Introduction

An Introduction to a Different Point of View About Emerging Technologies for Digital Preservation and Information Modelling

To leverage knowledge we need to enhance both thinking and information. (...) The technical challenge is to design human and information systems that not only make information available, but help community members think together. -R. McDermott, Why information Technology Inspired but Cannot Deliver Knowledge Management, 1999

After more or less thirty years of experimentation and use, new Information Technologies (IT) are no longer new processes, but are a common practice for everyone. Also in the Cultural Heritage (CH), Architecture Heritage (AH) and archaeology fields they are the main tool to develop management, preservation, conservation, communication tasks.

Unfortunately, methods and techniques IT-based today used are a kind of childhood compared to the complexity of processes in which they must be applied. IT-related technologies (e.g. 3D modeling software) in CH, AH and archaeology conservation are used as simple digital surrogate of a physical procedure with some marginal advantages: dematerialization of processes, easy modification and transfer of ouputs (files more than physical media). In any case, nothing is changed in the processing. Also the new presence of the software alongside the hardware as a tool between the professional operator and the final work – theoretically a rich potential solution as already stated by William J. Mitchell at the end of 1970 - produced marginal and usually not positive changes (more speed but not more quality or insight).

Thus, we are witnessing a very strange phenomenon. On the one hand, we have technologies at this point mature, often innovative and usually with great potential. On the other hand, we need to carry out and/or tune tasks and functions generally very complex. Unfortunately, the matching between technologies and task to be done is generally unproductive and impractical for the user inability to understand the technology, for the inability of technology to be appropriate to users.

IT-based technological innovation has not yet made substantial advantages, although desirable both as regards the management and as regards the communication and use of assets. It is still weak, for example, the receipt of the paradigm of the Internet of Things (IoT) and of the Machine-to-Machine communication (M2M), also if in the last years some solutions have been developed, mainly related to protection, access and interpretation of the Heritage.
A major case concerns the lifecycle management of Cultural artefacts. This is a complex process, derived from multidimensional data and approaches. Its achievement involves carrying out many different but connected operations concerning the goods: analysis, knowledge, monitoring, conservation, preservation, organization, exploitation and communication. Moreover, these activities are based on an ongoing collaboration between owners, art historians, architects, scholars, conservators, managers and specialists. This implies the need for a common platform to promote a real collaborative work between all parties involved and a unique management system. Finally, the process of conservation and restoration requires an increasing degree of automation.

In the face of these requirements, today it is usual to have separate processes for each operation, often with multiple players involved in the same stage but using different tools to do the task. We are witnessing then a total lack of accessibility to the entire corpus of information that should be shared by the specialists and the breakdown of the process into discontinuous isolated parts. This makes the process of CH, archaeological and AH management and communication fragmented, expensive, generating marginal richness, completely unrelated to the context in which the item is located, and still limited to major Monuments or Artworks. The main reason of this deficit lies not only in the large amount of heterogeneous data (3D models, images, photos, drawings, written documents, etc.) required by the process, which prevents the immediate usability and an easy transfer of information, but also in the complexity and partiality of the IT-based systems developed to provide an answer to these problems. The best tools of today developed 3D web-based Information System enriched by heterogeneous data, is a solution inadequate, complex to use for CH operators. They also generate high costs and present a lot of other issues.

On the other hand, the rise of portable digital devices, network services everywhere, and user-friendly interfaces led to new workflows, potentially powerful and very efficient.

The availability of a dense interconnected IT infrastructure allows to create a dense network of interconnected global knowledge based on IT-based cognitive systems due to its ability to integrate information and processes in a single medium and then pipeline and distribute contents anywhere, anytime. Today, statistics demonstrate in detail the fact. In 2014, the world had 1.6 billion mobile Internet users, 3 billion fixed-line Internet users, 2.3 billion email users, 1.4 billion Facebook users, and 2.1 trillion Google searches. The overall emerging pattern, then, is a global knowledge that is shared and available at all times and in all places for all type of users, based on a capillary system of infrastructure regarding general concepts and data, such as Open Linked data as defined by Open Knowledge Foundation: “Open data is data that can be freely used, shared and built on by anyone, anywhere, for any purpose”.

A significant shift occurred in the last decade due to the ‘Web 2.0’ paradigm: new applications that enable users to actively participate in the creation, sharing and aggregation of Web contents, rather than mere passive visualization. From this point of view, the era of the ‘webmaster’, which characterized the ‘1.0’ phase, is over because users today generate most of the content.

The phenomenon is today known as user-generated content (UGC) and is a family of Open Data of impressive dimensions, in the way that YouTube hosts more than 16 billion videos uploaded by the users or Flickr hosts more than 10 billion users’ photos.

User Generated Content (UGC) covers a vast spectrum of typologies, including sophisticated products that were a prerogative of professionals only a few years ago. This shift occurred in parallel with significant changes in the Web application development cycle, which today is increasingly based on modular approaches that combine publicly accessible applications and data. A key aspect of these new approaches (which are sometimes indicated as ‘software as services’) is of course the diffusion of stan-
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dards, which makes it possible to integrate different components regardless of the specific architecture and technology with which each is developed.

A second key issue lies in the presence of semantics in structuring recipients accommodating the UGC, to ensure sharing and, often, geolocation.

Geolocation is the identification of the geographical location in the real world of a given object such as, e.g., a mobile phone or a computer connected to the Internet, using different techniques: GPS, mobile network, Wi-Fi network, IP address of Internet network. A key feature of geolocation services is the ability to enable spatial skills that meet the inherent property of man to try to improve their ability to think in spatial terms, and to use spatial skills. The geo-spatial technologies and Location-Based Services (LBS) offer users several means to activate - and sometime improve - basic spatial human skills, answering to basic questions such as “Where am I?”, “What is around me?”, “What can I expect?” and “How do I get there?”.

Recent developments of mobile and web technologies enable Augmented Reality applications to be distributed globally and used by hundreds of thousands of people simultaneously. This approach is called Augmented Reality 2.0. Just like with Web 2.0, the goal of AR 2.0 is to provide widely deployable location-based mobile AR experiences that enhance creativity, collaboration, communication, information sharing and rely on user generated content. With an AR 2.0 platform, a user should be able to move through the real world and see virtual overlays of related information appearing at locations of interest, and easily add their own content. Application areas of AR 2.0 include the following (Schmalstieg D., Langlotz T., Billinghurst M., Augmented Reality 2.0, 2011):

1. **Personal Exploration:** Users can create and browse recommendations, comments and hints about works of arts and leave personal, user-generated content created by tourists and citizens for others in the community;

2. **Culture Information:** Cultural objects can be enriched by virtual media that explains its origin and significance for the city. The accurate overlay of digital 3D work art can simulate new views. Users can contribute with their annotations, post comments or recommendations;

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4. **Art Planning:** Planned, virtual art can be viewed within the real environment of the city. This provides a completely new way in which artist can visualize and examine their visions. The same data can be kept open for the public to give interested citizens the chance to comment on planned works.

In parallel with these trends new proposals and practical experimentations are appearing in the direction of ‘Web 3.0’: ‘The Web of Data’, ‘The World Wide Database’, ‘The Executable Web’, ‘The Internet of Services’, ‘The Giant Global Graph’, ‘The Intelligent Web’, etc. The basic idea underlying such terms is that the Web is going to increasingly support the execution of complex tasks that are currently considered a human prerogative. A typical example is the real-time planning of a vacation by networked machines, services and data providers in a way equivalent to the expert work of a human travel agent.

The main feature of Web of Data is that it is real time. Sensors applied to objects trigger the process.

Different terms have been used to describe this development, including the ‘Internet of Things’; the ‘Machine to Machine communication’; the embedded wireless; and the Smart Living, Cities, Metering,
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Grids, etc. These technologies allow us to combine the real world and information system by connecting the physical and the digital entirely made by machines. When objects can sense the environment and communicate, they become powerful tools for understanding complexity and responding to it effectively. Though such smart objects can interact with humans, they are even more likely to interact with each other automatically, without human intervention, updating themselves according to daily schedules. Kim Veltman (Learning Habits versus Habits for Knowledge: New Horizons, 2012) focuses on IoT effects: “The earliest Internet focused on bits and on born digital words and images on computer screens. The Internet of things is linking the electronic world of computers with objects in the physical world. Present day links are indiscriminate. Future links need to be tagged as relating to persons (who), things, ideas (what), spatial (where), temporal (when), procedural (how) and causal (why)”. Of course, this is not a simple technological progress: this is a key feature in the field of CH, AH, and archaeology where the data are highly heterogeneous. A fully integrated system of systems containing sensing, storage, analytics, and interpretation is required and possible to achieve. A CH information framework enabled by IoT provides a means for consolidating these tasks and sharing data between various stakeholders and Institutions.

The widespread use of the above-illustrated technologies (UGC, Web 2.0, AR 2.0, IoT, M2M) makes increasingly necessary the knowledge of the basic principles of operation of these tools and methodologies going to change the process of acquisition, modeling, and results generation using digital data.

In this book you could find many attempts to exchange and share know-how in the areas of IT-based applications in support of CH, AH & archaeology documentation, preservation and communication, with a lot of attention to these emerging technologies and their relationship with the system of CH, AH & archaeology. The chapters aims to demonstrate innovative uses of these emerging technologies for the discovery, analysis, interpretation and presentation of cultural material, and illustrate applications in the Heritage. Most important for us, the emphasis is not on the most advanced technologies but on the most appropriate solution to many and different unsolved problems in the deputy field. Topics covered range from robotics applications for visiting a museum when the museum is closed, to Building Information Modeling (BIM) processes, to the use of Photogrammetric techniques to (Re)Discover Rock Art Carvings, to pseudo-holography and Augmented Reality applications, to the analysis of painted architecture, to historical reconstruction and virtual restoration of lost architectures and much more.

I can only give one piece of advice to the reader: please enjoy this beautiful book. Through reading you could discover a new world where IT-related technologies and themes are finally going together on a path steadily based and rich in prospects.

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