around the world has to visit all of these sites for every search they do, this approach will become hopelessly inefficient.

An alternative is to link this distributed model of individual collections with a centralized repository for meta-data. The basic idea behind such a repository is to use the methods established by thousand of years of library experience as a general framework for searching libraries, museums, galleries and other digitized collections. This centralized meta-database will have three basic functions:

First, it serves as a master list of all names (who?), subjects (what?), places (where?), calendars, events (when?), processes (how?) and explanations (why?). This master list contains all typical variants and versions of a name, such that a person searching for Vinci, Da Vinci or Leonardo da Vinci, will be directed to the same individual.

Second, this master list contains a high-level conceptual map of the parameters of all major databases in cultural and other institutions. Hence, in the case mentioned above of the user searching for Chinese art of the Han dynasty, the master list will identify which databases are relevant. Recent initiatives in site mapping and content mapping will aid this process.

Third, this master list of names and subjects is linked to indexes of terms (classification systems), definitions (dictionaries), explanations (encyclopaedias), titles (bibliographies), and partial contents (reviews, abstracts, and citation indexes). Thus this centralized database effectively serves as a digital meta-reference room which links to distributed contents in libraries, museums, galleries and other institutions. This process of contextualisation of otherwise disparate information enables the centralized source to act as a service centre in negotiating among distributed content sources.

Libraries have long ago discovered the importance of authority lists of names, places and dates. Indeed, a number of international organizations have been working in this direction during the past century, including the Office Internationale de Bibliographie, Mundaneum, the International Federation on Documentation (FID⁵), the International Union of Associations (UIA⁶), branches of the International Standards Organization (e.g. ISO TC 37, along with Infoterm) as well as the joint efforts of UNESCO and the International Council of Scientific Unions (ICSU) to create a World Science Information System (UNISIST). Over 25 years ago, the UNISIST committee concluded that: "a world wide network of scientific information services working in voluntary association was

feasible based on the evidence submitted to it that an increased level of cooperation is an economic necessity".⁷ Our recommendation is that this world-wide network should include both cultural and scientific information.

As a first step one would combine the lists of names already available in RLIN, OCLC, BLAISE, PICA, GABRIEL, with those of the Marburg Archive, the *Allgemeine Künstler Lexikon*, *Iconclass*, the Getty holdings (ULAN, Thesaurus of Geographic Names), and the lists owned by signatories of the MOU. This will lead to a future master list which is essential for all serious attempts at a meta-data approach to cultural heritage and knowledge in general. Because such a list represents a collective public good it is important that it should be placed in safekeeping with UNESCO. Senior officials at UNESCO already support this idea. It would make sense to link this list with related bodies such as UNISIST or ICSU. A series of copies will be replicated in various centres around the world.

The basic framework for such a digital reference room might come under the combined purview of the European Commission's Memorandum of Understanding in its next phase and the G8 pilot projects 5 (Multimedia Access to World Cultural Heritage) and 4 (Bibliotheca Universalis). A series of national projects can then add country specific information. These national projects can be organized by consortia of industry and government. By contributing lists from a given country, that country receives access to the centralized meta-data base. An outline of the structure is provided in Appendix 1.

5. Museums, Galleries, Drawing and Engraving Cabinets

As in the case of libraries, initiatives are underway to produce electronic images of the art and artifacts in galleries and museums. At the local level many museums already have projects to make some or all of their collections available on-line over the Internet. A number of collections are already available in electronic form including: the National Galleries of Canada, Britain and the United States, the Louvre in Paris, and the Uffizi in Florence. At a national level the Canadian Heritage Information Network (CHIN, founded in 1974) was the first electronic network connecting all the major museums of a country. At the European level the European Commission has produced a Memorandum of Understanding (MOU) concerning Multi-Media Access to Europe's Cultural Heritage, the signatories of which now include 282 museums and cultural institutions, 25 governments and regional government organisations, 10 communications service/software companies, 2 telecom/CATV operators, 22 IT-telecom equipment companies, 22 new media companies and 24 non-governmental organisations. A stated aim of the MOU is that fifty percent of the collections of the museums concerned will be available in electronic form by the year 2000.

Meanwhile at the G7 level, one of the eleven pilot projects has been dedicated to this theme, namely, pilot project 5: Multimedia Access to World Cultural Heritage. An initial presentation at the Information Society and Developing Countries (ISAD) Conference (Midrand, May 1996) included sections on methods to capture (the 3D laser camera of the National Research Council of Canada), archive (the integrated multimedia system of

the Museum for the History of Science in Florence), display (the virtual reality reconstruction of the tomb of Nefertari by Infobyte/ENEL in Rome) and navigate (the System for Universal Media Searching, SUMS, Toronto). Through working group one of the MOU there is a framework for co-operation between initiatives at the European level and those of G7.

6. Education and Training

In the past the educational resources available to a student depended almost entirely on the location of their school. Someone in a major city with great libraries and museums had available to them very different resources than a student in an isolated rural village. When the resources in great museums and libraries are on-line, students in both cities and rural areas can have access to the same cultural heritage.

There are many initiatives in this direction. Individual schools are becoming connected. In Canada, Schoolnet has a project which foresees all schools throughout the country being on line. Analogous albeit less comprehensive projects exist in a number of countries. The European Commission, in collaboration with the Pegasus Foundation, has begun a project which makes cultural monuments available on-line within the framework of schools. Plans exist to integrate materials from libraries, galleries and museums within this framework. At the global level, G7 pilot project 3 focusses specifically on education.

Thus far such educational initiatives have focussed on translating traditional resources into electronic form such that they can be shared on the Internet. These resources include traditional lesson plans, curricula, outcomes, exams. A next challenge will lie in co-ordinating and integrating these materials such that one can relate items on an exam to a specific text, course, curriculum and the corpus of knowledge in that field. This will have two fundamental consequences. It will expose students and teachers alike to an immensely greater corpus of materials from which to learn. It will also re-contextualize this existing knowledge.

Ironically there has been relatively little attention as to how the new technologies will introduce new methods and activities to learning. Some educators point to e-mail and collaborative learning groups but this is almost incidental compared to that which is now possible. For our purposes, a few examples may suffice. In the past students learned about the religious revivals in the Middle Ages which brought the development of Romanesque and Gothic art. Already today it is technically possible to consult a map of Europe and watch how these new movements spread geographically and spatially, influenced in no small part by the existing pilgrimage routes. A student thus sees how and why the cathedrals at Cologne in Germany and Burgos in Spain are related. They can choose a motif, such as the *Last Judgement* and trace its evolution on the tympanums over the west portals of churches. Or they can choose a theme such as Lives of the Saints and trace the evolution of major narrative cycles over the centuries, while being able to see these in context as they wish and to consult written sources such as Voragine's *Golden Legend (Legenda Aurea)* as appropriate. Or there is the brilliant example of the engineering students at the technical university in Dresden. During the Second World

War, the famous Church of our Lady (Frauenkirche) was reduced to a rubble heap of stones. In the late 1980's and early 90's students recorded photogrammetrically and numbered every stone in this heap. Each stone was then recreated using a Computer Aided Design (CAD) programme, then reassembled in order to produce a complete reconstruction in virtual reality which is being used in turn as a basis for rebuilding the original church. This project accomplished in conjunction with IBM was a star attraction of the 1994 CEBIT exhibition in Hanover.

Some of these connections have been well established and merely need to be presented in multi-media form. Many such connections have never been made because the material has been too widely dispersed: one wing of a triptych may be in its original place, while a second wing is in some European museum and a third wing is in an American or Japanese museum. Creating reconstructions of these physically dispersed art works could become a task for students.

In other cases the evidence is lacking, equivocal, or in any case open to multiple interpretations. Students would then produce alternative reconstructions or simulations of what a former work of art, monument or church might have looked like. Such efforts could begin in elementary school and become progressively more complex through secondary school, university and throughout a scholar's professional career. Not every product of these exercises will be memorable just as every child's school notes is not obvious archival material. Resource centres in elementary schools and libraries in other institutions of learning would have the challenge of sifting, collecting and making accessible the better examples and making these generally accessible. Just as galleries now sometimes feature the work of children, galleries, museums and libraries could feature multi-media products from all levels of the educational system. In so doing libraries would become repositories for new as well as old knowledge.

7. Public-vs Private

Throughout the Middle Ages libraries and museums were typically the outgrowth of personal collections by noblemen. In the Renaissance, rich bankers such as the Medici and the Fuggers and other merchants also amassed collections which often became the property of the city state or province. In the nineteenth century the growth of national libraries, often inspired directly by Panizzi's model at the British Museum, introduced new levels in the universality of collections. It was assumed, quite rightly some would insist even today, that such public collections could offer a wealth of cultural heritage far beyond the scope of even the richest patron. Implicit in this assumption of a public heritage, open to be enjoyed by all, was the principle that everyone would contribute in small way to its upkeep and expansion by way of tax monies.

The past decades as business interests continue to gain power, the business model has been extended to many other areas. It is assumed that business operates efficiently and therefore other bodies would be more efficient if they were run along the lines of a business. Public structures, the rhetoric goes, would be more effective if only they could be privatized. According to this reasoning, the same should hold true for culture, i.e.

culture would be more effective if it were linked with business. For some this means simply that culture should look to business for sponsorship. Others would go further to argue that business is the only model for success, and that culture should therefore emulate the supposed efficiencies of business.

Some assume that the aims of business and culture are effectively synonymous and speak calmly about the business of culture, the cultural industries etc. In so doing they overlook some fundamental differences between business and culture. Business is concerned with selling. Culture is concerned with collecting. If a business collects too many things its warehouse overhead becomes prohibitive and the business fails. This model, if applied to cultural institutions would be disastrous. Imagine the Library of Congress, British Museum, the Louvre or the Vatican putting all its items up for sale. No doubt they would sell well and, yes, they would receive a great deal of money. But what would happen the next day? No tourists would wish to come to an empty museum. No readers would come to an empty library. The institutions would have lost their *raison d'être*. The great libraries and museums are valuable and significant only to the extent that they do not sell their contents.

This is not to say, of course, that libraries and museums should have no business sense. It is fully reasonable for them to sell reproductions of their images in various sizes from postcards through to large posters. In an electronic network they can make low level versions of their collections available free of charge for study purposes and then provide postcards on demand at a charge. Given the latest developments in stereolithography there can even be sculpture on demand. Hence, libraries and museums should not have business as their primary and central concern. Yet they can very reasonably have ancillary business activities.

In short, the efficiencies of libraries and museums are basically different from those of business because their goals are fundamentally different. Business is concerned with turnover of goods and amassing of wealth. Libraries and museums are concerned with amassing of goods in the form of precious books, paintings, objects etc. The time frames are also very different. Business is judged in terms of short term gains, how much profit they make in a specific quarter or a given year. Cultural institutions are judged on the amount they collect in the course of a century or even a millennium.

From a narrow business viewpoint such cultural institutions are inevitably non-profitable. The better they are the more they collect and to collect they need to spend money. From a larger viewpoint these same institutions can nonetheless contribute greatly to business interests by indirect means. A great collection attracts tourists who spend money on hotels, restaurants, shopping, transportation etc. A great collection also brings a public good because it raises the cultural dimensions of a city. For these reasons, it is simplistic to speak of culture as business as if the two were synonymous. It is also misleading and wrong to assume that long term public interests will be more efficient if they are reduced to the short term aims of business in the narrow sense of making money.

8. National-Local-International

A failure to distinguish clearly between long term public interests and short term private goals helps to explain some important political trends of the past decade. Rhetoric would have us believe that governments, which have traditionally been the supporters of cultural institutions and education, will be more efficient if they privatized and their various assets run as businesses. In response to this rhetoric, federal governments typically privatize important national assets. In Britain, this has included not only industries such as telecommunications, coal and hydro but even national research laboratories, with the result that long term core research has almost entirely been destroyed. Elsewhere, there has also been a tendency to transfer federal responsibilities to provinces, who in turn try to shift them to municipalities. The challenge is to recognize that the whole gamut of interests have economies to scale. Some local libraries and museums are just that: others play an integral part in defining our sense of what our country is. To sell our National Gallery would diminish our sense of Canada. To sell the Louvre would diminish our concept of France.

Culture, Janus like, has two seemingly contradictory expressions. One is in the present, in capturing the genius of the passing moment which finds expression in the performing arts: music (from the bravura of a soloist to the range of the symphony), ballet, opera and theatre. This is the time bound side of culture. The other is in finding links with lasting values, which are unaffected by the passing whims and fashions of the day, which somehow link us to the eternal. This is the role of libraries and museums. The physical books and objects are only the surface of these institutions. Libraries and museums house a community's, a country's spiritual memories and achievements. They store, protect and nurture a cumulative awareness of the possible. As such they are also the centres of the imagination and hopes of a country. By showing us our past in ever new ways in the present they effectively shape the potentials of the future.

Governments and countries are not unlike the libraries and museums they support. They can sell off their assets and have excellent profits for a given quarter but in so doing they destroy their long term value. They become like libraries without books or museums without paintings.

Ironically, leading individuals in the business world have recognized that the narrow business viewpoint of maximal profits in the short term is counter to long term business interests⁸. They have recognized that unless companies take into account environmental issues such as global warming, they may not be viable in a few decades time. So politicians are seeking to impose on governments and cultural institutions such as libraries and museums a rhetorical narrow model of business which has been dismissed by the leaders of industry.

Paradoxically this shift from national to regional and local village concerns has been paralleled by a contrary movement to consolidate local municipalities into megacities or megalopoli. This dual trend has only gradually come into focus. A generation ago Marshall McLuhan coined the phrase *global village* to characterize the phenomenon of how television was connecting persons all around the world. The implication seemed to

be that new media such as television would introduce a general homogenization of experience. More recently analysts such as Barber have noted that computers are introducing a more complex picture. On the one hand, there is still a trend towards internationalisation, which Barber characterizes with the phrase *McWorld*. On the other hand, there is an opposite trend towards what used to be called balkanization, a tendency to focus on one's local realities as if they were all that existed, which Barber terms *jihad* to underscore how it is frequently linked with religious fanaticism. In the past it was easy for persons in a given village to imagine that their problems were unique. As mass media make us aware of commonalities with persons in villages throughout the world, there is a greater incentive to re-examine and redefine the particular characteristics of our village in order to re-assert its uniqueness. Thus globalization simultaneously teaches us how we are the same and challenges us to discover wherein our uniqueness actually lies.

9. Dangers

This twin tendency towards internationalisation (McWorld) and localization (jihad) points to one of the greatest dangers of the emerging global network of information. The same network which could bring to light the magnificent richness and diversity of world cultural heritage in libraries and museums could serve only to highlight certain narrow stereotypes, as if all Iraqis were as CNN portrayed them in the Gulf War and so on. Librarians and museum curators must take great care to ensure that the new media convey the riches of their collections and not simply their symbolic pieces such as Leonardo's *Mona Lisa* in the Louvre and Botticelli's *Venus* in the Uffizi. Most museums have 95% of their collections in their basements and storage rooms. It is such riches which the Internet needs to make visible.

Closely connected with this is the problem of standards. If libraries, museums and other content holders are to share records they need to have common standards. However, this quest for standards which ensures interoperability holds within it the danger of a common plateau that is less rich than the sum of its parts. The standards must assure access to the diversity and not just the lowest common denominator.

There is a great concern as to who will pay for all these developments. In a climate of decreasing funding, museums and galleries need all their existing budgets simply to continue their traditional responsibilities of buying, collecting and preserving books, paintings and other objects. They cannot afford to pay for scanning images, creating databanks and maintaining servers. It is assumed that industry will somehow help with this process. This is an excellent idea. Libraries and museums need the advice and cooperation of computer and telecommunications companies to arrive at the most suitable technical solutions to their needs. On the other hand, if industry is allowed a completely unfettered hand, there is a great danger that they will treat this strictly from the viewpoint of short term profit. This has already occurred in some of the early experiments (e.g. Telecom France under the guise of its subsidiary Télésystèmes) which would have led to excessive user fees, greatly widened the gulf between the rich and the poor and ultimately destroyed the concept of public institutions existing as a reflection of national interest.

The need for co-operation between vendors of technology and users in libraries is rendered more complex by other factors. Salespersons frequently do not understand the long term needs of these institutions and even when they do, they may find that these long term needs conflict directly with their short term sales goals. An individual selling storage technologies, for example, will be wanting to sell new technological solutions as frequently as possible, rather than providing a permanent solution. Some become so caught up with this mentality that they look upon the records themselves as short term disposables. This may sound an exaggeration. At a recent imaging conference an international representative from Kodak cited the case of a U.S. lawyer who had used the evidence of a company's archives to sue the company, in order to recommend that companies should destroy their records as soon as is legally permitted. When the present author pointed out that if this mentality had been successful in the Renaissance there would be no studies of that period today, the salesperson was visibly surprised and annoyed. He had not considered that his sales pitch was destroying the sources of future historians, another case of conflicts between short term business sales and long term cultural accumulation.

10. Possibilities

The possibilities posed by the new electronic media are nearly boundless. Traditional libraries involve real books which have to be organized using a single classification scheme. Electronic libraries can have multiple classification schemes as points of entry or access to the virtual records of those books. Each classification scheme serves as a mental map of a particular culture at a given time. So multiple classification schemes become a method for multiple mind sets, multiple entry points into what the French have termed *histoire des mentalités*.

As noted above, electronic libraries can be rearranged to reflect different stages in the evolution of a major collection. One can also create virtual libraries and museums in the sense of collections which do not or perhaps could not exist physically in one place, for example, the complete works of a genius such as Leonardo, combined with all the secondary literature thereon, and all the paintings and objects somehow connected with that person now scattered around the world. Of great importance here is the integration of library and museum materials, reconstructions of actual physical objects and plans within a single framework.

At the annual conference of the International Institute of Communications (Munich, October 1996), there was a special panel on the future of public broadcasting. A chief from Nigeria noted that outside the major cities where it was impossible to have telephones and televisions in every home, the tribal hut of the village chief which had these technologies served as a meeting place for the community. The same hut also served as the village library. At that same meeting, it was striking that Michael McEwen, representing the Canadian Broadcasting Company (CBC), defended his institution on the

grounds of its role as a public meeting place which helps create a national sense of community. For the reasons outlined earlier we would argue that libraries and museums are also integral elements in creating this national sense of community. They reveal to us more than any propaganda, the enduring values of a culture, expressions of the spirit which have stood the test of time. Electronic versions of libraries and museums should not, must not replace the physical sources on which they are based but they can give to a widespread populace a coherent vision of an otherwise scattered heritage.

In a sense libraries and museums are the repositories of the collective memory of a culture. Just as individual memory is the richer if it is refreshed, this collective memory is the richer if libraries and museums become centres for its ongoing interpretation and reappraisal. In this way they become more than records of past deeds. They become the source for present discussion about future directions, hopes, and dreams.

11. Conclusions

This paper began with an outline of recent developments in technology and their consequences for libraries. Some obvious effects such as automated cataloguing, and on-line inter-library-loan were mentioned in passing. The main thrust of the paper explored ways in which the new technologies are changing and will eventually transform the roles of libraries. The possibilities of meta-data were outlined. It was noted that some see these new roles of libraries and museums in terms of a business model, as if this were the key to their future efficiency. The pitfalls of this view were analysed. Fundamental differences in the goals of business and libraries were noted. Some dangers and possibilities posed by the new technologies were outlined.

Libraries and museums are much more than storehouses of physical books and objects. They serve as centres which collect and nourish the collective conscious and unconscious memory of a country variously described as our heritage or culture. For this reason they play an essential role as centres of community which is more than community centres in the usual sense. The new technologies will make aspects of this heritage accessible on-line such that it can be shared by individuals throughout the country and not only in the large centres. Yet paradoxically, because the most dramatic new technologies, such as virtual reality, are so expensive, these products will need to be limited to specialized institutions such as libraries and museums and thus provide a new foundation for their role as centres of community.

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Appendix 1

Some Key Elements of the SUMS-SUMMA Model (©1997) as a Framework for a Meta-Data Digital Reference Room

Access (User Choices)

1. Cultural Filters
2. Access Preferences Views
3. Level of Education
4. Purpose
5. Preliminary Search Tools
 1. URI,URL, URN
 2. MIME Types
 3. Site Mapping
 4. Content Mapping
 5. Abstracts
6. Strategies
 1. Random terms
 2. Personal lists
 3. Data base fields
 4. Related terms

Content Negotiation (e.g. Copyright)

Rating System e.g. Protocol for Internet Content Selection (PICS)

Library Meta-Data A: Dublin Core Fields Warwick Framework Schema of Subject

Library Meta-Data B: Content Pointers

Who What Where

When How Why

1. Terms Classifications
2. Definitions Dictionary
3. Explanations Encyclopaedias

Contents of Digital Reference Room

1. Terms Classifications
2. Definitions Dictionary
3. Explanations Encyclopaedias
4. Titles Card Catalogues, National

No

¹ Clifford Stoll, *Silicon Snake Oil*, New York: Doubleday , 1995.

² For more on this topic see a standard survey of the latest techniques, by Linda Kempster.

³ This, for example, is the approach taken by the Civita Consortium (Rome).

⁴ For an example of this problem in the context of historical studies see the author's: "Past Imprecision for Future Standards: Computers and New Roads to Knowledge", *Computers and the History of Art*, London, vol. 4.1, (1993), pp. 17-32.

⁵ Based on its French name: Fédération Internationale de la Documentation

⁶ Based on its French name: Union Internationale des Associations

⁷ UNISIST. *Synopsis of the Feasibility Study on a World Science Information System*, Paris: UNESCO, 1971, p. xiii.

⁸ For an insightful analysis see: *Climate Change and the Financial Sector. The Emerging Threat-The Solar Solution*. ed. Jeremy Leggett, Munich: Gerling Akademie Verlag, 1996.