Cultural heritage plays a crucial role in our social and economical life. During the past few years, there has been a significant increase in research projects related to the effective presentation, quality of service, provision, and management of cultural information through technology. As network technologies become faster and software development environments become more intelligent, researchers and practitioners must understand user needs and propose new, advanced, more secure and more adaptive applications for effectively managing cultural information. Cultural heritage management is a useful means to control and manage cultural information in digital systems. Transforming from a socio-economic understanding of cultural heritage diffusion to digital approaches, cultural heritage management can help in designing and developing efficient digital systems. In an environment of highly heterogeneous accessing mediums, diverse user needs and multiples levels of knowledge, the digitization and management of cultural heritage environments is a promising technology which promises to facilitate the organization of content, dissemination of data, and collaboration among users.

Cultural heritage management is a multidimensional and multidisciplinary concept. This concept has been studied in various disciplines ranging from economics to business administration, from psychology to sociology, and from archaeology to computer science. However, researchers in different disciplines agree about the importance of cultural heritage dissemination in the cultivation of human spirit.

Various cultural heritage management systems have been described in the literature. All these systems face challenges with common characteristics that can be classified in five categories: data capture in many formats under a variety of conditions (environmental or not), semantically-based representation and processing of cultural data and artifacts, visualization and communication (reconstruction, interfaces, interactive games), usage of mobile, distributed and networked systems for data dissemination, and long-term availability (preservation, data migration, legal frameworks, digital rights management, and intellectual property rights).

This handbook focuses on the management of a wide range of cultural environments that can profit from using information and communication technologies in order to support content organization and dissemination. Cultural environments include museums and archaeological sites, festivals and artistic events, government organizations and institutions, and so forth. All of these environments have content that is either being gathered and further organized for internal use and for the public, using various mediums (e.g., organizing the findings of an archaeological excavation; documenting the books of a library; annotating the exhibitions of a museum; presenting an archaeological site and its findings; creating an educational game based on some cultural artifacts).

All of the above processes may be supported today by information and communication technologies at many, if not all, stages. Firstly, databases and digital libraries may be used for organizing cultural content with the use of protocols and standards. Collection owners, museum curators, librarians and
government institutions can use these infrastructures in order to classify and document their information pools. Then, this organized content may be disseminated through the World Wide Web and multimedia applications. Presentation applications that exploit multimedia and Web technologies can be deployed on single computers; on information kiosks; on open areas by using large displays; over wireless connections; and through new interface mediums that exploit motion and position. Trustworthy and secure mechanisms for the distribution of cultural information in heterogeneous computing environments should be deployed along with techniques that permit the provision of guaranteed quality of service to the end-user. Information retrieval systems are able to draw cultural content from repositories and feed them appropriately to the above applications. Additionally, educational applications and games may further exploit cultural content. In all of these processes, some special issues regarding long term availability, content protection, and quality of transmission also play an important role. Conclusively, a variety of information and communication technologies, software applications, hardware systems, and supporting infrastructures can provide rich structuring, retrieving and dissemination capabilities of cultural content environments, while lessening administrative burdens.

This handbook shows how the management of cultural environments can be transformed from a social, economical or bureaucratic concept to a digital one. Thus, it helps readers understand how digital technology can enhance the promotion of cultural heritage and build trust in the usage of new technologies for accessing and managing cultural heritage information. Unlike other publications which focus mainly on the theoretical aspects of digital cultural environments or on specific domains (e.g. museums), this handbook investigates the role of ICT in cultural environments from e-museums to cultural event management systems, and from online artwork promotion sites to virtual reality tools. We want the reader to become familiar with the issues (user needs, design aspects, security issues, quality of service issues) involved in developing software applications for managing cultural information. Special attention is given to the presentation of innovative applications and applied solutions for the effective integration of information systems into the management of cultural information. More importantly, we aim to reveal how to digitize cultural heritage based on social, cultural and technical understanding and how to deploy and disseminate digital cultural artefacts and environments to benefit social cultural conscience.

**Objectives**

The handbook can be used as a reference, providing a general overview of applications and environments and exploring the management of cultural heritage through new technologies.

Specifically, this handbook:

- investigates various definitions or understandings of cultural heritage environments and their characteristics in the digital era;
- overviews the literature on cultural heritage environments modelling and management;
- overviews the literature on existing cultural heritage multimedia applications and potentials;
- discusses the design and development issues of information systems for culture;
- presents functional examples of cultural heritage software applications (digital libraries, databases, information retrieval);
- considers long-term availability issues in the presentation and distribution of cultural information (preservation, data migration, digital rights management, intellectual property rights);
- discusses country specific problems in promoting cultural heritage through the Web;
• explores specific methods for commercial and tourist exploitation of cultural heritage and modern art products;
• and provides expert views on special areas of digital cultural heritage management, human-computer interaction, and other issues related to cultural heritage management, including security, adaptivity, accessibility, personalization, context-aware modelling, multimedia content distribution and dissemination, Web 2.0 and so forth.

The prospective audience would be anyone who is interested in cultural heritage and technologies: academics, museologists, archaeologists, multimedia application developers, web professionals, multimedia network designers and administrators, information security officers, database administrators, museum curators, government staff, cultural organizations administrators, and educators. Scholars and graduate students from information science, computer mediated communication, new media studies and other related areas may also refer to this handbook when designing and developing applications for cultural heritage. We expect this handbook to provide the central leadership for this emerging field, directing scholars and practitioners to the major issues, theoretical perspectives, and interdisciplinary research on the efficient development and utilization of digital media in cultural environments.

Organization

We had 36 chapter submissions for this handbook. We have selected 24 chapters and organized them in sections:

• Web 2.0 applications for cultural purposes: applications used in museums and other cultural installations
• Content management applications including database applications, issues regarding information and digital right management.
• Human-computer interaction issues for cultural environments.
• Design issues for cultural environments, including interface design.
• Cultural applications including museums, open space applications. Applications using new mediums. Access to digital collections and cultural assets.
• Multimedia applications (overview of existing applications and potentials).
• ICT for bureaucratic procedures in cultural heritage facilitating the operation of libraries and museums.

Brief descriptions of the chapters, are as follows:

Web 2.0 Applications for Cultural Purposes: Applications Used In Museums and Other Cultural Installations

Museums and Web 2.0: Some Thoughts about Authority, Communication, Participation and Trust: This study concerns the deployment of Web 2.0 applications in virtual museums. Issues such as the authority, trust, equal participation and efficient communication are considered. The paper analyzes the role of authority, its influence on traditional and future museum communication and its effects on participation and trust. The challenge for the museum is to find a way to cede authority and control over
content without losing its status as a trustworthy institution and to open up for social media and user participation in order to attract new audiences and maintain existing ones.

**Combining Semantic Web and Web 2.0 Technologies to Support Cultural Applications for Web 3.0:** This chapter will help cultural web application developers benefit from the latest technological achievements in Web research area. The authors introduce a 3-tier architecture that combines Web 2.0 principles, especially those that focus on usability, community and collaboration, with the powerful Semantic Web infrastructure, which facilitates the information sharing among applications.

**Web 2.0 and Interactive Systems: Aesthetics Cultural Heritage for Communicability Assessment:** This chapter presents a review of the evolution of interactive systems aimed at the cultural heritage in Spain and Italy. The main goal of the chapter is to establish metrics for the heuristic evaluation of the quality attributes that make up interactive systems for cultural heritage. A methodology for the evaluation of communicability in cultural heritage, Aesthetics Cultural Heritage for Communicability Assessment (ACHCA), is briefly presented.

**Content Management Applications, Including Database Applications and Issues Regarding Information and Digital Right Management**

**BAM: A German Portal to Libraries, Archives, Museums:** This chapter presents BAM, the joint portal for libraries, archives and museums in Germany. The goal of BAM is to provide access to and increase the visibility of German cultural content on the Web. Users are directed from the list of results on the BAM website to the digital object on the participating institution’s website. In addition, an alliance was formed with Wikipedia Germany to offer the possibility to link directly from an article’s web link section to the results of a corresponding BAM search.

**Intangible Heritage Management and Multimodal Navigation:** This chapter concerns the management of multimedia ethnographic archives, containing text, images, audio and videos. Various retrieval options are available in the presented tool and the results can be displayed in an interactive 3D mode. The presented tool is used for the archive of Ethnography and Social History of the Italian Lombardy Region.

**Digital Rights Management in Peer to Peer Cultural Networks:** Digital rights management systems and digital watermarking techniques are employed to encrypt copyright information in cultural content. This chapter explores their complementary roles in a peer-to-peer infrastructure which supports exchange of copyrighted digital cultural content. The study claims that the presented watermarking key detection process within the peer-to-peer framework is very efficient and outperforms the most popular infrastructures used directly for many solutions for peer-to-peer information discovery.

**Human-Computer Interaction Issues for Cultural Environments**

**Museums on the Web: Interaction with Visitors:** A survey of current best practices of virtual museum-visitor interaction is discussed in this chapter. Examples of specific interaction cases are presented and promising research directions for improving the interactivity of e-museums are discussed. The material in this chapter is arranged around the interaction paradigms of Web 1.0, Web 2.0, Web 3D, and mobile Web. The main focus of the analysis is on art museums.

**Activating the Networked Object for a Complex World:** This work focuses on what is called “networked object” which is a concept that resonates with the notion of the operation of virtual collections
within mobile fluids and flows of culture outside and beyond the specific museum context concerns of
traditional documentation systems. It acts as a mediator between the museum world and public culture,
as it circulates between these spaces, and in various cultural, social, political and technological forma-
tions, consumed in many different and unexpected ways.

**Heritage, Place and Interactivity: Rethinking Space Representation as Interface Design:** The present chapter examines the requirements for heritage spatial representation to suggest design guidelines for these interpretive environments. It focuses on the concept of play and its role in the construction of place, or meaningful space, by means of rituals and regulated actions. Examples are given not only from virtual heritage applications but also from other digital works, especially video games, whose implementations to foster user engagement must be regarded as possible key strategies towards creating virtual places in their broadest sense, that is, spaces of multiple possible meanings.

**Representing Culture via Agile Collaboration:** This chapter discusses the special issues presented when developing software for cultural or creative organizations, the development philosophy behind targeted applications, and methods to design ecosystems of small applications that can be combined to meet a wide variety of needs.

**Evaluating the Use of Virtual Reality and Multimedia Applications for Presenting the Past:** Virtual reality applications offer various possibilities for cultural heritage interpretation, such as giving users the feeling of immersion and appealing to all their senses, making their experience lively and memorable. In order to test their effectiveness for assisting learning and successful integration in exhibitions, an extensive evaluation study was carried out in Rome, Belgium and Greece. The chapter analyses how the applications were used, the type of learning different systems supported, how this was affected by the conditions of use, and their suitability for different groups.

### Design Issues for Cultural Environments, Including Interface Design

**Context-Aware Cultural Heritage Environments:** The aim of this chapter is to present the value of context in applications designed for cultural heritage environments and to demonstrate an infrastructure that effectively exploits it. Aspects of context-aware cultural heritage environments and a system for managing context in such applications are presented. The management process of context consists of a number of steps attempting to decouple the acquisition of lower level context from its interpretation to higher level and from its use to define system reactions. Context management is based on a rule-based reasoning process that takes into account both local and global knowledge.

**Requirements on System Design to Increase Understanding and Visibility of Cultural Heritage:** The chapter reports the activities started of a project called MUSE, within the Italian National Research Program on Cultural Heritage PARNASO, which eventually continued within the “Mobile and Ambient Systems” Work Group of the European Network of Excellence in Open Cultural Heritage as part of the CIMAD project. The experiences of the authors towards increasing visibility of cultural heritage sites are reported.

**Personal Digital Collections: Involving Users in the Co-Creation of Digital Cultural Heritage:** This chapter explores the development, implementation, and evaluation of different types of personal digital collection interfaces on museum websites, from simple bookmarking applications to sophisticated tools that support high levels of interactivity and the sharing of collections. It examines the potential impact of these interfaces on the relationship between museums and their online visitors, explores the possible benefits of involving users as co-creators of digital cultural heritage, and offers an analysis of
future research directions and best practices for system design, presenting lessons learned from more than a decade of design and development of personal digital collections systems on museum websites.

**Cultural Applications: Museums, Open Space Applications, Applications Using New Mediums, and Access to Digital Collections and Cultural Assets**

*An Adaptative User Interface for Genealogical Document Transcription:* This chapter focuses on genealogy research in Spain where according to the authors several cultural heritage digitization projects are realized. The chapter analyses the opportunities and characteristics of transcription projects and presents a transcription user interface tool which allows the management of genealogical documentation.

*Urban Memory in Space and Time:* Urban memory can be regarded as an expression of collective memory that has been shaped within a particular space as time goes by. This chapter considers urban memory as an important aspect of the cultural heritage of a city, as it can be captured and preserved for the next generations. It first introduces the concept of urban memory and how this is related to space and time. Then it presents a survey of applications that aim to capture, preserve and exploit urban memory and proposes a system that allows citizens to interact with urban memory both by offering their memories and by viewing the recollected experiences of others.

*e-Infrastructures for Cultural Heritage Applications:* e-Infrastructures, made of high-speed networks and geographically distributed multi-domain computing and storage resources, are nowadays supporting many virtual research communities from all over the world, belonging to various scientific disciplines, making their applications running at a scale of complexity that allows unprecedented studies of very important multi/inter-disciplinary problems. This chapters shows how such platforms can also be beneficial for Arts, Humanities and Cultural Heritage at large. Some exemplar hardware infrastructures, middleware services, and software applications will be shown, in order to provide the readers with an updated information on the state of the art.

*Building Multimedia and Web Resources for Teaching Mathematical Concepts through Their Historical Development:* This chapter describes how heritage and history can be utilized through technological means to build learning materials and non-traditional lessons, which students are expected to learn more willingly due to the link of the mathematics to their own heritage and due to its presentation in an exciting technological way. The chapter, which is based on a project carried out in a teacher training college, presents the structure of the site, which is a web-based learning environment that includes all the learning materials developed by the pre-service teachers who participated in the project.

**Multimedia Applications: Overview of Existing Applications and Potentials**

*Multimedia Technology: A Companion to Art Visitors:* This work reports the experiences of the authors of a project targeted to design and use multimedia technology for personal guides and public projections. The experiences from designing personal guides on Apple iPod touch devices for two exhibitions on ancient and contemporary art are discussed. The exhibitions are rich in content and structure. The guide design are evaluated with questionnaires and automatic tracing of device use.

*User Centered Technologies, Serious Games and Learning: A Critical, Speculative Perspective:* This chapter focuses on the games and mobiles applications for improving the access to digital cultural information. The authors argue that although several multimedia applications and virtual reality simula-
tions have been proposed or implemented for the domain of Cultural Heritage, they fail to achieve mass diffusion due to some inherent limitations. Therefore they propose the above technologies for increasing the user interest for cultural heritage.

**ARCO: Building Virtual Museum Exhibitions with Flex-VR:** This chapter presents a virtual museum exhibition system called ARCO. ARCO enables museum staff to create, manage and display virtual exhibitions of museum artifacts in rich 3D and multimedia forms both internally within the museums and remotely over the Internet through a configurable virtual reality application, called Flex-VR. The chapter provides an overview of the ARCO system, a description of the virtual exhibition design process and examples of virtual exhibitions built with ARCO.

**Educational Personalized Contents in a Web Environment: The Virtual Museum Net of Magna Graecia:** The aim of this work is to present a system called “Virtual Museum Net of Magna Graecia”, by the aid of which personalized learning paths related to Cultural Heritage are supported. The system has been realized in a project promoted by the Regional Operational Programme 2000-2006, aiming at providing an unitary vision of the archaeological patrimony of Magna Graecia in Calabria (a region of Southern Italy).

**ICT for Bureaucratic Procedures in Cultural Heritage: Facilitating the Operation of Libraries and Museums**

**A Strategy Framework for Digital Heritage:** Digital heritage covers a very broad spectrum of human knowledge and expression and thus this chapter focuses primarily on the cultural heritage space. A three-box, three-layer strategy framework is proposed for managing innovation in digital heritage. The concept for this framework is derived from the Govindarajan Three-Box strategy framework. The three layers identify the major sets of challenges that a digital heritage ecosystem has to address. A detailed Singapore case study of a surrogate framework, iGOV2010, is discussed in the chapter.

**Web 2.0 and Idiosyncrasy of Cultural Heritage: A Perspective from Indonesia:** Instead of presenting a technically-focused applications of Web 2.0 technologies for cultural heritage, this paper highlights the inquiry, dialogue, and collaboration behind culture and cultural heritage activities. It also discusses technocultural issues, including Web 2.0, globalization 3.0, and the rise of a new technocultural class, in order to create a framework for culture and cultural heritage approaches before implementing technological solutions to cultural heritage problems.

*Georgios Styliaras*
*University of Ioannina, Greece*

*Dimitrios Koukopoulos*
*University of Ioannina, Greece*

*Fotis Lazarinis*
*University of Ioannina, Greece*