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# ERMIONE - AN E-LEARNING RESOURCE MANAGEMENT SERVICE FOR CONSTRUCTING INTEROPERABLE NETWORKS IN THE EUROPEAN CULTURAL HERITAGE DOMAIN<sup>1</sup>

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## 1. Introduction

As cultural heritage is defined, according to the United Nations Educational, Scientific and Cultural Organization (UNESCO), ‘our legacy from the past, what we live with today, and what we pass on to future generations’ [1]. In particular, according to the most important international treaty in this area, named the ‘Convention concerning the Protection of the World Cultural and Natural Heritage’ [2], which has been adopted by the UNESCO General Conference (Paris, 16th October 1972), cultural heritage includes ‘monuments (architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science), groups of buildings (groups of separate or connected buildings, which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science) and sites (works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view)’. Subsequently the concept of cultural heritage has been broadened and included also the ‘intangible cultural heritage’, which according to UNESCO is defined as ‘the practices, representations, expressions, as well as the knowledge and skills, that communities, groups and, in some cases, individuals recognise as part of their cultural heritage’ (manifested inter alia in the following domains: oral traditions and expressions, including language as a vehicle of the intangible cultural heritage; performing arts; social practices, rituals and festive events; knowledge and practices concerning nature and the universe; traditional craftsmanship)’ [3].

The importance of protecting and safeguarding of cultural heritage in all its forms, tangible and intangible, has been widely recognised. Especially for Europe its rich cultural heritage is of critical importance. For this reason the European Union regards the protection and management of European cultural heritage as a highly significant issue, both as a vehicle of cultural identity and as a factor in economic development; the European cultural heritage section of the official web-site of the European Union stresses that ‘How much people know about cultural heritage depends both on what is done to promote it and also on the capacity of Europeans to become familiar with and appreciate their own culture and those of the other EU Member States’ [4]. In 1974, the European Parliament adopted an initial resolution concerning the need for Community action in the cultural sphere with special emphasis on the protection of cultural heritage. Since 1993, the Treaty establishing the European Community has provided a legal basis specifically for activities concerning the preservation and enhancement of cultural heritage. Article 151 of the Treaty stipulates that the Community must support and supplement action by the Member States in order to conserve and safeguard cultural heritage of European significance. In this direction the action initially taken by the Community was mainly focused on supporting the restoration of ‘built heritage’, such as the Acropolis in Athens and the Chiado historic centre in Lisbon. However, subsequently the Community enriched its spectrum of activities in this area, and took actions with regard to ‘movable and immovable heritage (museums, collections, libraries and archives); archaeological and architectural heritage; natural heritage

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(landscapes and sites of natural interest); linguistic and gastronomic heritage, and traditional occupations' [4].

Information and Communication Technologies (ICTs) offer tremendous capabilities for improving all the functions of cultural heritage management, such as collections management, scholarly study, restoration and preservation, dissemination to the widest possible audiences, etc. According to the 'DigiCult Report' of the Directorate-General for the Information Society of the European Union [5] the digitisation of cultural heritage resources create new opportunities for reaching much wider audiences (e.g. much wider than the people residing in or visiting the place where a specific museum or archaeological site is located), and also for offering them enhanced and attractive interactive cultural heritage services and products. In the same report it is also concluded that the most important application area for such digital cultural heritage services and products will be for education purposes, even though significant demand is expected for recreation purposes as well; however, it is also stressed that in order to produce highly valuable services for these audiences at reasonable costs extensive co-operation and co-ordination will be required between cultural heritage institutions and combination of their cultural heritage resources; the participation of both bigger and smaller cultural heritage institutions will be of critical importance.

In these directions attempts to contribute the ERMIONE (E-Learning Resource Management Service for InterOperability Networks in the European Cultural Heritage Domain) project ([www.ermione-edu.org](http://www.ermione-edu.org)), which is described in this paper. Initially the background and objectives of this project are outlined, then are described the functional and the technical architecture of the e-learning environment it is based on, and finally the methodology of the project is briefly analysed, followed by the conclusions.

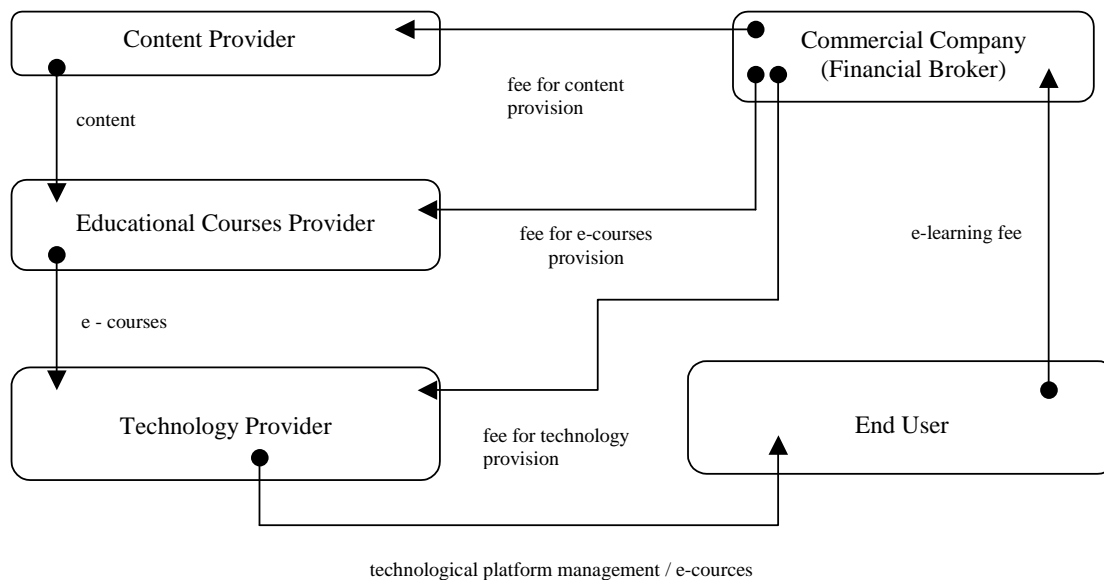
## 2. Background and Objectives

Most cultural heritage institutions (museums, galleries, libraries, archives, etc.) are facing rapid and significant transformations, due to both the development of new highly sophisticated ICTs, which are offering tremendous capabilities, and also at the same time a re-examination of their role in modern societies and an increase of the demands and expectations of the users of their services and products. Gradually cultural heritage institutions are transformed into 'hybrid institutions', which have to manage both 'real' (material) and digital cultural heritage resources, the latter usually including both digitisations of their 'real' resources and 'born digital' resources (which have been created from the beginning in digital form); also, based on both these kinds of resources, they have to offer high quality 'traditional' and digital cultural heritage services and products. However, both the supply of such products and services (by numerous museums, galleries, libraries, archives, etc. geographically dispersed) and the demand for them (by numerous cultural and educational organizations and also by individual consumers) are highly fragmented. Moreover, the development of highly valuable digital cultural heritage content and courses necessitates the formation of partnerships and networks with many digital cultural institutions (e.g. many galleries from several countries with paintings of the same artist), educational organizations, commercial promotion companies, ICT companies, etc.

Electronic marketplaces, according to the extensive relevant literature (e.g. [6], [7], [8]), can improve significantly the functioning and the efficiency of markets characterized by high levels of fragmentation of supply and demand; moreover, electronic marketplaces can also support the collaboration among their participants for the design, production and delivery of new products and services. Such an approach can be very useful in the European cultural heritage sector, especially if it is combined with offering e-learning capabilities as well, which according to the relevant literature (e.g. [9], [10], [11], [12]), has significant advantages: improved quality of education (e.g. through increased use of multimedia educational content including images, audio, video, etc.), easy and low cost modification and update of the educational content, increased 'learner centricity' and personalization capabilities, reaching wider audiences, cost reductions, alleviation of capacity constraints, etc.

In this direction the ERMIONE project, which is implemented as part of the eTEN Program of the European Union (with a total budget of 2,088,304 Euro and a duration of 18 months), aims at the

initial development (up to the level of a number of pilots) and the market validation of an eRM (e-learning Resource Management) service, which is based on an electronic environment supporting the collaborative development and delivery of complex digital content and e-courses concerning the European cultural heritage, through collaboration among many cultural heritage institutions (e.g. museums, galleries, libraries, archives, etc.), educational institutions (e.g. Universities), commercial promotion companies, ICT companies, etc., from all over Europe. Also, ERMIONE aims at creating an ‘electronic-one-stop-shop’ for learners, teachers and researchers in need of cultural heritage resources (content and e-courses); in particular, ERMIONE aims at providing the learners, teachers and researchers a wide range of electronic content and training courses, coming from cultural and education actors from all over Europe. It will allow teachers to build courses concerning European cultural heritage using content and e-learning modules from multiple cultural institutions, and to create and operate virtual classes with students from all over Europe; these mixed studying groups will be able to follow multicultural education programmes and share their experiences, enhancing their access to and knowledge about the European cultural heritage. It will offer to the learners the valuable opportunity to follow virtual classrooms consisting of students coming from all over Europe, and to access high quality courses, contents and virtual classrooms under an European dimension and without limitation of time, place and pace. The higher education sector is expected to be one of the most active users of this service. A ‘technology provider’ company will be responsible for the technical administration of the electronic environment that will support this service. Also, commercial



companies will be responsible for promoting and selling this service. The whole business model of this eRM service that will be developed and market validated in the ERMIONE project is shown in Figure 1.

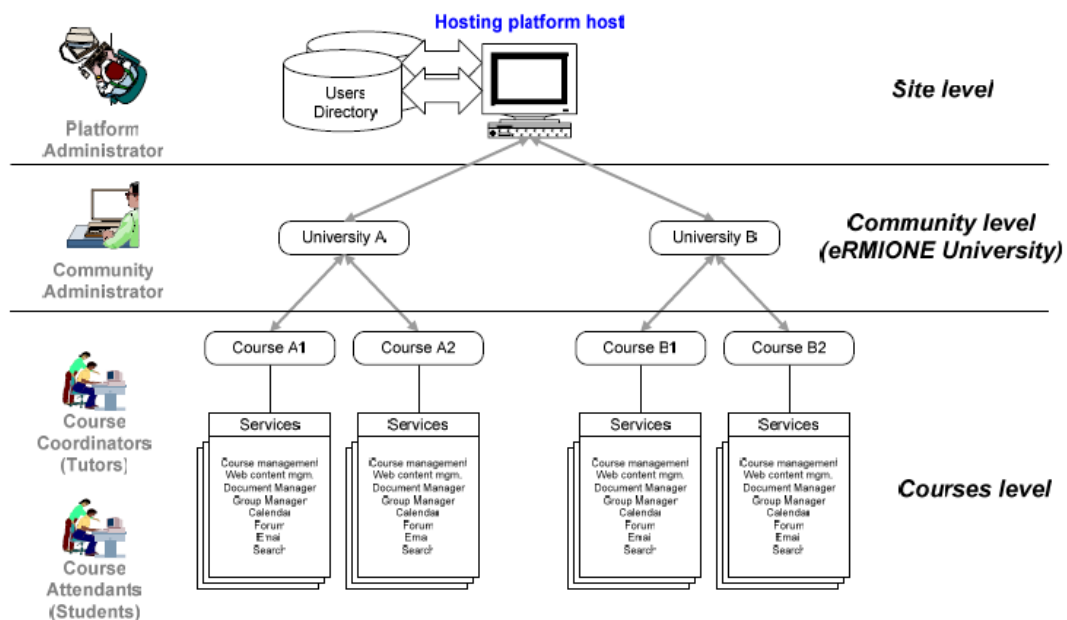
**Figure 1. Business Model of the eRM service of ERMIONE project**

For achieving the above objectives the ERMIONE consortium actually consists of prestigious content providers, higher educational institutions and technical and commercial service enablers. In particular, in the ERMIONE project participate as content providers: Fratelli Alinari ([www.alinari.it](http://www.alinari.it)), who possess the oldest photographic archive in the world, Tilde ([www.tilde.lv](http://www.tilde.lv)), an innovative digital archive based in Latvia and the Head Office of the State Archives of Poland ([www.archiwa.gov.pl](http://www.archiwa.gov.pl)), who will bring to ERMIONE project their valuable collections of records and documents. Also, in the project participate two higher education institutions, who will create, manage and share electronic training courses addressing cultural heritage matters: University of the Aegean ([www.aegean.gr](http://www.aegean.gr)), who will provide their experience in the areas of cultural informatics and e-learning, and Katholieke Universiteit Leuven ([www.kuleuven.ac.be](http://www.kuleuven.ac.be)), who will provide their relevant expertise in intercultural learning and research processes. In the project also there are three service enablers, whose role is to define the business strategy, to set-up the pilot service, to ensure that all the components are properly put in place and integrated: Fondazione IARD ([www.fondazioneiard.org](http://www.fondazioneiard.org)) as project coordinator,

European Dynamics ([www.eurodyn.com](http://www.eurodyn.com)), as provider and technical administrator of the electronic environment (IT platform) of the project and Atos Origin ([www.atosorigin.es](http://www.atosorigin.es)), who will bring their expertise in the areas of market studies and development of Pan European business.

### 3. Functional Architecture

In Figure 2 the functional architecture of the electronic environment of the project is shown. It has a hierarchical structure. At the highest level of this hierarchy we can see the 'Site level', which is only accessible by 'platform administrators', who will set up the 'communities' (each community can be considered as a virtual university, offering a number of courses), as well as connections to particular (existing) user directories. The 'Community level', which is the second level in the hierarchy, will be accessible by the 'community administrators', who will be responsible for connecting courses to each community and for securing the services to them. The basic platform item, the course, is located at the third level, which is the 'Courses level'; this level includes eight basic services, which support the collaborative development and delivery of complex digital content and e-courses: web content manager, documents manager, courses manager, group manager, search engine, calendar, forum and e-mail. This third level is accessible by all users of the platforms (such as 'course coordinators' (tutors) and 'course attendants' (students)), albeit with different access rights.



**Figure 2. ERMIONE Functional Architecture**

The above functional organization of the platform and its services, in combination with its technical architecture, which is described in the next section, offers enhanced scalability and extensibility capabilities. This flexible and hierarchical organisation also enabled the definition of clear roles for each system user and an easier implementation of the security module.

### 4. Technical Architecture

In Figure 3 we can see the technical architecture of the electronic environment of the project. It is a three-tier architecture, based on J2EE and following the J2EE standards and suggestions. Concerning the 'client tier', it can be accessed through several client types, such as standard web browser, desktop applications, personal digital assistants (PDA), mobile devices and third party systems exchanging content in standardized ways. In the market validation phase of the project web browsers and mobile devices (using SMS) will be used as clients; however, depending on the market needs, other mobile devices will be enabled in the initial deployment phase. In the 'middle tier' Servlets and JSPs are responsible for collecting the user input and presenting the system response. The controller servlet on the other hand is a special type of servlet and connects the presentation tier with the business logic tier,

which communicates with the different data sources located in the ‘persistence tier’. The web services module gives the ERMIONE platform an additional dimension for exporting its services and content to external systems and applications. For presentation purposes, several web service enabled methods (user login, list of available courses, list of available universities, list of course members) are available. Other platform methods can also be made accessible via this way. Furthermore, the architecture also supports several connections to possible back-ends (LDAP, file system, database, etc.) as shown in Figure 3.

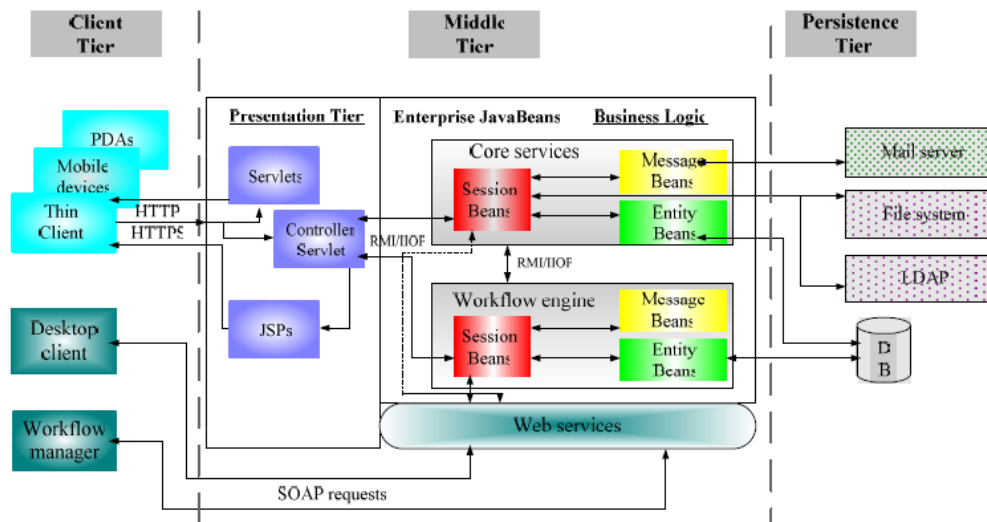


Figure 3. ERMIONE 3-tier Technical Architecture

The design and development the above eRMIONE platform was based on reusing Open Source Software (OSS) components; we decided to proceed to a homogenous platform solution rather than a combination of technologies and platforms. In this direction the following OSS tools have been used for the creation of this platform: the Basic Collaborative Platform (BCP) which has been developed by European Dynamics, JBOSS J2EE application server, Tomcat web container, MySQL RDBMS, Jakarta Struts Apache foundation (powerful Web application framework), Jakarta Lucene Apache foundation (powerful full text search mechanism), Jakarta Log4J user activities and system events logging mechanism, Netscape LDAP JDK (LDAP server connectors), a set of Jakarta XML frameworks (Xerces, Xalan Xerces and Xpath), Axis web services platform and Jakarta Ant building and distribution tool. The platform can run on a big number of RDBMSs (e.g. Oracle, MS SQLServer, etc.) and application servers (e.g. BEA Weblogic, IBM WebSphere, Oracle Application Server).

## 5. Methodology

As mentioned in section 2, the main objective of the ERMIONE project is the initial development and the market validation of an eRM (e-learning Resource Management) service, which is going to support the creation and operation of interoperable networks in the European cultural heritage domain, and the collaborative development and delivery of complex digital content and e-courses in this area, in order to create the foundations for the full scale deployment of this service at a pan-European level. The main focus of the project is to validate in ‘real-life’ conditions the business model of this service, which has been described in the previous sections, to verify the market response, to assess to what extent this service meets users' needs, to identify possible business partners in all European countries and to investigate sources for financing the complete roll-out of the service in Europe. In order to accomplish the above objectives the following tasks will be carried out:

**D) Market analysis:** first, a preliminary version of the business plan will be developed, based on a market analysis in the participating countries (namely Italy, Belgium, Spain, Greece, Poland and Latvia); this preliminary version of the business plan will be then constantly updated and refined during the lifetime of the project and based on the results of the market validation phase.

II) Validation of the service/business model through pilots: a number of pilots will be set-up, which will include the development and delivery of e-courses in the area of cultural heritage by the two higher education institutions participating in the project, using digital content that will be provided by the three content providers participating in the project; then the real market validation phase will start, with users accessing the service and providing feedback on their reactions and level of satisfaction.

III) Evaluation and development of the final deployment and business plan: finally all the operational and market information that will be collected in the previous tasks will be analysed and evaluated in order to validate the whole business model of this service and the feasibility of its deployment in the market; for this purpose we are going to develop an integrated evaluation framework, based on the Technology Acceptance Model (TAM) ([13], [14]), and extended with variables measuring the extent of accomplishment of the educational objectives; based on the above conclusions the final deployment and business plan will be developed.

## 6. Conclusions

The ERMIONE project aims at the initial development and market validation of an eRM (e-learning Resource Management) service, which is based on an existing electronic environment, and supports the collaborative development and delivery of complex digital content and e-courses in the area of European cultural heritage. This service is expected to assist the formation of cultural heritage networks, consisting of cultural heritage institutions (e.g. museums, galleries, libraries, archives, etc.), educational institutions, commercial promotion companies, ICT companies, etc., from all over Europe IT, for the design, production and delivery of advanced digital cultural heritage products and services.

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