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Cultural and Historical Metadata: MEMECS (Metadonnées et Mémoire Collective Systématique)

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1. Introduction

When the Internet began in 1969 it was largely a communication channel for high-energy physics. This soon expanded to include astronomy. When the World Wide Web emerged in the 1980's it rapidly became a repository for all subjects. In the past decades there have been three important trends:

- 1) digitising enduring knowledge in memory institutions (libraries, museums, archives)
- 2) evolution of collaborative knowledge through virtual laboratories and collaboratories
- 3) rise of personal knowledge through e-mail, chat groups, MOOs, lists etc.

Visionaries now speak of a time in the --near-- future when all recorded knowledge will be accessible through the World Wide Web. How to integrate these three kinds of knowledge will thus become an increasing challenge. Fortunately, many of the obstacles standing in the way of such a vision are already being tackled by organizations such as the W3C and the Internet Society. At first, problems of technological interoperability at the level of hardware and software dominated the scene. More recently, there has been increasing interest in interoperability of content. Here, work is being done on heterogeneous, distributed databases. Metadata has emerged as one of the key concepts. In this context, the efforts of the Dublin Core (DC) to define a common ground through basic data entry fields are extremely valuable. The European Commission is supporting

multilingual approaches. The W3C is working on a Resource Description Format (RDF), which will integrate other initiatives such as eXtensible Markup Language (XML), eXtensible Style Language (XSL), and the Protocol for Internet Content Selection (PICS). This paper focusses on three sets of problems which remain concerning metadata. First, there are problems of quantity introduced by the enormous proliferation of images, words, sounds and other materials made available through the multimedia revolution. Second, there are problems of determining the quality and veracity of these images, words and sounds. Third, there is the challenge of developing dynamic metadata.

2. Copies and Versions

In the past, photographers typically made an image of the selected paintings in museums and galleries, which were then used by a relatively small number of scholars who published books and articles. Today, with JPEG technology a single painting produces a vignette, an imajette, a regular image, high definition image and a very high definition image. A single painting thus generates five images. Given developments in infrared reflectography one can see different layers. Assuming there were only three such layers under the surface, a single painting would thus generate 20 images (figure 1).

In the case of a famous painting there is more than the original to be considered. There are copies. If there were four copies then those 20 images mentioned above would become 100 images. There are frequently also versions, variants, images based on and caricatures. Even assuming there were only one each of these for the original and the four copies, then there would be another 80 images (for the five resolutions), each with surfaces and three layers, i.e. 320 images. Thus one original painting would generate 420 images Each of these would also be subject to reconstructions. Assuming three of these reconstructions for the each of the above one would have 1260 images generated by a single painting (figure 2). If we include moving images of the same the problems multiply. It is true that the Motion Picture Experts Group (MPEG 7) and the MPEG 21 group, as well as the Society for Motion Picture and Television Engineers (SMPTE) group are addressing some of these aspects. But we have no means, at present to gain systematic access to the whole spectrum of images linked with a single painting. Similar problems and examples could be found with respect to text and sounds.

3. Quality and Veracity

Given the immense advances in ease of --digital-- reproduction questions of quality also become paramount. Here methods such as digital watermarks can help determine whether a given image represents an unaltered version of the original.¹ To illustrate the deeper problems entailed with respect to veracity it is useful to begin with an example of a relatively "simple" contemporary event such as a plane crash. At the local scene all the details of this event will be recorded. We will read in the local paper of who was killed, who their families were, how this has affected their neighbours.

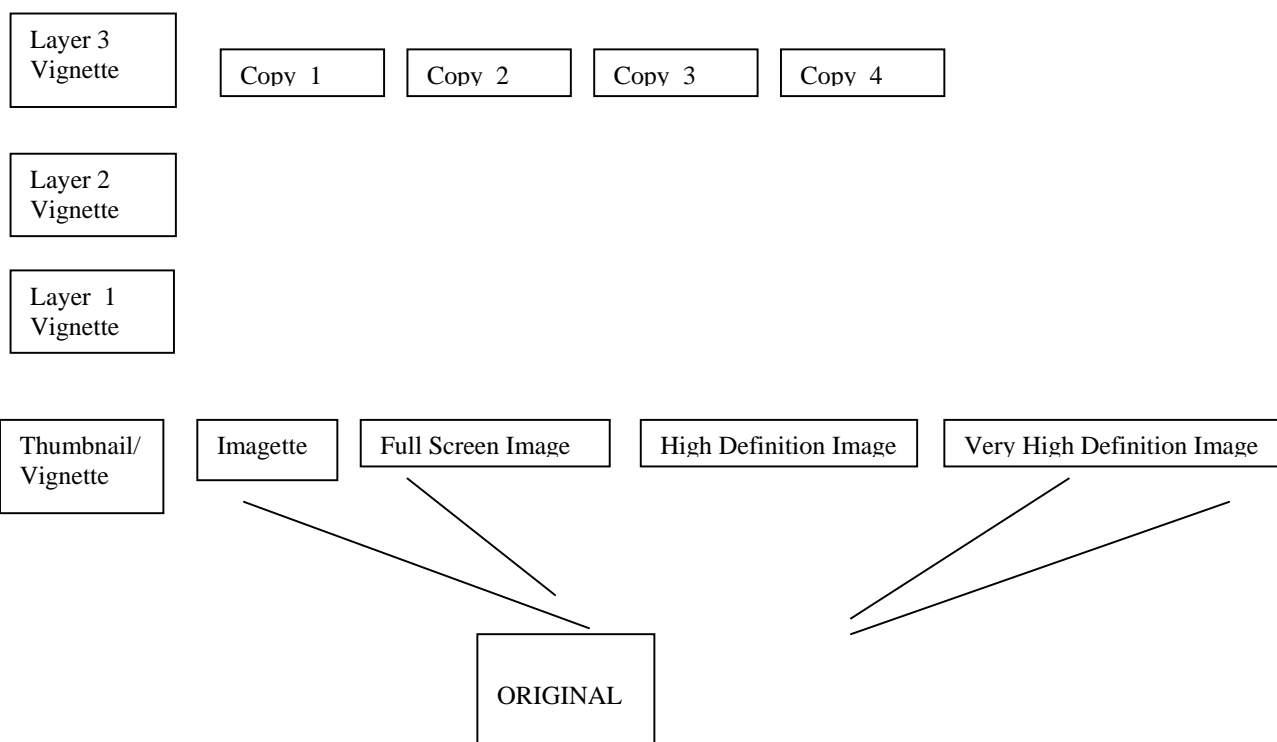


Figure 1. Access to different resolutions and different layers of a single image within a single medium.

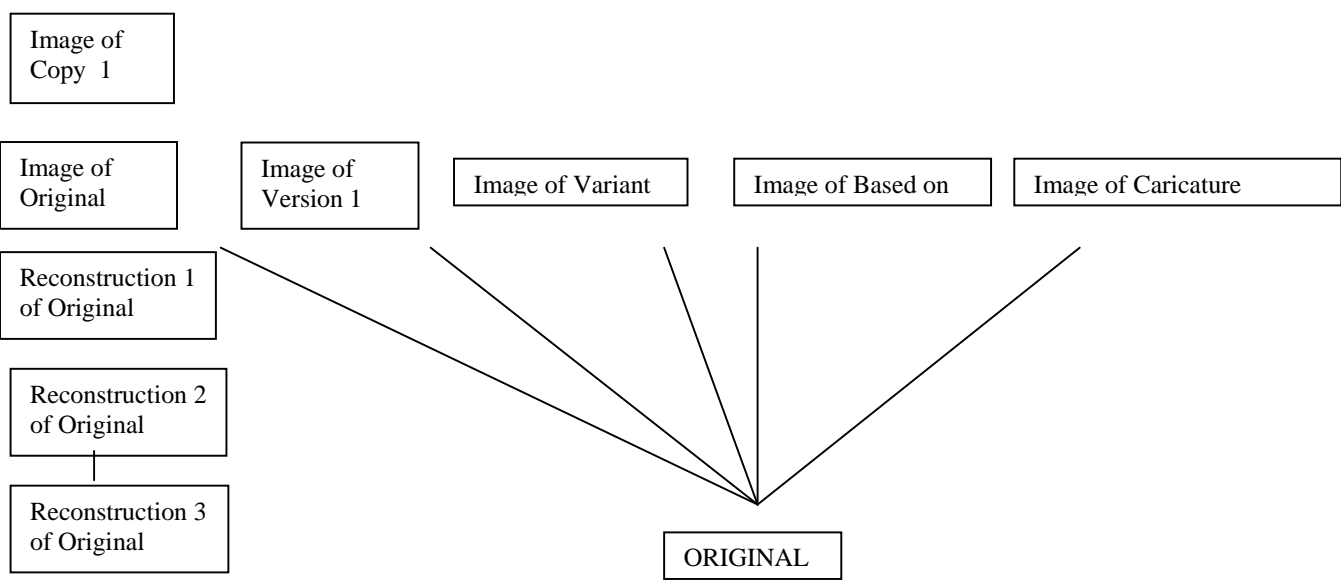


Figure 2. Access to different copies, versions etc. of the same image within a single medium. In combination with the resolutions of figure 1, a single painting thus potentially generates 1260 images.

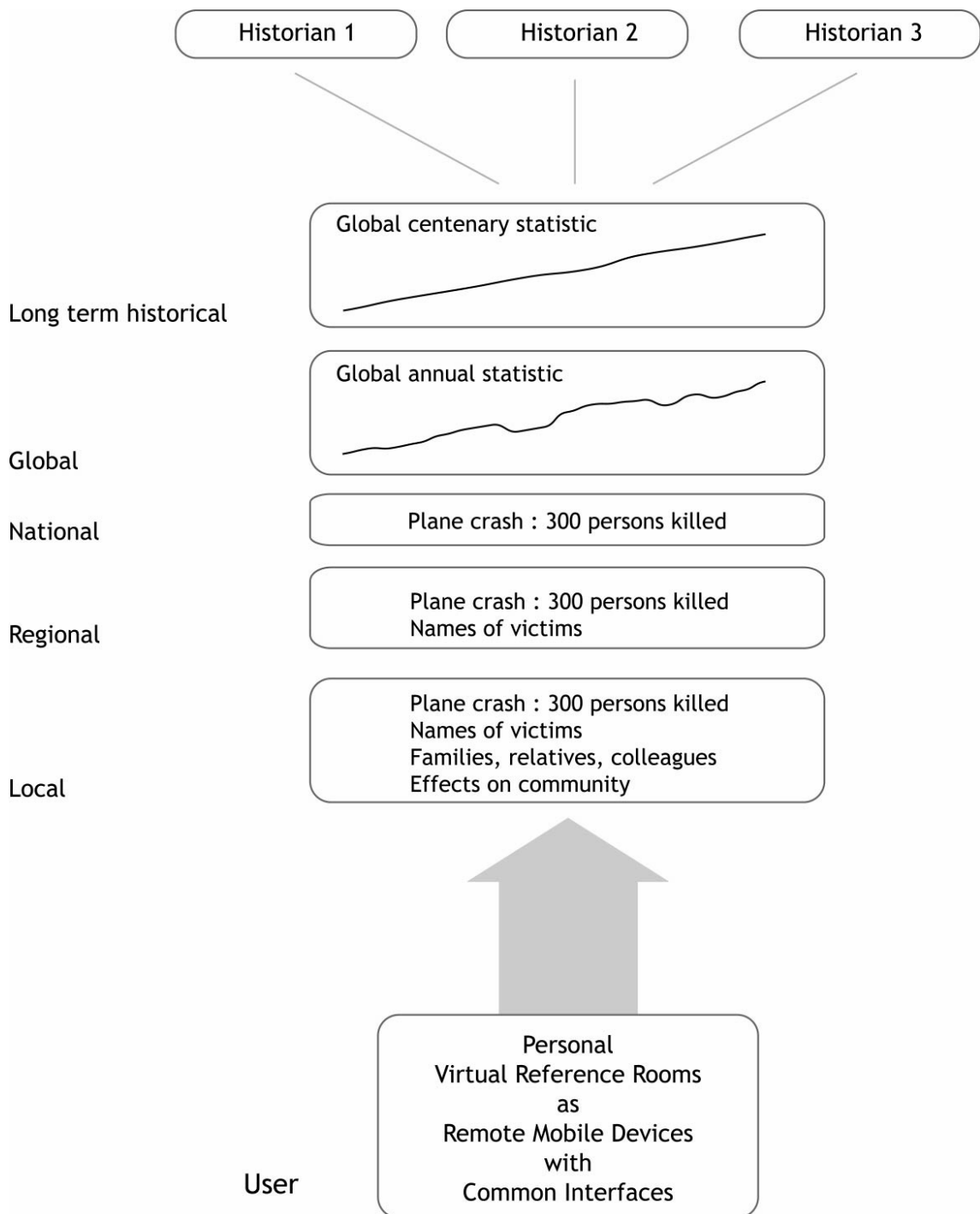


Figure 3. Differences between local, regional, national and global knowledge.

their colleagues at work and so on. At the regional level the same event will be recorded as a plane crash and a smaller number of details concerning the most important crash victims will be provided (figure 3). At the national level, there will be a more matter of fact report of yet another plane crash. At the global level, the actual event is not likely to be described. Rather we shall probably witness a tiny fluctuation in the annual statistics of persons who have died. In historical terms, say the statistics concerning deaths in the course of a century (what the *Annales* School might call the *longue durée*), this fluctuation will become all but invisible.

This example points to a first fundamental problem concerning meta-data. Those working at the local, regional, national and historical levels typically have very different foci of attention, which are frequently reflected in quite different ways of dealing with, recording and storing their facts. The same event, which requires many pages at the local level, may merely be recorded as a numerical figure at the historical level. Unless there is a careful correlation among these different levels, it will not be possible to move seamlessly through these different information sources concerning the same event.

Implicit in the above is also an unexpected insight into a much debated phenomenon. Benjamin Barber, in his *Jihad vs. McWorld*,² has drawn attention to a seeming paradox that there is a trend towards globalizations with McDonalds (and Hiltons) everywhere and yet at the same time a reverse trend towards local and regional concerns as if this were somehow a lapse in an otherwise desirable progress. Looking at the above diagram (figure 3) it becomes clear why these opposing trends are not just a co-incidence. Clearly we need a global approach if we are to understand patterns in population, energy and the crucial ingredients whereby we understand enough of the big picture in order to render sustainable our all too fragile planet. But this level, however important, is also largely an abstraction. It reduces the complexity of the everyday into series of graphs and statistics allowing us to see patterns which would not otherwise be evident.

Yet in that complexity, are all the facts, all the gory details, which are crucial for the everyday person. Thus trends towards CNN are invariably counterbalanced by trends towards local television, local radio, community programmes, and local chat groups on the Internet. This is not a lapse in progress. It is a necessary measure to ensure that the humane dimension of communication remains. In retrospect, Marshall McLuhan's characterisation of this trend as one towards a "global village" is much more accurate than Barber's metaphor because it acknowledges the symbiotic co-existence rather than the dualistic opposition between the two trends.

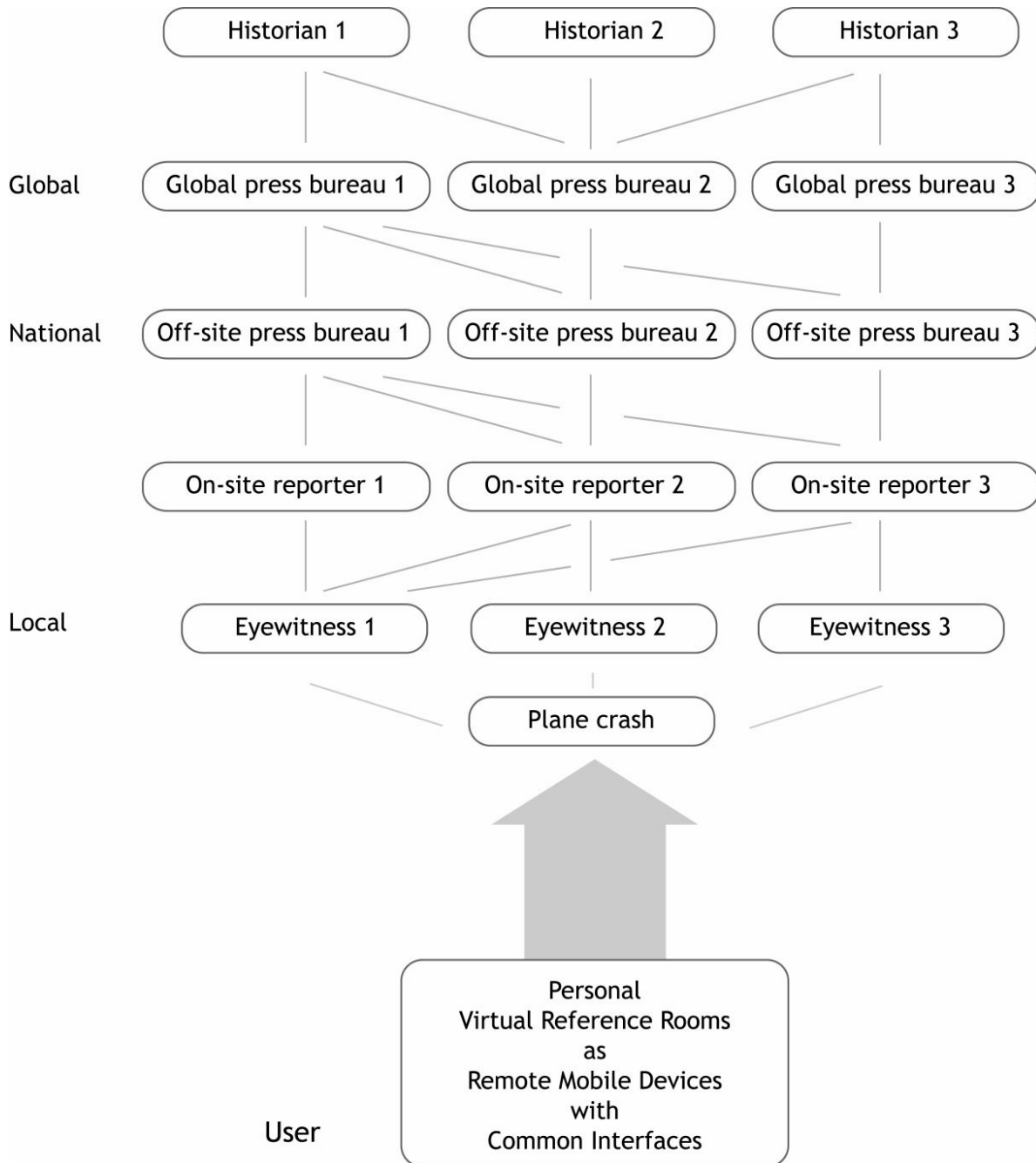


Figure 4. Different eyewitnesses, reporters and press bureaus concerning an event such as a plane crash.

The problems of meta-data become clearer if we pursue the hypothetical case of a plane crash from a slightly different point of view (figure 4). At the event there are usually eye-witnesses. For the sake of our illustration let us posit that there are three. There will also be on-site reporters who may not have been eye-witnesses. Again we shall posit three. They send their material back to (three) off-site press bureaus. These gather information and send them on to (three) global press bureaus. This means, that in our hypothetical example, the "event" has gone through some combination of 12 different sources (3 eyewitnesses, 3 on-site reporters, 3 off-site press bureaus and 3 global press bureaus, ignoring for the moment the fact that the latter institutions will typically entail a number of individuals). When we look at the six o'clock news on the evening of the event, however, we are usually presented with one series of images about the event.

It may in fact be the case that all twelve of the intermediaries have been very careful to record their intervention in the process: i.e. the meta-data will often be encoded in some way. What is important from our standpoint, however, is that we have no access to that level of the data. There is usually no way of knowing whether we are looking at eyewitness one as filtered through on-site reporter two etc. More importantly, even if we did know this, there would be no way of gaining access at will to the possibly conflicting report of eyewitness two, on-site reporter three and so on. There may be much rhetoric about personalisation of news, news on demand, and yet the reality is that we have no way of checking behind the scenes to get a better picture.

Such a level of detail may often seem superfluous. If the event is as straightforward as a plane crash all that is crucial is a simple list of the facts. But the bombing of the Chinese Embassy during the recent Kosovo war offers a more complex case. We were given some facts: the embassy was bombed but not told how many persons were killed. We were told that the Chinese objected as if they were being unreasonable and only many weeks later were we told that this had been a failed intervention of the CIA. Until we have useable meta-data which allow us to check references, to compare stories and arrive at a more balanced view, we are at the mercy of the persons or powers who are telling the story, often without even being very clear as to who is behind that power. Is that satellite news the personal opinion of the owner himself or might it represent the opinions and views of those in whose influence they dwell? If we are unable to check such details we must ultimately abandon our attempts at truth concerning what we see.

The problems concerned with these contemporary events fade in comparison with historical events, which are the main focus of our cultural quest. It is generally accepted that in the year 33 A. D. (give or take a year or two depending on chronology and calendar adjustments) there occurred an event, which might be described as the most famous dinner party ever: the *Last Supper*. From a contemporary standpoint there were twelve eyewitnesses (the Apostles) of whom four were also the equivalents of on-site reporters (Matthew, Mark, Luke and John). In today's terms, their reports were syndicated and are better remembered as part of a collection now known as the *New Testament*— a collation of all the reports of the time minus the meta-data tags. Popular versions with less text and more pictures were also produced: expurgated equivalents of a *Daily Mirror* known as the *Biblia pauperum*.

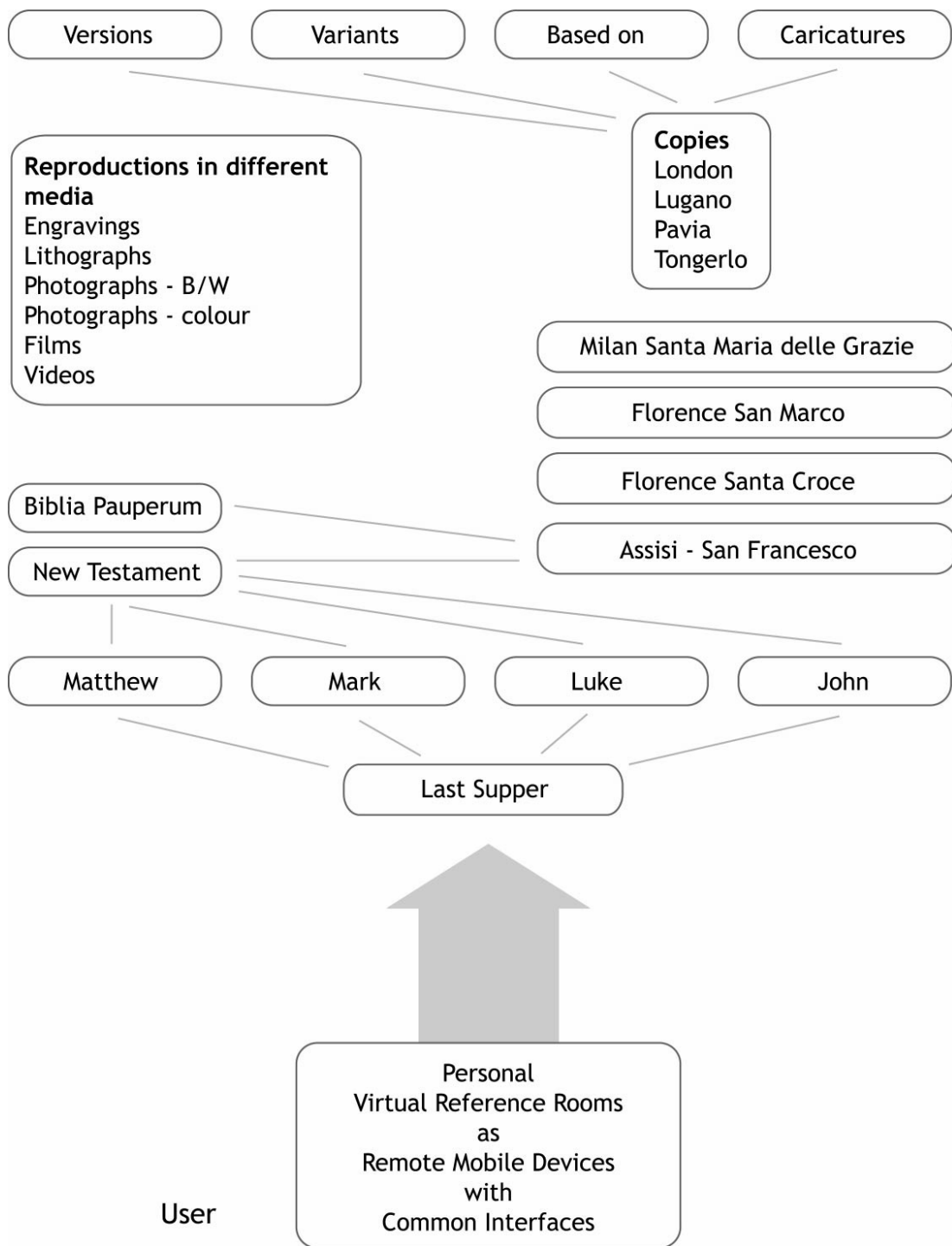


Figure 5. The Last Supper as an historical event recorded in many versions.

The theme was then taken up by the Franciscans in their version of billboards -- without the advertising fees -- known as fresco cycles. This idea developed in Assisi was marketed in their Florentine branch known as Santa Croce where the idea caught on and soon became the rage, so much so that the Dominicans soon used it in San Marco and elsewhere including the church of Santa Maria delle Grazie where Leonardo da Vinci gave a new twist to what had by now effectively become the company slogan. The idea soon became part of the Church's international marketing strategy. Copies appeared on walls as billboards, or rather, paintings in Pavia, Lugano, Tongerlo and eventually London. As part of the franchise strategy multi-media was used. So there were soon reproductions in the form of engravings, lithographs, photographs, three-D models, and eventually even films and videos. In the old tradition that imitation is best form of flattery, even the competition used the motif, culminating in a version where Marilyn Monroe herself and twelve of her Hollywood colleagues made out of the *Last Supper* a night on the town.

As a result of these activities in the course of nearly two millennia, there are literally tens of thousands of versions, copies and variants of the most famous dinner in history, which brings us back to the problems of meta-data. If I go to one of the standard search engines such as Yahoo or Altavista and type in *Last Supper*, I am given an indiscriminate number of the tens of thousands of images concerning the event, which happen to be on-line, or to speak technically, a subset of somewhere between 10 and 30% of that amount which have been successfully found by the leading search engines.

There is no way of limiting my search to the text versions of the original reporters, to large scale wall sized versions in the scale of Leonardo's original, which was eight by four meters, let alone to distinguish between Franciscan and Dominican versions, authentic copies as opposed to lampoons, caricatures and sacrilegious spoofs. To a great expert requiring a system to find such details might seem a little excessive because they might know most of these things at a glance. But what of the young teenager living in Hollywood who, as an atheist, has no religious background and sees the version with Marilyn Monroe for the first time? How are they to know that this a spoof rather than something downloaded from a fifties version of CNN online? A true search engine would help not only the young Hollywood teenager but also help every true searcher. Indeed it should provide truth even if the searcher is "false."

4. Dynamic Metadata

Underlying the difficulties considered above with respect to the *Last Supper*, is a deeper set of problems. We expect our search engines to provide a single, static answer. By contrast, the realities of cultural and historical knowledge entail multiple, dynamic answers with respect to space, time, individuals, objects, concepts etc. Accordingly we need dynamic meta-data to deal with each of these. Some simple examples will illustrate this need.

Space

Current printed maps in atlases are static. Historically the boundaries and names of countries, regions and cities are continually changing. Electronic maps should therefore be dynamic such that they can reflect changes over time: how, for instance, a St. Petersburg becomes a Leningrad and subsequently returns to St. Petersburg, or how a Roman Empire begins in Italy, expands enormously throughout the Mediterranean basin, and then contracts again. As a result if I were searching for something in fourteenth century Poland, the search engine would consult a different map than for the Renaissance or for today.

At the Joint Research Centre (JRC), the Institute for Systems, Informatics and Safety (ISIS), has already developed very impressive three-dimensional maps. In conjunction with the European Space Agency much work is being done in the area of co-ordinating Geographical Information Systems (GIS) and Global Positioning Systems (GPS). A spatial meta-data project should produce dynamically changing atlases and link this with GIS and GPS. This is a pre-requisite for visualising changing political boundaries and new approaches to history.

Time

Current search engines are typically linked to a single time scale. Western knowledge typically assumes a Gregorian (or Julian) calendar. We are aware of Jewish, Muslim, Chinese, Indian and other calendars, but seldom use them. To ensure the development of a global system will require mapping between the standard chronological systems. SUMMA will include these mappings such that one can move effortlessly from a Christian to a Muslim calendar.

A second project will address historical temporal meta-data, whereby one has a standard method for correlating the different time scales of various chronological systems and calendars.

Individuals

A third project will address three problems: changing historical knowledge about an individual, changing perceptions of an individual and problems of assessing the authority of sources concerning an individual. First, there is a problem that what is known about the writings or paintings of an individual changes over time. Today there are static lists of complete works or of a *catalogue raisonnée* of paintings. Such lists need to be dynamic. A second problem entails a paradox that persons now famous such as Montaigne or Leonardo were judged very differently throughout the centuries, almost forgotten in some generations, particularly praised and often for different reasons in other generations. Most of our present methods of presenting individuals do not take adequate account of such aspects.

Third and most difficult is that with a genius such as Leonardo, thousands of persons feel prompted to write something about the man. The number of persons in any generation, who have actually read his notebooks, has never been more than a handful. The Internet potentially offers us access to everyone who cites Leonardo, but has almost no mechanisms in place to distinguish between standard works, generally respected works and non-authoritative lists. A radical proposal of some to re-introduce censorship is, in our view, not a reasonable solution. The problem is made the more elusive because the recognised world authority in one decade may well be replaced in another decade. Needed, therefore, are new kinds of dynamic, weighted bibliographies, which allow us to have subsets on the basis of field specific acceptance, new ways of expressing and recording in electronic form the well established traditions of peer review, (which is totally different from attempts to do simplistic electronic computations of quality), to arrive as it were at peer review with an historical dimension in electronic form and yet still have access to a wider range of less authoritative or more precisely, less established by the authorities, sources in a field. In tackling such alternatives between the authority of sources vs. (mere) citations, we would be using technologies in new ways to return to central questions of quality. Using Leonardo as an example might be a useful way of making visible these new methodological possibilities.

Objects

Present day sources typically focus on objects as static entities. Moreover the limitations of print frequently lead us to focus on one example as if it were the whole category. Accordingly we all know about the Coliseum in Rome but most of us are unaware of the dozens of colisseums spread throughout the Roman empire. Using the dynamic maps and chronologies outlined above (in 1 and 2), new kinds of cultural maps can be developed, which allow us to trace the spatial-temporal spread of major cultural forms such as Greek theatres or temples, Roman colisseums, or Christian Romanesque churches. This will allow novel approaches to long standing problems of central inspiration and regional effects, the interplay between centre and periphery, in some cases between centre and colonies. Such questions pertaining to original and variants (versions, copies, imitations), are again central to the challenges of a European Union which aims to maintain diversity.

Concepts and their Relations

Presently we have many different classification systems and thesauri. Concrete proposals for mapping among these systems exist (Williamson, McIlwaine). Systems such as the Universal Decimal Classification (UDC) and developments in terminology allow more systematic treatment of relations among subjects into classes such as subsumptive, determinative, ordinal etc. (Perrault). A dynamic system, which allows us to switch between classifications in different cultures and historical periods would provide new kinds of filters for perceiving and hopefully appreciating subtleties of historical and cultural diversity. The enormous implications for learning range from the philosophical and epistemological domain, where we could trace the changing relations of concepts dynamically to the humanities with courses on culture and civilisation (a term which again has very different connotations in French, German and English). Instead of just

citing different monuments, works of art and literature, we could explore the different connections among ideas in different cultural traditions. For example, Ranganathan's classification from India is much weaker than Dewey with respect to the fine arts, yet much more subtle than Dewey with respect to metaphysics and religion.

Historical and Cultural Concepts

An integration of the methods outlined (in 1-5) above will lead to new kinds of knowledge maps which allow us to trace the evolution of a concept both spatially in different countries and temporally, in different historical periods. This will allow us to return with new depth to the problems already broached above on several occasions of standard/model versus variants/versions, of centre versus periphery and the role of continuity in the spread of major forms and styles of expression. Here one might use the concept of perspective as an example.

Narratives

An integration of the above methods will further allow a new approach to the history of narrative and thereby new approaches to literature, art and culture as a whole. A culture such as Europe is confined to a significant degree to a relatively small number of major narratives deriving on the one hand from the Judaeo-Christian tradition (the *Bible*, *Lives of the Saints*) and on the other hand from the Greco-Roman tradition (Homer, Virgil, Ovid). We belong to the same culture if we know the same narratives, if we have the same stories in common. Paradoxically those who have the same stories, inevitably develop very different ways of telling those stories. The media differ. For instance, in Italy the lives of the saints most frequently become the great fresco cycles on the walls of churches. In France and the Netherlands, the lives of the saints are more frequently treated in illuminated manuscripts. In Germany, they frequently appear in complex altarpieces. Not only do the media vary but also the ways of telling stories. The Life of Christ in Spain is very different than in the Balkans or within the Orthodox tradition in Russia. Even so the commonality of themes means that a European can feel an affinity towards a Russian Orthodox church, which they cannot readily feel with an Indian temple with stories from the *Mahabharata* or the *Ramayana* (unless of course they know these stories as well).

In these transformations of the familiar lies at once the fascination of change through continuity which inspired the studies of Aby Warburg and his school, but also implicitly, a series of important lessons about the keys to diversity. The most diverse narratives are precisely about the most familiar stories. To visualise and make visible the complexities of our historical diversities of expression is our best hope for understanding the challenges of future diversity. Inherent in such questions lie the seeds for understanding changing definitions of Europe and for developing a vision of the Europes of tomorrow: dynamic phenomena, processes rather than static definitions. Such new multimedia tools will lead many scholars to change their research and others to research the implications of such changes (cf. figure 3 on page 8).

5. Conclusions

Besides interoperability of hardware and software, we need interoperability of content. Three basic problems stand in the way:

- 1) How do we **access** sources in different media distributed in museums, libraries, archives and on the Internet?
- 2) How do we **pre-structure** this information?
- 3) How do we **present** this information using coherent interfaces?

Underlying these three basic problems are ten questions (listed on p. 7 above and discussed in Appendix 4), which are being studied in research institutes around the world. Areas such as remote mobile devices (question 8), geographical information systems (question 9.2), and secure transactions (question 10.1), are being solved by major consortia. Hence, the challenge today is not so much invention as integration of existing methods.

MMI will thus pursue three goals. A first goal, in conjunction with the Centres of Excellence in Digital Cultural Heritage, is to create an intellectual infrastructure for interoperability of digital cultural content. A second, practical, goal is concerned with the creation of prototypes. Here MMI will focus on: a) virtual reference rooms (question 6) as a new approach to how we can **pre-structure** information; and b) common interfaces (question 10) to ensure that we can **access** and **present** information systematically. The Learning Lab and Competence Centre will pursue educational and business applications respectively. A third goal, at the level of theory, in conjunction with the Faculty of Cultural Sciences, is to study the implications of these developments.

The content of cultural heritage marks a first step in a larger vision for a complete interoperability of both scientific and cultural content: a bridging of Snow's Two Cultures. This requires integration (see figure 1) with the important work already underway for a global network of scientific literature and knowledge (Global Info Project). Only then will the global information ecosystems envisioned by the European Commission become a reality. By acting as initial node and co-ordinator of a European Network of Centres of Excellence in Digital Culture and ICT, MMI hopes to play its role in an evolving vision of a European Information and Knowledge Society.

If our goal is truly a systematic access to culture in all its forms, we need a system that includes art in museums, texts in libraries and archives, performances in concert halls and theatres as well as other sources on the Internet. In spite of many important initiatives such as the Dublin Core, the Resource Description Format, the Interoperability Forum and many metadata initiatives we are not in a position to do this today. For the purposes of this paper three simple figures will suffice to make our initial point.

1	Individuals and Concepts	classification of term
2		single term of an individual
3		single text of an individual
4		corpus of an individual
5		quality of corpus
6	Objects/events	resolutions and layers of image in one medium
7		resolutions in detail from local to global
8		copies, versions etc. of same image
9		relevant maps with boundaries adjusted over time
10		relevant calendars with instant conversion to equivalents
11		versions etc. of present event
12		versions etc. of past event.

Figure 6. New kinds of meta-data needed to achieve multimedia access to world cultural heritage.

To achieve these will require more than quick fixes. Entailed is much more than scanning in all the evidence. It goes without saying that the system must reflect all the languages of the world, which is becoming possible through Unicode. We need the materials in some form equivalent to Standardized General Markup Language (SGML).

As was noted earlier (figure 7), we need to be able to take a term or concept and contextualize it. We need to be able to go from any term to all the ways in which it appears in different classification systems and thesauri. We need to be able to trace how an individual author uses that term, to consult the given texts of the author in which that term occurs in all their versions and editions. Similarly we need access to the history of the corpus of texts by an author, with reference to the different ways they were received. (Just as there are fashions in clothes there are fashions in the way authors are appreciated. There were periods in the past few hundred years where even Leonardo da Vinci faded out of the public eye). Ultimately we also need access to information about the quality of the interpretations we are consulting. (Is the person who claims Leonardo was insignificant qua his contribution to science, someone who has actually read the texts?). We thus need new metadata for access to changing cultural/historical interpretations of both individuals and concepts as well as objects and events (figure 6)

With respect to objects we need a systematic correlation of all images concerning them, in all their resolutions, in all the layers of the object (through methods such as infrared reflectography), as well as all the copies and versions of those paintings or objects. We need not just contemporary maps to show us the locations of these objects but also historical maps which reflect the changing boundaries of countries over time. (As a result a query about Poland in the fourteenth century will search a different area of Europe than a query about Poland in the twentieth century). We need adjustable chronologies. And as noted in the diagrams above (figures 13-15) we need seamless movement among resolutions in detail from local to global; different versions, etc. of a present event and versions etc. of past event. To achieve this new form of meta-data a long-term project within the European Commission may be necessary.

Grammar	Structure	Inflexional forms Syntax	SGML, XML
Dialectic	Logic	Search for truth of statement Semantic=Meaning=Semasiology	Resource Description Format (RDF) Virtual HyperGlossary VHG
Rhetoric	Effect	Expression, Style	CSS/XSL

Figure. 17. Links between the ancient *trivium* and recent Internet developments

In the early days of literacy in the West, a series of rules for the use of language evolved. This gradually led to the fields of grammar, (which dealt with the structure), dialectic, (which dealt with the logic) and rhetoric (which dealt with the effects of language). Together grammar, dialectic and rhetoric became the *trivium*, the humanities side of the seven liberal arts (which had its proto-scientific side in the *quadrivium* of mathematics, arithmetic, astronomy and music).

When the Internet began in 1969 it was intended primarily to provide new ways for humans to communicate at a distance. In the past decades, have seen the emergence of a new challenge for the Internet: to provide new ways for machines to communicate with each other without the intervention of humans. This quest helps to explain why the theme of meta-data has become central to the world of computers. In the process it is instructive to note that groups such as the World Wide Web Consortium and the Internet Society are effectively engaged in re-formulating in electronic form, the rules of grammar, dialectic and rhetoric. The syntax aspects of grammar are covered by Standardized Graphical Markup Language (SGML) and eXtensible Markup Language (XML). Recent developments with respect to a Virtual Hyperglossary (VHG)³ are addressing semantic elements of dialectic. Elements of expression and style relating to rhetoric are being covered by Cascading Style Sheets (CSS) and eXtensible Style Language (XSL, cf. figure 17). In other words, the Internet is not just about scanning in our cultural objects and other bits of content. It is also about finding electronic equivalents for all our rules and definitions of knowledge.⁴ And ultimately it is changing our conceptions of knowledge itself. The challenge that faces us is to ensure that these transformations reflect all the diversity of our being rather than reducing us to the limitations of some algorithm. That is why the goals of culture and art are so essential for our future.

Some fundamental aspects of the questions outlined above cannot reasonably be solved by a two or three year project. This is particularly true in the realm of metadata where the current fashion is to concentrate on seeming answers such as the Dublin Core which, while laudable for their pragmatism, are ultimately little more than “quick and dirty solutions.” The reason for momentary success of such approaches is that they promise universal access to at least some basic aspects of collections. A profound danger herein is that an ability subsequently to perform deeper queries of sources may disappear. If Europe truly aims to create a union which maintains the realities of local and regional diversity then it cannot follow the path of a country which aims at a “melting pot” of cultures, guided by the motto: *E pluribus unum*. Europe needs to go *Ex uno plures*.

Further problems with solutions such as Dublin Core are that they focus entirely on contemporary knowledge without attention to cultural or historical changes in knowledge and that they focus exclusively on static knowledge. Needed are new dynamic methods, which will enable access to the complexities of historical and cultural diversity, such that we can develop new kinds of dynamic knowledge maps, some of which are evolutionary. To this end, it is recommended that the European Commission, in the context of its long-term research programme, establish a new kind of meta-data.

Given the complexity of the challenge a certain number of precautionary steps are suggested. First, precisely because this will entail very high level and large-scale technologies in areas where industry will reasonably not see immediate gain, it is recommended that the underlying technologies be developed by the Joint Research Centre (JRC) possibly in conjunction with national research institutes such as GMD and INRIA. Second, a series of key elements, which can be seen as complementary modules, can be developed and subsequently completed in the manner of a puzzle. To ensure that the pieces will indeed fit together is a further reason for giving to JRC a co-ordinating role with respect to development of basic technology. In preliminary terms, we would identify seven elements or building blocks for this new concept of meta-data.

Notes

¹ For an introduction to the problems involved see William Mitchell, *The Reconfigured Eye*, Cambridge, Mass.: MIT Press, 1994.

² Benjamin Barber, *Jihad vs. McWorld*, New York: Times Books, 1995.

³ Peter Murray Rust, Lesley West, "Terminology, Language, Knowledge on the Web: Some Advances Made by VHG," *TKE '99. Terminology and Knowledge Engineering*, Vienna: TermNet, 1999, pp. 618-624. Cf. <http://www.vhg.org.uk/pub/pub.html>

⁴ This has recently been discussed in another context in the author's opening keynote for the Terminology and Knowledge Engineering (TKE '99) Conference: "Conceptual Navigation in Multimedia Knowledge Spaces," Innsbruck, 1999.