Kim H. Veltman
Scientific Director, Virtual Maastricht McLuhan Institute
Kim_veltman@hotmail.com

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Abstract

The idea of networks for culture goes back to visions of a world brain (1907) and Paul Otlet's ideas concerning world knowledge (1935). Practical steps go back to the founding of the Canadian Heritage Information Network (CHIN, 1972). The 1990s saw efforts through the European Commission to treat libraries, museums and archives as part of a single challenge (cf. conference title). Since then, three waves of convergence have transformed the Internet into a) Multimedia networks; b) Networked Information Communication Technologies (ICT), and more recently towards c) Universal Convergence Technologies (UCT), variously called NBIC, CTEK and Bio-Systemics Synthesis.

These changes are transforming expectations, and challenges for memory institutions and the public alike. Since 1990, the Internet has expanded from 1 million to over 1,173 million fixed users (as of 30 June 2007) with an estimated 700 million mobile Internet users by the end of 2007. English, which was over 95% of the Internet in 1990, is 31.7% in July 2007. Chinese and Spanish are now in positions two and three. The scale of projects has expanded enormously. Scanning of text has risen from 1 MB to 767 MB per page. Scanning of images has risen from 1MB to 30GB. Demos of reconstructions have grown from 10 MB to 8 Terabytes. The largest library networks now have over 76 million unique titles. There are plans to scan the full texts of over 60 million books by the year 2020. The frontiers of the film industry now transmit an average of 1 terabyte every 24 hours.

The trends towards convergence also introduce new possibilities, whereby mobile cameras can become networked with memory institutions and part of a learning and knowledge life-cycle. Ultimately we need new systems, which open research into multiple ways of knowing, multiple "knowledges". In the past, we went to libraries to study the recorded world. In a world where cameras and sensors are omnipresent we have new recording worlds. In future, we may also use these recording worlds to study the riches of libraries and memory institutions.

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1) Introduction

The idea of networks for knowledge and culture goes back to visions of a world brain (*Gehirn der Welt,* 1907).[1] It was taken up by Ostwald (1912) and subsequently by H.G. Wells (1937) and Teilhard de Chardin (1946). This became the planetary brain with Otter G'Zell (1970), popularized by Joel de Rosnay. It has since become fashionable through the buzzword of collective intelligence.[2] Active in this vision for a global brain and a global access to world knowledge and culture were two Belgians, Paul Otlet and Henri LaFontaine. They developed the Mundaneum, created the Universal Decimal Classification, and laid the foundations for systematic bibliographical control of secondary literature. In 1935, Paul Otlet outlined his full vision:

> "Man would no longer need documentation if he were assimilated into an omniscient being - as with God himself. But to a less ultimate degree, a technology will be created acting at a distance and combining radio, X-rays, cinema and microscopic photography. Everything in the universe, and everything of man, would be registered at a distance as it was produced. In this way a moving image of the world will be established, a true mirror of his memory. From a distance, everyone will be able to read text, enlarged and limited to the desired subject, projected on an individual screen. In this way, everyone from his armchair will be able to contemplate creation, as a whole or in certain of its parts." [3]

A decade later, Vannevar Bush outlined his widely publicized: "As we may Think" (1945).[4] The Internet began in England in 1968. Four years later, the year that the UNESCO World Heritage Convention[5] was signed, the Canadian Heritage Information Network (CHIN, 1972)[6] was founded.

2) Museums

It was nearly two decades before Europe launched its European Museum Network (EMN) project (1989-1992). When the project began, its founders were assured that by the time the project was finished, the Internet infrastructure would be fully in place. Although this proved overoptimistic, the next project, Remote Access to European Archives (RAMA) continued the vision in a similarly optimistic tone:

> "The RAMA project is one of the major initiatives in Europe sponsored by the Commission of the European Communities under the RACE Programme. Its goal to offer an open tool for any professional user in a telecommunication service environment, to interface with archives, databases, and LAN software currently existing in the museums. The users are validating all the phases of the project, thus ensuring the final acceptance of the product. The result is an open, scalable, and interoperable architecture, implemented as a client server approach over a low cost equipment set."[7]

RAMA (1992-1995), was followed by the "Multimedia European Network of High Quality Image Registration (MENHIR) project, which attempted to build an Internet catalogue of museum images based on a unique ISO standard. It resulted in an online catalogue of 120,000 images from a variety of large, small and medium museums in Europe."MENHIR (1996-1997) was followed by OpenHeritage (2001-) which networked "30 museums in five regions of Europe with a novel multimedia collection management system."[8] The European

Commission launched a number of other initiatives including the Memorandum of Understanding (MOU) for Multimedia Access to Europe's Cultural Heritage and the MEDICI Framework.[9] This initiative brought together well over 1000 signatories. E-Culture Net[10] reviewed progress and offered a vision of what lay ahead. It outlined the need for a Distributed European Electronic Repository (DEER) with a Virtual Reference Room and Virtual Agora.

While none of these initiatives created full-scale networks as some had hoped, a great deal was achieved. The 1990s saw efforts through the European Commission to treat libraries, museums and archives as part of a single challenge and introduced the idea of memory institutions. Other than the conference title, this has led to concrete projects such as: Gemeinsames Internetportal für Bibliotheken, Archive und Museen (BAM).[11]

Major museums such as the Louvre, which had no commitment to an online presence in the 1980s, now make their collections accessible online[12] through four databases[13]: 1) paintings with 35,000 works of art; 2) drawings with 140,000 works on paper, 3) American artists with 1,700 works produced by United States artists that entered the national collections of France before 1940, and 4) developed by the Direction des Musées de France, Joconde, which "incorporates 120,000 descriptions of drawings, prints, and paintings from the 7th century to the present day, from the collections of over sixty French museums." In addition, the Centre de Recherche et Restauration des Musées de France (C2RMF)[14] has developed further databases and launched the idea of a European network for conservation analogous to the Canadian Conservation Institute (CCI).[15] As a result, a single museum complex now makes available more images than all the networked efforts of fifteen years ago. Meanwhile, the 33 national museums of France are also online.[16]

These French experiences in the direction of a cultural portal are a starting point for the Multilingual Inventory of Cultural Heritage in Europe (MICHAEL) project.[17] This is very important because it makes accessible collections from over 3,000 institutions/resources (figure 1), including significant, smaller collections such as the Dulwich Picture Gallery.[18] There is still much to be done. The present site with three languages (English, French, Italian) is a long way from the vision of Accès Multilingue au Patrimoine (AMP)[19] outlined by the French Ministère de la Culture. The maps on the present site do not yet work properly. Clicking on Italy or Russia leads to the UK, while clicking on Sweden or Spain leads to France. But these are minor details.[20]

Topic	Institutions/Resources
Education	74
Science	499
Culture	1690
Social and Human Sciences	548
Information and Communication	139
Politics, Law and Economics	326

Figure 1. A list of topics and institutions/resources covered by the MICHAEL project. [21]

Another project by Museen.de, by Rainer Göttlinger gives a better glimpse of where this approach is going.[22] When one sees the extraordinary developments using maps through projects such as Google Earth or Microsoft's Virtual Earth,[23] which continue the vision of European projects such as Terravision,[24] the enormous potentials of this approach are evident.

A challenge remains of ensuring that the technologies developed by such private enterprise companies become available and integrated in the case of cultural sites, which are in the public domain as part of the public good.

Since 2000, there have been two significant developments. First, there have been moves towards e-Content (see § 4 below). Second, the Commission has recognized the importance of policy accords at the governmental level. This began with European content in global networks - Coordination mechanisms for digitisation programmes (Lund Action Plan, 2001),[25] which led to the NEtwoRk for Valorising Activities in digitisation (MINERVA).[26] MICHAEL is part of this initiative. In the longer term, such policy work needs to evolve on a whole range of levels including physical infrastructures, long-term preservation needs, and multimedia contents in the widest sense of the word. It is very important for such policy actions, which have thus far been short-term European projects, to be integrated into the long-term workings of governments. Networks as projects are a good beginning, but networks need to become part of long-term infrastructures in order to become an important dimension of an evolving knowledge society.

3) Archives

In the realm of archives, pioneering work was done by the Scottish Cultural Resources Access Network (SCRAN), which has now become the Scottish Archive Network (SCAN).[27] In July 2003, SCAN in conjunction with the National Archives of Scotland (NAS) launched Scottish Documents.com, a project aimed at digitisation and preservation of over 520,000 Scottish wills and testaments.[28] Until June 2005, SCRAN also had an e-commerce website provided free access to the index to wills and testaments of Scots from 1500 to 1901. These have now become part of ScotlandsPeople, "one of the largest online sources of original genealogical information, with almost 50 million records to access…and the opportunity to order high quality digital images of the documents by e-mail."[29]

The German Social Science Infra-structure Services e.V (GESIS)[30] has important collections at the national level and has introduced the East European Data Archive Network (EDAN).[31] The United Kingdom has made significant contributions through JISC (Joint Information Systems Committee),[32] which has also helped launch an Arts and Humanities e-Science Support Centre (AHeSCC).[33] France has made contributions through its Maisons des Sciences de l'Homme en France (MSH),[34] which has also launched a significant project for Mapping of European Social Sciences and Humanities (MORESS).[35] The Netherlands has Data Archiving and Networked Services (DANS). The UK, Netherlands France and Germany are co-operating together on a Digital Research Infrastructure for the Arts and Humanities (DARIAH).[36] This is part of an European Strategy Forum on Research Infrastructures (ESFRI).[37]

Since 2000, the vision of e-science has moved from plans to a series of projects starting with a systematic approach in the United Kingdom[38] and an increasing series of grid projects including: DataGrid[39] and Enabling Grids for E-sciencE project (EGEE).[40] In 2006, a Workshop on European Infrastructure for Repositories of Scientific Information[41] explored possible approaches to pan-European knowledge infrastructure and found that whilst existing: "repositories contain very large holdings, often many hundreds of thousands of digital objects, and whilst a great diversity of multimedia objects—documents, datasets, images, video, publications, transcriptions, reference works, etc—are included, they represent only a tiny fraction of what will be possible in a pan- European knowledge infrastructure of the future."

While very laudable the figures were more than slightly off. While experimental grid projects are dealing with hundreds of thousands of items, by 2006, the Karlsruhe Virtual Catalogue, in the regular library world, attained 500 million items. Admittedly the great majority of these were titles and not full-texts, but even so it remains the case that those intent on creating a new infrastructure have not always been fully informed of existing efforts. Fortunately, the workshop concluded that: "The pan-European knowledge infrastructure should be built on existing national and trans-national knowledge infrastructures." So there is hope that new integration may lie ahead.

The initial e-science efforts were focussed almost exclusively on e-science but this is changing. There are projects such as Digital Repository Infrastructure Vision for European Research (DRIVER)[42], Digital Library Infrastructure on Grid Enabled technology (DILIGENT)[43] and TextGrid (Modular platform for collaborative textual editing - a community grid for the humanities).[44] The German e-Science Conference 2007 (GES2007)[45] included papers on a Federation of Language Archives Enabling Future eHumanities Scenarios.[46] Terms such as Humanities Computing introduced in the 1980s by pioneers such Willard McCarty (then Toronto, now London) and Ian Lancashire (Toronto) are becoming the vogue in Europe and e-Humanities is now becoming fashionable.

While all these steps forward are exciting and significant, it is important to note that most of this work is on archives in the sense of computer science, namely digital repositories of materials. With some exceptions, e.g. Scotland, systematic access to traditional archives remains an open field. Integration of archives at local regional and national levels across countries is a domain where an enormous amount remains to be done.

4) Libraries

Efforts at automation of library catalogues go back to the 1960s. During the 1970s there were initial efforts towards national networks, often hampered, especially in Germany, by infrastructures at state/provincial levels and accompanying mentalities, which had difficulty in thinking beyond borders. Today, after 35 years of efforts, national networks are a serious reality and typically range from 10 to 40 million items. Efforts to create a Academic Subject Gateway Service in Europe (RENARDUS),[47] led to projects for The European Library (TEL) and more recently the vision of a European Digital library (EDL).[48]

Only a decade ago, most libraries only offered access to books, manuscripts and periodicals. This has changed dramatically. For instance, today the material selection of the German Gemeinsamer Bibliotheks-verbund (GBV) includes fifteen choices (Figure 2). The European Library entails 11 choices [49] in a virtual environment in 20 languages that presently (July 2007) allows one to search through the resources of 30 of the 47 national libraries.[50] Within the next years this will be expanded to include all 47 national libraries.

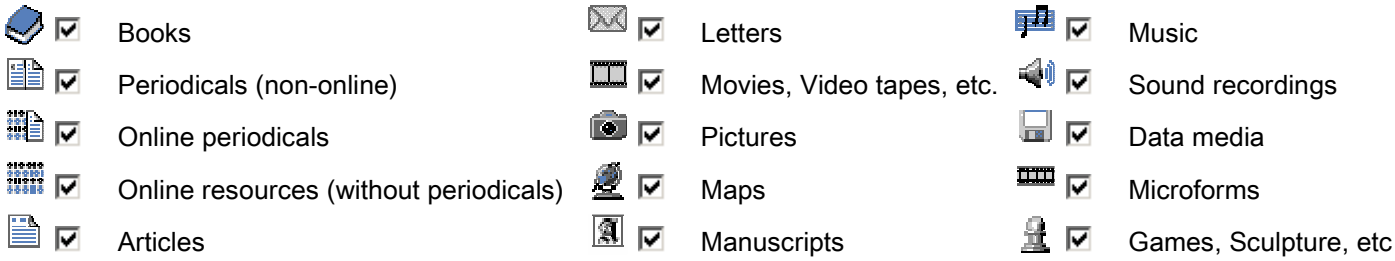

Figure 2. A list of material selection in the GBV.[51]

We noted earlier that there have been two significant changes within the European Commission since 2000. One is in co-ordinating policy, The other has been a decision to become involved in e-Content. Initially, this was more a gesture than a systematic plan. By 2006, partly in response to Google's announcements to scan the full texts of 15 million books (cf. § 5 below), the European Commission committed itself to scanning the full-texts of 6 million books.[52] While this marks an enormous step forward, it has been overshadowed by other developments around the world.

5) International Developments

The Internet is growing rapidly. It grew from c. 1 million users in 1990 to 200 million in 2000. Despite the dot.com bust in 2001 it has since grown to 1,173 million fixed line users (as of 30 June, 2007), with an estimated 700 million mobile Internet users by the end of 2007. English, which was over 95% of the Internet in 1990, is 31.7% in 2007. Chinese and Spanish are now in positions two and three. The scale of projects has expanded enormously. Scanning of text has risen from 1 MB to 767 MB per page. Scanning of images has risen from 1MB to 30GB. Demos of reconstructions have grown from 10 MB to 8 Terabytes. The largest library network, namely WorldCat, now has over 79 million unique titles.

During the 1990s, one of the eleven G7 projects was devoted to a Bibliotheca Universalis (Pilot Project 5). Since then there have been no less than six projects worldwide with plans to scan in books. Google is scanning in 10-15 million full-texts and has announced that they have a 300 year plan. The combined effect of these projects will be to scan the full texts of over 60 million books by the year 2020.[53] The enormity of such plans becomes evident when we recall that in 1950, the largest library in the world scarcely had 10 million books.

There have been parallel developments in the Museum world. The International Council on Museums (ICOM)[54] has over 21,000 members in 140 countries and sponsors a list with many thousands of online museums begun initially though the efforts of Jonathan Bowen.[55] The Virtual Museum of Canada sponsored by CHIN now has an image gallery of over 420,000 images; contains more than 150 interactive games and hosts over 500 Virtual Exhibits and Community Memories Exhibits. In addition it "is launching a pilot project, AGORA-The VMC Learning Centre, in the spring 2007. This initiative will provide Canada's educators and learners with an interactive online environment that offers a compilation of learning resources (text, images, video and multimedia) and tangible outcomes, created by Canadian Institutions."[56]

In Europe, the 20th century saw a series of policy decisions, led largely by France, whereby the creative expressions were not subject to regular laws of commodities (*l'exception culturelle*).[57] This notion continues. Even so new networks are evolving whereby digital film, viewed at 4K (4000 x 2000) resolution, is being sent on high speed networks linking Japan, China and Russia with Europe. There are now distributed games networks, experimental grid games networks and there is discussion of combining (graphic) design networks, games networks and digital film and television networks. In a digital world, expressions from any of these domains can be adapted and transformed into other formats for other domains. The frontiers of the film industry now transmit an average of 1 terabyte every 24 hours. If such networks are expanded to include the full gamut of expressions, the so-called creative industries may be soon be linked through creative networks on a scale that is surprising even for the Hollywood mentality.

6) Emerging Technologies

The term New Media has been fashionable for decades. However, what this entails has evolved dramatically. At present, two large trends are underway. One is a convergence of the three main methods, whereby media are transmitted, namely, Telephony, Cable Television, and Internet. According to Japanese estimates this convergence will occur by 2010. According to Siemens, it will occur by 2015 in Europe. Everyone is agreed that when this happens, it will have fundamental implications for all our networks. Yet hardly anyone agrees as to what precisely these implications might be. So paradoxically, today we are further than in 1990 from feeling sure that we know what the future will bring technologically.

This feeling of uncertainly is compounded by a second, large trend whereby there are waves of convergence that have transformed the Internet into a) Multimedia networks; b) Networked Information Communication Technologies (ICT), and more recently towards c) Universal Convergence Technologies (UCT), variously called NBIC (Nano-, Bio-, Info-, Cogno-); CTEK (Communication Technologies for a European Knowledge Society) and Bio-Systemics Synthesis.[58] New methods such as DNA computing and quantum computing which seemed pure science fiction in the 1980s, are now becoming realistic possibilities for the near future. A BBC programme in 2000 noted that one gram of DNA could hold the same information as one trillion CD-ROMS. Such information would also be safely storable for thousands of years. Waiting another decade for this technology to mature should not seem an excessive request for patience.

7) New Knowledge Possibilities

The trends towards convergence also introduce new possibilities, whereby mobile cameras can become networked with memory institutions and become part of a learning and knowledge life-cycle. We already have technologies for 1) mapping; 2) reconstructing; 3) recognizing and 4) sensing our environments. These capacities are also converging. So in the near future we can foresee using the equivalent of our digital cameras and mobile phone cameras in new ways. A scenario: we take an image as we do today. We send it to a virtual reference room via our Internet cell-phone. At the reference room, the same image recognition technology now used to recognize the numbers of licence plates and the faces of suspects and terrorists can be used to identify the objects in the picture we have sent; connect them with images in the library's databases and send us further information about them. Hereby cell phone cameras and digital cameras, which were traditionally passive instruments to record images from the natural world, are transformed into active search engines for exploring and discovering knowledge. Meanwhile, the natural world, which was traditionally simply something "out there" now becomes a new kind of interface for the exploration of knowledge. In the past, we went to libraries to study the recorded world. In a world where cameras and sensors are omnipresent, we shall have new recording worlds and in future, we may also use these recording worlds to study the riches of libraries and memory institutions.

8) Challenges

Many challenges remain. When plans for the Internet began seriously from the 1960's onwards, there was a notion of information as digital bits and bytes. The Internet was conceived as a cloud at the end of which were IP addresses. Giving these addresses unique names seemed to be a way to meaning. When the Internet evolved into a World Wide Web (WWW) there arose an Internet Assigned Naming Authority (IANA) and also the vision of a

Semantic Web. If machines could recognize the naming procedures, if machines could "talk" to machines, then, said the optimists, we would have a semantic web. Some have been less optimistic and have noted that this only gives us a transaction web. Semantics, the science of human meaning is a more complex goal that involves, as the early 20th century was well aware, a range of disciplines including semiotics, lexicology, lexicography, semasiology and onomasiology,

To play on images one could say that vision of a semantic web at points around an Internet cloud has been clouded and perhaps transformed forever by the trends whereby mapping reconstructing, recognizing and embedding (sensors) are becoming intertwined. The 20 million networked surveillance cameras in England alone, the billions and soon trillions of sensors in every imaginable object, mean that simple distinctions between an Internet as a cloud and a physical world below are about as realistic as excessive musings about cloud 9. The world of Internet as a World Wide Web is now integrally connected and intertwined with the world of the heavens (astronomy through space telescopes); earth (through remote sensing and GIS) and the oceans (oceanography through deep sea sensing). Finding the address at the end of the cloud is no longer enough. We need to find the source. In the past, if a scholar discussed the Mona Lisa it was enough if they referred back to the Louvre. In a networked electronic world, a future scholar will need a link directly back to the appropriate point of the Louvre site. The real way to a web of trust is to create a web that is prepared and able to take any and every doubter back to the original object. Traditional footnotes and today's hyperlinks typically entail a single link. Needed are new kinds of links at multiple levels such that the same linking mechanisms can take us not only back to the original but also to definitions, titles and other reference materials. In the past we had hyperlinks for special words. Already today there are demonstrations of omni-links where every word in a text is linked.[59]

Those at the frontiers of these efforts constantly speak of services. What they mean, but very seldom say, is paid services. When questioned or if challenged they explain that this is necessary to make a proper business case. In the case of business and industry, this is an appropriate and necessary response. In the case of culture, which is about a collective memory of mankind and a public good, this is misleading. To be sure tourist shops can make profits on publications, replicas and cultural souvenirs, replicas. But the measurement of profit, should be in terms of how much we profit mentally and spiritually rather than the amount a bank account increases.

On the positive side, the discussions of a Pan-European Knowledge Infrastructure and plans for a World Digital Library are reviving discussions of a Global Brain (*Gehirn der Welt*) launched precisely a century ago. Organizations such JISC or The Max Planck Gesellschaft offer tantalizing glimpses into these possibilities, often with an implicit suggestion that their solution will suit everyone. Needed, however, is something on a much bigger scale. The most ambitious visions of the European Digital Library foresee it one day providing access to the full contents of all memory institutions. This is wonderful. But we also need co-ordinated access to the research results, not just of the Max Planck Gesellschaft, but also the Deutsche Forschungs-Gesellchaft (DFG); the Volkswagen Foundation and their equivalents in all the European countries: i.e. CNRS, INRIA, CNR, NWO etc. To achieve a vision of a global brain we need a World Online Networked Distributed Electronic Resource (WONDER), which as the acronym suggests will require something well beyond the inevitability of the everyday. The good news is that national research initiatives are already well organized. Needed is action at the policy level whereby governments decide to pool their knowledge to create a

Distributed European Electronic Repository (DEER) and work towards a WONDER. As always this repository will have different levels of users, but as the open source model has taught us, we gain more by sharing than by hoarding. Linux, which a decade ago was a novelty, is now the operating system of over 70% of all supercomputers.[60]

Many enthusiasts of new media, especially in computer science, assume that the way forward is in terms of more of the same, in the sense of much more. The experience of the last centuries should warn us that it cannot be that easy. In the latter 19th century. the explosion of knowledge that came with new policies that entailed national libraries aided by less expensive publishing methods, required a radical re-organization of knowledge in memory institutions. Universal classification systems (e.g. Dewey, Library of Congress, Universal Decimal Classification, Riders, Ranganathan, and Bliss) were one result. Systematic bibliographical control of secondary literature resulting in catalogues of articles, reviews and subsequently citation indexes were other results.

Scanning in the full-texts of millions and eventually hundreds of millions of books and materials implies a quantum increase in the amounts of material that will potentially be available. Navigation through these terabytes and gradually exabytes, zettabtes and yottabytes will require a systematic reorganization of knowledge analogous to that which occurred at the beginning of the 20th century. So one scenario is to create a new kind of Knowledge Organization Institute that builds on the initiatives of the International Society of Knowledge Organization (ISKO). Much work has, for instance, been done in the study of relations and relationships. Most efforts in computer science remain focussed on "is a" (*divisio* in logic or taxonomy in science) and "has a" (*partitio* in logic or partonomy in librarianship). As Perreault and Dahlberg have shown, these are subsumptive relations (involving Who? And What? In addition, there are determinative relations (involving How? and Why?) as well as ordinal relations (involving When? and Where?). We need new systems that focus on all these relations and integrate them.

At present, the evolution of the World Wide Web resembles the evolution of software, which has a tradition of versions. Accordingly the site of TEL is called: The European Library - v1.5. The analogy and the resulting appellation are touching, slightly humorous and also potentially dangerous. In the case of software, the idea of versions is entirely appropriate. A first attempt is flawed, or to use a biological metaphor, it has bugs, but not like fleas which can simply be sprayed away. Subsequent versions then remove, eliminate, eradicate, kill dead etc. the bugs; the system improves and creator and clients rejoice that this a good thing. In the case of libraries and memory institutions the situation is slightly more subtle. To begin with, the knowledge that a memory institution presents at any moment of its existence is not wrong in a naïve sense. It represents the cumulative insights at that stage of culture. In the human sciences (language, literature, art, culture, history), when a so-called advance comes, the new insights are put in place, but this does not render the earlier versions obsolete. They become a part of a cumulative tradition of commentaries, annotations, interpretations on collective memory.

This cumulative dimension, which lies at the heart of the very idea of collective memory institutions points to challenges, which the idea of versions obscures rather than solves. To be sure the first and primary challenge of memory institutions is to remember. But a next and no less profound challenge is to remember what has changed. In this context, today's version is of interest. It is of greater interest if we can see precisely how it is different than the version of 1950, 1900, 1800, 1600, 1000, 100 B.C., 1000 B.C. etc. In simple terms, versions only

become interesting when they can show us multiple versions, which are open to comparison. Paradoxically the efforts of computer scientists who are at such pains to assure us that their ontologies have none of the overtones of ontology in the Platonic or Aristotelian senses, nonetheless, tend to present us with programs and operating systems, that assume the existence of one truth, one version, the one that they have just prepared for us.

So the more elusive challenge is to create not just a new version, but rather a version that shows us versions. Ultimately we need new systems, which open research into multiple ways of knowing, multiple "knowledges" as Francis Bacon would have said. The challenge is not just to see what we (can) know today, but to see how our ways of knowing have changed, grown and evolved over the centuries. A key to a richer future is not just more of the same and more sameness, but more understanding of the kinds of diversity that make life more interesting.[61] We need to experience anew what Aristotle expressed clearly two and half millennia ago, that the way to knowledge is not through simple listing but through differentiation (*differentiae*). In this process, countries such as Lithuania have an important role to play. They are different than both Russia to the East and older definitions of Europe to the West. Used in a positive way, these differences can help to create new bridges in understanding other cultures.

9) Conclusions

We began by noting that the vision of networked knowledge and culture is at least a century old: that it goes back to visions of a global brain (*Gehirn der Welt*, 1907). It took nearly three decades for a clear vision to evolve (1935) and over three more decades before the Internet began in practice (1968). It took a two decades for the initial Internet to reach one million users. The pragmatic notions of an English physicist and his Belgian colleague began transforming this picture in the same year that the idea of a European Museum Network (EMN) was launched (1989).

The next decade saw a radical change from an Internet of 1 million to a World Wide Web of 200 million. In terms of memory institutions, initial efforts such as RAMA led to an MOU and a MEDICI Framework. The past six years have seen a further radical growth to over 1.173 billion fixed line users and over 700 million mobile users. A number of concrete achievements in the realms of museums, archives and libraries were reviewed. At a fundamental level, there have been two changes in the European Commission's approach: attention to the role of policy (MINERVA, MICHAEL) and increasing concern with detailed content (e-Content). These efforts in terms of initial projects need to become integrated into the everyday workings of governments.

An initial quest to connect memory institutions has evolved into networks with millions of images online; hundreds of millions of titles of books and other materials and plans for the scanning of full text versions of over 60 million books world-wide. Europe, which was once at the centre of developments, now risks being overshadowed by other efforts, not only Google, but also the governments of India and China.

These enormous developments are in the midst of emerging technologies ,which are along two lines. First, there is a trend whereby the individual networks of telephony, cable television and Internet will be integrated into a single system sometime between 2010 and 2015. Second, there is a trend towards universal convergence technologies, whereby a series of existing approaches will be integrated. Alternative names for this phenomenon include Bio-

Systemics Synthesis (Canada), NBIC (US), and CTEK (Europe). One potential by-product of such developments is the advent of DNA storage, whereby a gram could store the equivalent of a trillion CD-ROMS and be able to last for thousands of years.

Implicit in the new technologies are a series of new possibilities with respect to knowledge. Four techniques which have evolved in parallel are converging, namely, mapping, reconstructing, recognizing and embedding (using sensors). If these are combined then everyday digital cameras and cell phone cameras, which were passive devices could become active instruments in knowledge exploration and the natural world, which was the object of study, could potentially be transformed into an interface for knowledge discovery.

While all these developments are remarkable indeed a series of challenges remain. One entails a reconsideration of our basic images of the Internet which was a cloud, bounded by a series of Internet addresses. The spread of new technologies to the heavens, throughout earth and below the oceans means that this image is no longer sufficient. The emerging challenge is not end-to-end; not simply to end at a reliable Internet address, but rather to have pointers that take us back to the original object under discussion. Meanwhile, the overenthusiastic quest for services risks commoditizing activities, which belong in the cultural domain as part of the public good, independent of economic concerns.

The quest for Pan-European networks and knowledge infrastructures is much to be lauded. To be truly effective these cannot be limited to either the ambitions or the visions of a particular national body. The larger challenge is to integrate the research efforts in countries across Europe. It is likely that this will require a series of policy interventions not unlike those initiated by the MINERVA efforts, but on a larger scale and as part of the permanent workings of both a) national governments and b) in conjunction with the European Parliament. The dramatic plans to scan in tens of millions of books are praiseworthy. The enormous increases in knowledge that these imply, cannot be mastered by simply adding a little more of the same with respect to tools. In practice, the new commitments to scanning require new methods for their mastery, new levels of bibliographic control. To this end a new European-wide institute for Knowledge Organization is required.

The tendency of computer science to impose even on their clients, the notion of versioning is understandable, but risks obscuring as much as it reveals. Ultimately memory institutions require more than the latest version. There is a need for multiple versions showing history rather than only the ultimate version. If such challenges can be addressed then the prospects of memory institutions in a networked world are exciting indeed. Today's metadata is focussed on showing which components are the same which is essential for interoperability. But a deeper challenge lies in revealing how expressions are different; we need the cultural equivalent of bio-diversity. If we can build these differences into our systems, then our systems will make a difference in a profound sense.

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Notes

[1] Friedrich Naumann, „Das Gehirn der Welt“, *Süddeutsche Monatshefte*, 4, 1907, 759-764.

[2] For the full references to these see the author’s *Understanding the New Media. Augmented Knowledge and Culture* (Calgary: University of Calgary Press, 2007), online version at: http://www.sumscorp.com/kavai/newmedia_cd/ under Subjects: World Brain.

[3] Paul Otlet, *Monde: essaie d'universalisme -- connaissance du monde; sentiment du monde; action organisée et plan du monde*, Brussels, Editions du Mundaneum, 1935

[4] Vannevar Bush, “As we may think”, *Atlantic Monthly*, Boston, June 1945.

[5] Convention Concerning the Protection of the World Cultural and Natural Heritage, UNESCO: http://whc.unesco.org/en/conventiontext/

[6] CHIN: http://www.chin.gc.ca/

[7] RAMA: http://henoch.inist.fr/cgi-bin/main.cgi/demo_henoch/desc_notice.template?user=is95&tsetrowid=undef&w=600&h=500&ov=150&ow=150&oh=150&fnt=tr12&type=template&where=t_doc.rowid%3D'00002F5C.0008.0004'; cf: http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel3/1447/5953/00230861.pdf?arnumber=230861

[8] Dominique DeLouis, “Online Museums: from Research to Innovation, from RAMA to OpenHeritage”, *Cultivate Interactive*, 2001: http://www.cultivate-int.org/issue3/rama/

[9] MEDICI: http://www.medicif.org/

[10] E-Culture Net: http://www.eculturenet.org/

[11] BAM : http://www.bam-portal.de/

[12] Louvre: http://www.louvre.fr/llv/commun/home_flash.jsp?bmLocale=en

[13] LouvreDatabases: http://www.louvre.fr/llv/oeuvres/bdd_oeuvre.jsp?bmLocale=en

[14] C2RMF: http://www.c2rmf.fr/

[15] CCI: http://www.cci-icc.gc.ca/services/index_e.aspx

[16] DMF: http://www.culture.gouv.fr/culture/min/index-dmf.htm

[17] MICHAEL: http://www.michael-culture.eu/consortium.html

[18] Dulwich: http://www.dulwichpicturegallery.org.uk/collection/default.aspx

[19] See for instance, Newsletter no. 1: www.**culture**.gouv.fr/mrt/numerisation/fr/actualit/documents/**amp**-newsletter1-en.pdf; Newsletter no. 3: www.**culture**.gouv.fr/mrt/numerisation/fr/actualit/documents/**amp**-newsletter3-en.pdf

[20] MICHAEL Map : www.michael-culture.org/en/search/map-europe.html?base=dcollection&from1=&val1=map.world.w005&sf=ftitle

[21] MICHAEL resources: http://www.michael-culture.org/en/search/browse.html%3Ffilename%3Dbrowsing_subject.xml%26from1%3DbrowseSubject

[22] Museen für sakrale Kunst: http://webmuseen.de/Karte-t21.html

[23] In addition to the regular websites for Google Earth and Microsoft Virtual Earth Live Local, see the recent presentations at the TED conference: http://www.ted.com/index.php/talks/view/id/129.
A tour of MS Virtual Earth, on TED.com (http://blog.ted.com/2007/06/microsofts_step.php

[24] Terravision: http://www.artcom.de/index.php?lang=en&option=com_acprojects&id=5&page=6
As presented here is a 1996 project, but already in 1994 this project was transmitted by satellite from Berlin to a World conference in Kyoto. This Terravision project was followed by an American project of the same name, directed by SRI, which was linked with DOD and became linked with NASA before becoming linked with Microsoft’s Virtual Earth plans.

[25] Lund Action Plan : http://cordis.europa.eu/ist/ka3/digicult/lund_ap_browse.htm
[26] MINERVA: http://www.minervaeurope.org/
[27] SCRAN: http://www.scan.org.uk/aboutus/websites.htm
[28] Scottish Documents: http://www.scottishdocuments.com/content/default.asp
[29] Scotland's People: http://www.scotlandspeople.gov.uk/
[30] GESIS: http://www.social-science-gesis.de/en/index.htm
[31] EDAN: http://www.social-science-gesis.de/en/cooperation/data_service/eastern_europe/index.htm
[32] JISC: http://www.jisc.ac.uk/
[33] AHeSSC jointly funded by the JISC, AHRC, and EPSRC: http://www.ahessc.ac.uk/about-ahessc
[34] MSH: http://www.msh-reseau.prd.fr/LesMSH/
[35] MORESS: http://sid.ish-lyon.cnrs.fr/document/MORESSRapportEN300304.pdf
[36] Großes Interesse an E-Humanities auf der GES2007: http://www.textgrid.de/index.php?id=178&tx_ttnews[tt_news]=66&tx_ttnews[backPid]=162&cHash=518440e7d9
[37] ESFRI: http://www.nordforsk.org/_img/voksenaasen_26_mars_2007_b_henrichsen.ppt#286,1,Dia 1
[38] E-science projects: http://www.nesc.ac.uk/projects/
[39] DataGrid: http://eu-datagrid.web.cern.ch/eu-datagrid/
[40] EGEE: http://www.eu-egee.org/
[41] Workshop on European Infrastructure for Repositories of Scientific Information : 8—9 June 2006, Brussels, CJ Wright, University of the Witwatersrand, Johannesburg, Report: http://www.esastap.org/esastap/pdfs/report_eirsi_jun2006.pdf
[42] DRIVER: http://www.driver-repository.eu/
[43] DILIGENT: http://www.diligentproject.org/
[44] Text-Grid: http://www.textgrid.de/index.php?id=startseite&L=5
[45] GES:2007: http://www.ges2007.de/
[46] GES 2007 Papers: http://www.ges2007.de/papers/
[47] RENARDUS: http://renardus.sub.uni-goettingen.de/
[48] For a review of developments in the library world see the author's: „Keynote: Rahmenbedingungen der digitalen Langzeitarchivierung aus politischer und wissenschaftlicher Sicht," *Digitale Langzeitarchivierung. Strategien und Praxis europäischer Kooperation, Deutschen Nationalbibliothek, anlässlich der EU-Ratspräsidentschaft Deutschlands*, 20-21. April 2007, with text in English: http://www.langzeitarchivierung.de/eu2007/modules.php?op=modload&name=PagEd&file=index&page_id=45
[49] EDL Material Selection: http://www.theeuropeanlibrary.org/portal/index.html
maps & atlases, cartography
photographs, posters and images
portraits
childrens literature
digitized books
newspapers and periodicals
manuscripts
music collections
religion
scientific articles
thesis and dissertations

[50] TEL: http://libraries.theeuropeanlibrary.org/organisation/aboutus_en.html
[51] GBV Material Selection : http://gso.gbv.de/DB=2.1/LNG=EN/ADVANCED_SEARCHFILTER
[52] E.U. Plans Digital Library, March 06, 2006: http://www.copycense.com/books/index.html
[53] For a discussion of these plans see the author's article on libraries cited in note 48 above.
[54] ICOM: http://www.icom-deutschland.de/
[55] Virtual Library Museums Page: http://icom.museum/vlmp/
[56] VMC: http://www.virtualmuseum.ca/English/About/index.html
[57] L'exception culturelle : what does it mean?: http://www.understandfrance.org/France/FrenchMovies.html
[58] Gregor Wolbring, What Convergence is in the Cards for Future Scientists? http://www.bioethicsanddisability.org/convergence.htm. These trends are discussed in more detail in the author's Augmented Knowledge cited earlier.
[59] See for instance the online version of the author's book at: http://www.sumscorp.com/kavai/newmedia_cd/ Under Books, New Media and Omni-Linked.
[60] See: www.zwahlendesign.ch/en/node/130
[61] For a political and policy version, see: Giorgio Ruffolo, The Unity of Diversities - Cultural Co-operation in the European Union, Florence: Pontecorbolo, 2001, which also gives an excellent history of European decisions.
[62] SUMS: www.sumscorp.com