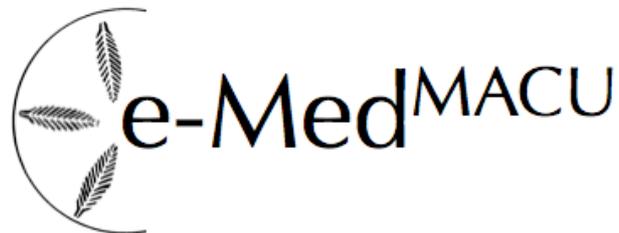# STARTPAGE

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PART B



# A *Virtual Research Environment* for Multidisciplinary Based Typological and Chronological Studies on Late Roman Material Culture in the Western Mediterranean

# Part B -Table of Contents of Proposals

**B1 Scientific and technological Quality (maximum 8 pages)**

**Scientific and technological Quality, including any interdisciplinary and multidisciplinary aspects of the proposal**

'Material culture' is a generic term used for objects produced by human beings, including buildings, structures, tools, weapons, art and indeed any manmade physical items (Darvill 2002). Among the archaeological artefacts that pertain to material culture, pottery has been widely used to reconstruct ancient societies and cultural identities (Hurcombe 2007; Skibo and Shiffer 2008; Knappett 2005; Childe 1958). Since Neolithic times, pottery is the most abundant material found in archaeological excavations. This is because pottery was commonly used in the transformation processes and many other activities but also to the fact that once broken and deposited in the archaeological record is practically indestructible. Also for this reason pottery characterisation and classification does not concern only the systematisation and description of the found manmade objects operating during the archaeological excavations, but rather the starting point of an investigation of human populations with respect to all the declensions of their social and cultural activity (Bowser 2000; Neupert 2000; Starck *et al.* 2000).

Classification can be understood as the activity of arranging a number of items of a given domain of interest into pre-defined taxonomical structure of types. Within the field of archaeology, such structures have focused on the occurrence of specific attributes which were selected by researchers as diagnostic of particular chronological, spatial, or cultural boundaries (Krieger 1944; Adams and Adams 1991). Because types, as attribute clusters, are often equated with chronological or cultural stratigraphic sequences, the appearance, floruit, and decline of specific attributes in the archaeological record is frequently interpreted as the evolution of different stylistic markers in artefact classes over time and space (Ford 1949). The definition of types depends on the availability of certain information about features and properties of the domain items. We call 'characterisation' of an artefact the set of all the different kinds of information attached to it. In archaeology, 'typology' classifies objects on the basis of a given characterisation. In the case of pottery, the characterisation may include information about the geometric and mereological structure of the object, its morphology, the physico-chemical and mineralogical composition of the materials of which it is made, its intentional and non-intentional functional role, the modes of its production, its stratigraphic context, the geological features of the area in which it was found. We call 'multi-dimensional characterisation' (MDC), a faceted characterisation of an artefact that embodies information of different kinds (e.g. qualitative and quantitative) coming from different disciplines (e.g. archaeology, ethno-archaeology, archaeometry, ethno-archaeometry, material science and geology).

The current state-of-the-art of typology and artefact characterisation in archaeology shows epistemological and technological bottlenecks that impede the possibility to solve a number of issues and get historical conclusions in several contexts of investigation. Types are abstractions, developed from the arbitrary selection of specific attributes as definitive markers. In the absence of a well defined and commonly accepted methodology to identify markers and attributes, and to cluster them into specific types, it may occur that: (i) multiple type names are produced for the same cluster of attributes by distinct research teams; (ii) types remain so ill-defined in the specification of the attributes selection and clustering that they result useless for the rest of the scientific community; (iii) types are defined only on the basis of morphological and dimensional attributes, and do not take into account a MDC of artefacts.

The case of Late Roman Cooking Wares (LRCW) in the Western Mediterranean is paradigmatic on this respect. The specific characteristics of the subject make the application of traditional approach to ceramic research extremely problematic. In particular, the classification and its significance in archaeological terms may be difficult due to several reasons. First, these ceramics may not be very different in terms of typology as they have important similarities derived from similar functional requirements as they were used for the transformation of aliments. Secondly, the co-existence of *imported* and *local productions* and the progressive appearance of many local and or regional productions (indicated by the archaeological record) makes traditional typology based on morphological and dimensional attributes not very informative for LRCW because most of the times the productions identified in this way respond neither to cultural nor to chronological differences.

Experts on LRCW in the Western Mediterranean agree on the fact that problems of typology and chronology arise in this context mainly because the definition and use of types does never take into account the MDC of the ceramic artefacts. Even in the case in which a MDC of pottery is potentially available (as for the LRCW), the specification of *self-consistent*, *comprehensive* and *explanatory types* still remains a strong problematic issue. The reason is clear. The information contained into a MDC comes from distinct disciplines, for whose integration there is no established methodology yet. The absence of such a methodology has prevented untill now the design of a formal model for representing and manipulating multi-disciplinary knowledge on LRCW and, therefore, it has blocked the development of MDC-based computational systems able to support experts in solving typological and chronological issues.

A tangible effect of this lack of computational support is that experts are forced to use different tools and algorithms for performing artefact characterisation and classification according to the data to be used (e.g. tools performing multivariate statistical analysis and clustering on archaeometrical data, logic-based algorithms and Bayesian inference methods to analyse morphological or petrographic data, neural network systems for shape based classification). When inconsistencies or ambiguities in interpretation arise, experts can do nothing but handle them by hand. The ability of experts to solve this kind of inconsistencies based on a MDC of the artefacts still remains tacit and, for obvious reasons, it can never rely on a massive integration and comparison of large amounts of data.

Given these premises, our project aims at fulfilling the methodological gaps in the present state of art of typological studies of LRCW in the Western Mediterranean, and to provide a knowledge-based computational infrastructure supporting MDC and classification of LRCW. The computational infrastructure will assume the form of a *Virtual Research Environment* (VRE) with the following functionalities: (i) web-based access to very large information collections and analytical results that are stored up today into fragmented, heterogeneous and distributed digital repositories maintained by distinct research teams; (ii) multidisciplinary sharing of expert knowledge on characterisation, typology and dating of artefacts; (iii) geovisualization of information back to scientists; (iv) a 'virtual lab' for MDC-based analysis and classification of LRCW in the Western Mediterranean.

The integration of different yet interrelated disciplines (archaeology, archaeometry, raw material study and study of mechanical and thermal properties) ensures the interdisciplinary and multidisciplinary nature of our proposal. The project aims at exploiting Artificial Intelligence (AI) techniques to design a VRE for gathering, sharing, and manipulating data and knowledge coming from a number of distinct disciplines, and this also promotes the multidisciplinary nature of the proposal. The presence of an international network of scientists which are exploring innovative ways to integrate and synthesize the analytical results of distinct disciplines with the aim of solving questions about production, distribution and consumption patterns during the Late Antiquity, guarantees the scientific and technological quality of the project. The fact that their effort has been internationally recognised by means of an Exploratory Workshop of the European Science Foundation (Barcelona, Spain, 2008) confirms the interest of the case study and strengths in this respect the feasibility of our proposal.


**Objectives and expected results as outcome of the project**
The main objective of the project consists in the development of a *Virtual Research Environment* for multidisciplinary investigation of LRCW in the Western Mediterranean. The VRE will provide access to *information*, *knowledge* and *analytical results* coming from archaeology, archaeometry, raw material study and study of mechanical and thermal properties, together with the possibility of manipulating these resources and analysing them by means of an innovative classification system. Up to now, there is no consolidated multidisciplinary methodology for classifying LRCW's. The consolidation of such methodology is precisely one of the main goals of the project. The epistemological foundation of this new methodology is essential to design and implement a VRE with the above characteristics. This epistemological foundation will traduce into a formal (ontologically consistent) model for a MDC of the ceramic artefacts, on the one hand, and into a set of analysis and heuristic classifications, on the other.

In order to achieve these objectives, a number of specific results are expected concerning both the LRCW in the Western Mediterranean case study, and the technological development of the VRE:

- Recovery and systematisation of all the available archaeological and archaeometrical information;
- Recovery and systematisation of all the available data produced by raw material study and study of mechanical and thermal properties;
- Design and implementation of an ASP (Answer Set Programming) based system for multidisciplinary information and knowledge integration:
  - Specification and formal representation of a unified ontological view on the recovered information and acquired knowledge[1];
- Design and implementation of an ASP based system for the multidisciplinary analysis and classification of pottery:
  - Specification and formal representation of a mereological theory for manmade ceramic artefacts;
  - Specification and formal representation of a set of multidisciplinary heuristics, combining qualitative and quantitative markers, for the analysis and classification of ceramic artefacts;
- Design and implementation of a geovisualization module, based on existing GIS technologies, that is fully interoperable with the information integration and with the analysis and classification systems.

As regards to the fellow, one of the main results of the project will be that of giving him the opportunity to increase his competencies in KR and AI by playing an active role into the exploration of a completely new multidisciplinary line of research. The project is coherent with part of his previous research activity on the formal representation of knowledge about manmade artefacts production, and this will offer him a way to consolidate previously obtained results, to achieve new ones, and to strengthen the quality of his scientific investigation. Furthermore, the challenge of developing a VRE for a new multidisciplinary way of doing archaeological research, and with the collaboration of an international network of scientists, represents an ideal chance for him to acquire new professional skills in the field of *e*-Science and VREs development.


**Originality and innovative nature of the project, and relationship to the 'state of the art' of research in the field**

The case of LRCW in the Western Mediterranean is of particular interest for a rethinking of the methodological foundations of modern typological studies and artefact characterisation in archaeology. As regards to this domain, in fact, typology and ceramic artefact classification still suffer the lack of a comprehensive, systematic and digital collection of all the available information and, therefore, the lack also of a shared research ground for an integrated use of this information. The development of ceramic research incorporating new and innovative archaeometrical studies, complemented with raw material studies and the study of the mechanical and thermal properties of ancient pottery has been relatively scarce or even inexistent in the case of LRCW. It is true that several studies combining archaeology and archaeometry (between others: Peacock 1982, 1980; Fulford & Peacock 1984; Cau, 1993, 1994a, 1994b, 1996, 1998, 1999, 2003; *Cau et alii* 2002; Ramon & Cau, 1997; Buxeda *et alii* 1997, 1999, 2005; Santoro *et alii* 2003; Santoro, 2005; Montana *et alii* 2005a, 2005b, 2007; Chiocci 2005; Paoletti 2005; Pantili 2005; Rinaldi *et alii* 2005; Maurina & Capelli 2005; Treglia 2004; Pasqualini & Treglia 2003), some including basic studies of raw materials from surrounding areas, are now available. There are also studies combining archaeology and ethno-archaeology (Kramer, 1985; Costin, 2000; David and & Kramer, 2001; Kolb, 2001; London, 2000b; MacEachern, 1996; Sinopoli, 1991; Arnold, 2000; Hegmon, 2000; Krishnan, 1997; Matson, 1995a; Rice, 1996; Tite, 1999; Vandiver, 2001), ethno-archaeology and raw materials study (Buxeda *et alii* 2003; Cau et. al, in press), and studies focusing their attention exclusively on the study of mechanical and thermal properties (Kilikoglou *et.al.,* 1995; Kilikoglou *et.al.* 1998; Kilikoglou and Vekinis,, 1998; Kilikoglou, 2002; A. Hein and Kilikoglou**,** 2007**;** Hein *et.*

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[1] In general, the ontology engineer obtains the data from several source databases, which are combined in a unified ontological view. The instances of ontology entities are virtually populated by means of special ASP logic rules, which act as a mapping from the information stored in database tables to ontology instances.

al., 2008; Martínez *et al.*, 2008; Hein *et al,* in press). Nevertheless, there are no works published combining all the above mentioned disciplines together, when the integration of all these different disciplines is probably the only way to be able to provide a multi-dimensional characterisation of ceramic artefacts and to consider all the variables which affect the relationship between material culture and society - and this is one step further to the present state-of-the-art in this field.

Considerable effort has been spent in recent years to explore the possibility of automatic pottery classification by means of computational tools (Adams 2007; Barceló 2009), the state-of-the-art of automatic systems build on top of a multi-dimensional characterisation of the artefacts is still poor or even inexistent. The already implemented computational tools are inspired by: *connectionist* and *symbolic* AI, and *data mining* approaches. The literature shows an increasing trend in the application of neural networks (Barceló 1996; Reeler 1999; Ramil *et al.* 2008). These applications work often on artefact profile representations obtained by means of laser scanning techniques and automatic profiling (Kampel, Sablatnig 2007; Gilboa *et al.* 2004). Data mining algorithms, based on multivariate statistical techniques are also playing an important role in the field of pottery classification and clustering over archaeometrical results. However, due to the different characteristics of the materials, both the connectionist and the data mining approaches have found relevant applications with respect to the archaeological studies of lathed and quasi-serial artefact productions, while they are almost disappearing when local and handmade ceramic productions are concerned (as in the case of LRCW). This picture confirms that the methodological improvement the project aims at providing represents a genuine innovation in that field of research. On the other hand, the characteristics of the artefacts, their historical context (characterised by the change from the *world socio-economic system* of the Classic and Roman Antiquity, into the Late Roman, then Medieval *close or regional socio-economic system*), the issues the experts have to cope with, give to the project a scientific relevance that goes beyond the chronological and geographical boundaries of the specific case study.

Furthermore, the development of computational infrastructure, fostering the "collaboration between research teams and resources across Europe and around the world, the capacity to use and manage exponentially growing sets of data"[2] in the field of archaeological studies is today at its very beginning. In particular, the use of innovative VREs, that is one of the most visible part of the *e*-Science paradigm shift, is still far from being a consolidated practice in archaeology. The most consolidated examples of application of ICT technologies to develop *e*-Science systems for the archaeological research are today represented by the pool of projects supported by *Arts and Humanities e-Science Support Centre* (AHeSSC)[3]. The lead actor of this pool is the **Archaeology Data Service** (ADS) project[4]. Started at the end of Nineties the ADS represents an invaluable point of reference for all interested in the preservation of digital data in the long term, and for the promotion and dissemination of broad range of data in archaeology. Up to now, the data stored in the ADS are described with an ADS metadata set based on the **Dublin Core**. The project maintains: (i) an integrated metadata search facility for a catalogue of 1039110 items about archaeological interventions, sites, and monuments; (ii) project archives with data available for download and off-line analysis; (iii) special collections whose data sets can be queried using online tools; and (iv) library resources. Since the year 1999, several projects have received the contribution of the ADS[5] (see, in particular, the VERA project - Virtual Research Environments for Research in Archaeology - http://vera.rdg.ac.uk).

A number of other digital collections and repository projects are addressing problems related to the digital storage, maintenance, and dissemination of archaeological data. The **Online Cultural Heritage Research Environment** (OCHRE)[6] is the follow on to *XSTAR (XML) System for Textual and Archaeological Research*. This online centralized repository was created to facilitate the dissemination of archaeological and cultural heritage data. Users communicate via a Java interface

[2] *ICT Infrastructures for e-Science*, Brussels (2009).
[3] http://www.ahessc.ac.uk/.
[4] http://ads.ahds.ac.uk/.
[5] An updated list of the projects can be found at the URL: http://ads.ahds.ac.uk/project/projects.html.
[6] http://ochre.lib.uchicago.edu/.

to search for or, upload and download data sets. OCHRE uses a semi-structured data model characterized by hierarchical tree structures. ***ArchaeoML***, an XML-scheme for archaeological data sets, has been developed as part of the ***Integrated Facility for Research in Archaeology*** (INFRA). INFRA provides storage and retrieval of archaeological information and forms the basis of OCHRE (Schloen 2001). The ***Alexandria Digital Library*** (ADL)[7] project supports the earth and social sciences more generally, rather than just archaeology. It provides a federated, spatially searchable digital library of geographically referenced materials such as maps, photographs, and satellite imagery (Hill 1999). The ADL team developed their own metadata schema to address both physical and digital resources. The ***Electronic Cultural Atlas Initiative*** (ECAI)[8] provides access to shared datasets with an emphasis on geo-temporal data (Lancaster 2002; Buckland 2004). The data and their associated metadata are stored in a centralized database and data queries are made through a web-interface. The ECAI metadata used to describe the data are based on the *Dublin Core* metadata set and contain additional elements specific to archaeology (e.g temporal and spatial information). ECAI offers a map-based visualization tool called *TimeMap* (2007). The ***Pacific And Regional Archive for Digital Sources in Endangered Cultures*** (PARADISEC)[9] provides digital conservation and access to materials from endangered languages, cultures and music from the Pacific Region.  It uses open standards and tools, and currently has a 2.5 terabyte repository of digitized materials supported by a rich metadata catalogue of project materials. PARADISEC allows users to access, catalogue and digitize audio, text and visual materials.

The originality and innovative nature of our proposal can be evaluated along two distinct dimensions: the first one refers to the impact the MDC based methodology may have on the archaeological study of past ceramic artefacts; the second one concerns the development of a VRE for archaeological studies that combines: (i) web-based information access and multidisciplinary knowledge sharing among an international network of scientists with (ii) a virtual lab for the analysis and classification. As for the realization of the first task, the project will benefit from the expertise and knowledge of the ERAUB group of the University of Barcelona, and of the international network of scientists of which it is part. As for the second task, there are two distinct aspects that have to be considered: one is the *data management* and metadata creation; the other is *data analysis*. The project aims at developing the core computational structure for both the first and the second sub-task within the declarative framework of *Answer Set Programming* (ASP). Answer Set Programming (ASP) (Gelfond and Lifschitz 1991) is a powerful logic programming language, which is very expressive in a precise mathematical sense; in its general form, allowing for disjunction in rule heads and nonmonotonic negation in rule bodies, ASP can represent every problem in the complexity class $\Sigma^P_2$ and $\Pi^P_2$ (Eiter et al. 1997). In particular, the project will exploit the OntoDLV[10] system as ASP solver (Ricca et al. 2008), since it offers a number of facilities to create, modify, store, navigate, and query 'ontological knowledge bases' (or 'ontologies'), a visual environment supporting information integration from heterogeneous, distributed data sources, and powerful interoperability mechanism with OWL[11]. OntoDLV is today recognised as the state-of-the-art of *Disjunctive Logic Programming System* (Leone and Faber, 2008).

**Research methodology**
An illustrative description of the set-up of the research methodology is given below, together with a schema of the conceptual dependencies among them, and the identification of the outcomes of each WP. The expected final outcome of the project is introduced in relation with the description of the last WP.

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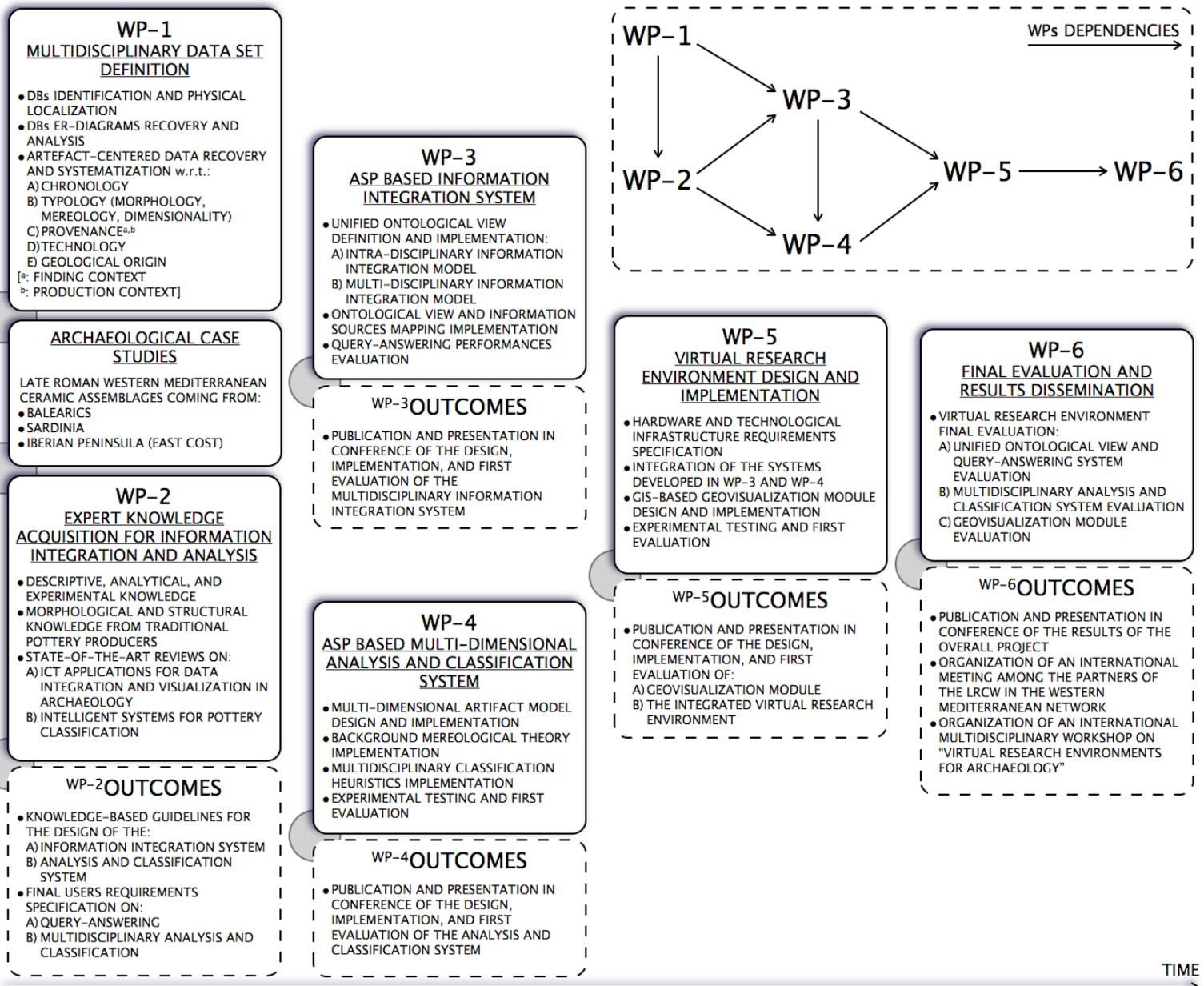
[7] http://www.alexandria.ucsb.edu/.
[8] http://www.ecai.org/.
[9] http://www.paradisec.org.au/home.html.
[10] http://www.mat.unical.it/ricca/downloads/rt-ontodlp.zip.
[11] *W3C Candidate Recommendation*, http://www.w3.org/TR/owl-guide/ (2003).

**Figure 1. A diagrammatic representation of the set-up of research methodology ('WP' = Work Package), together with a schema of the conceptual dependencies among WPs.**

As regards to the archaeological case studies, the project will take into account LRCW coming from several Western Mediterranean ceramic assemblages from the Balearics, Sardinia, and east coast of the Iberian peninsula, areas where a large project on the MDC of LRCW is being developed, conducted by Prof. Cau. In this way our proposal will be fully integrated into a larger initiative.

**Timeliness and relevance of the project**
The development of a VRE for the archaeological study of ceramic artefacts is understood here as the way to support a multidisciplinary research combining information, expert knowledge, and analytical results of archaeology, archaeometry, raw material study and study of mechanical and thermal properties. The fact that a new research methodology will be at the core of the VRE represents the added value our proposal aims at offering compared to present state of the art of ICT applications in this field. The project aims at defining a computational infrastructure that will be not only a portal to share, access, and query data and information on LRCW, but also a virtual

laboratory that the experts can use to perform cluster analysis and classification according to a new MDC of artefacts in this and related fields.

Multidisciplinarity and originality inform the project for various reasons: one of the most important is the foundation of a new methodology that the experts recognise as the only way to be able to understand the material culture as part of the social structure; the second is the computational support that the project will offer to the community of scholars interested in exploiting this new methodology to analyse and classify artefact collections.


**Host scientific expertise in the field and quality of the group/supervisors**

The host institution has a long history in managementof projects at national and international level. The ERAUB (Equip de Recerca Arqueomètrica de la Universitat de Barcelona), was founded for the necessity of adaptation of the archaeological research to the development of archaeometry, beginning the works in the research of the physical, chemical and mineralogical characterisation of ceramics. Here several international and national projects have been carried out and have lead to the production of a wide literature on the theme.

In particular, the supervisor is an experienced researcher in Late Antiquity archaeology and in archaeometry. Professor Cau (BA, M.Phil, MA, Ph.D) is in fact an archaeologist and he has focused his research in the Late Antique period in the Mediterranean. He has specialised in the study of archaeological ceramics to investigate their provenance, technology of production and distribution by the application of physico-chemical and mineralogical techniques. One of his aims is to investigate the transformation of the Roman world in Mediterranean insular systems. For this reason, he is co-director of the archaeological fieldwork at the Roman and Late Antique city of Pollentia and the Early Christian complex of Son Peretó (Mallorca, Balearic Islands) and Illa del Rei (Menorca, Balearic Islands), and major ceramic projects in Sardinia, Tunisia and the Balearic Islands.

He holds now a Research Professorship at the Institució Catalana de Recerca i Estudis Avançats (ICREA). He held a postdoctoral EU Research Fellowship at the Department of Archeology, University of Sheffield (UK). He is founder of the ERAUB and the series of international conferences LRCW. He has participated in many projects at national and international levels, such as the EU funded projects GEOPRO, CERAMED and Progetto Classe working in the World Heritage site of Ravenna. He has been promoter and coordinator, together with Prof. Paul Reynolds (ICREA, ERAUB) and Prof. Michel Bonifay (Université Aix/Marseille, CNRS), of the *Exploratory Workshop* on "Late Roman Fine Wares: Solving Problems of Typology and Chronology" organized as a joint venture between the European Science Foundation (ESF) and the Institució Catalana de Recerca i Estudis Avançats (ICREA) (Barcelona, Spain, 5-9 November 2008).

In particular, among the numerous research projects carried out by the ERAUB, Prof. Cau leads or has recently had the leadership in the following Projects:

- Co-director of the archaeological research at the Roman City of Pollentia (Alcudia, Mallorca) and Course on Roman Archaeology. From: 12/07/2002 To: present
- Director of the project Caracterización arqueométrica de la cerámica común del yacimiento de Can Sorà (Eivissa), Generalitat de Catalunya. From: 16/07/2004 – 15/01/2005.
- Director of the Plan Nacional I+D+I Poblamiento y cerámica durante la Antigüedad Tardía en las Islas Baleares (HUM2004-00663 and HUM2005-00996/HIST), Ministerio de Educación y Ciencia. From: 15/12/2004 To: 31/12/2008.
- Director of the Spanish-Italian Integrated Action HI2005-0067, Archaeology and Archaeometry of Late Roman Cooking Wares in the Western Mediterranean: the Sardinian case, Ministerio de Educación y Ciencia. From: 30/12/2005 To: 30/12/2008.
- Coordinator of the archaeological team at the archaeological excavation of San Severo,Classe, Ravenna World Heritage Site, European Commission (Culture 2000). From: 01/11/2005 To: 01/11/2006.

- Responsible for the Archaeometry of Vandal and Byzantine ceramic materials, archaeological excavation of Althiburos (Tunisia) (EXCAVA2005), Generalitat de Catalunya. From: 03/07/2006 To: present.
- Scientific director of the archaeological investigation at the Christian Complex of Son Peretó (Manacor, Mallorca, Balearic Islands) and Illa del Rei (Mahón, Menorca, Balearic Islands).

Prof. Cau has published more than 100 scientific contributions including books, articles and chapters of books, of which only three books related with the theme of the project are reported as well as some papers:

- Cau Ontiveros, M.A., 2003, *Cerámica tardorromana de cocina de las Islas Baleares: estudio arqueométrico*, British Archaeological Reports, International Series, Oxford.
- Gurt i Esparraguera, J.M.; Buxeda i Garrigos, J.; Cau Ontiveros, M.A. (Eds.), 2005, *Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean: Archaeology and Archaeometry*, British Archaeological Reports, International Series, 1340, Oxford.
- Cau, M.A. (Coord.) in press, *Estudi arqueològic i caracterització arqueomètrica de la ceràmica comuna romana del forn de Sa Mesquida (Calvià, Mallorca)*. Ed. El Tall (Palma de Mallorca) (submitted 2006), Palma de Mallorca.

Prof. Cau is referee of journals and books, such as *Journal of Archaeological Method and Theory*, *Pyrenae. Journal of Western Mediterranean Prehistory and Antiquity*, *LRCW*, *Late Roman Coarse Wares, Cooking Wares and Amphorae: Archaeology and Archaeometry*. He is also member of several Advisory boards and Committees that show the appreciation he receives at national and international scientific level.
Prof. Cau has supervised nine PhD thesis and trained in the ERAUB several students, not only Spanish, but also coming from different European countries. He is also co-director of the Master on Mediterranean Nautical Archaeology.

Prof. Cau is considered a leading scientist in the study of Late Roman Cooking Wares in the Mediterranean. He is founder and member of the international Standing Committee of the international series of conferences Late Roman Coarse Wares, Cooking Wares and Amphorae in the Mediterranean: Archaeology and Archaeometry, that has become a the main forum of discussion for these ceramics. He organised the first conference in Barcelona in 2002 and co-edited the first volume of the series.
All the above mentioned states the scientific expertise of the scientist in charge of the project and guarantees the quality of the research that will be carried out.


## B2 TRAINING (maximum 2 pages)

**Clarity and quality of the research training objectives for the researcher**
The supervisor is specialized in Late Antiquity archaeology and in archaeometry of ceramics for the study of provenance and technology. The ERAUB is part of an international network of specialists in Late Roman ceramics in the Mediterranean area, and Prof. Cau, that will be the supervisor of the project, play an active role of coordination of this network. The network contains specialists in all the disciplines the project will consider for the definition of the MDC based methodology for LRCW. To have the opportunity of being constantly in touch with these specialists (with their information resources and knowledge) is the only way to produce a significant scientific result at the methodological level, as well as, at the computational one. This is why the proposed Host institution is an ideal place where the fellow will have the possibility to carry out the project.
He will be trained in the frame of an investigation that has paid particular attention to the different aspects of the transformation of the Roman world in Mediterranean insular systems, and on the archaeometric analyses in particular. This will offer him the opportunity to enlarge his knowledge and to have an active role in the implementation of innovative computational tools for the multidisciplinary investigation of past complex dynamics.

For what concerns the study of the archaeological materials in Late Antiquity, and the formation in archaeometry, the fellow will attend the courses offered by the "Master d'Arqueologia". In particular with the subjects "Arqueometria", "Arqueotecnologia", "Teoria de l'Arqueologia", "L'estadistica en el tractament de la informació arqueològica: descripció i inferència", "Dibuix i imatge aplicats a l'arqueologia", he will be trained in the study of material culture of the period and in particular on technology and provenance of ceramics (archaeometry). This, together with the special training and constant supervising that he will receive in the ERAUB, will provide access to the resources and the expert knowledge needed to carry out WP-1 and WP-2 and, more in general, the whole project.

**Relevance and quality of additional scientific training as well as of complementary skills offered**

In the framework of the research activities of the host institution, complementary training and skills will be offered: (i) language courses; (ii) interdisciplinary courses organized yearly; (iii) bibliographic data search and access using the facilities of the University's Library; (iv) active participation in international conferences and publications in international journals.

Furthermore, the possibility of being in a host institution where several international projects are carried out will reinforce his capabilities of management.

The fellow will also benefit from the training he will receive from the team of the DLV System, leaded by Prof. Leone (Department of Mathematics, University of Calabria). DLV is the system for disjunctive datalog with constraints, true negation (*à la* Gelfond & Lifschitz) and queries that will be heavily exploited to carry out the WPs 3 and 4 as ASP solver. In the context of his collaboration with the ERAUB research group, and by common agreement with the Prof. Cau, the fellow has established a contact with the DLV System team and the Prof. Leone with the specific aim of receiving *at-a-distance* support and collaboration to achieve the technological objectives of the proposal.

**Host expertise in training *experienced researchers* in the field and capacity to provide mentoring/tutoring**

The University of Barcelona is one of the major universities within Spain with a long teaching experience.

The project will be supervised by Prof. Cau who has an important experience in management and leadership of projects, and in particular on international projects. Professor Cau has also a consolidated experience in teaching at undergraduate and postgraduate levels and of training of researchers and he has supervised nine PhD and DEA thesis. Prof. Cau is a former EU fellow and knows exactly the needs of the fellow in term of training and mentoring, being fully aware that not only scientific training is essential but also extra training in communication skills and management of science. In fact Prof. Cau is willing to involve the candidate in the daily practice of managing science. He is periodically in touch with the people at the Marie Curie Actions and he was recently invited to the Marie Curie Conference developed within the activities of the ESOF 2008 held in Barcelona, to present their case as a successful story. All these ensure the capacity of Prof. Cau to provide mentoring/tutoring for the fellow. He is also part of the Faculty commission to develop the Bologna system within the University, and he is the coordinator of the Master in Archeology. Also the rest of the team offers an exceptional opportunity for career development and training and the fellow will benefit from the contact with national and international experienced researchers and also with other fellows and Ph.D students.

As scientist he attracted several researchers at the ERAUB, at different level of experience. Prof. G. Montana, Università degli Studi di Palermo, visited the laboratory for a week to work on petrography and SEM of Late Roman Cooking Wares; Dr. Margarita Orfila Pons, Professor of Archaeology at the University of Granada on sabbatical for the entire academic year 2006-2007. However he has attracted and formed many students at postgraduate and postdoctoral levels such as Harriet White from the University of Sheffield (UK), to work on petrographic analysis of Byzantine pottery from Corynth (Greece); Elena Pinotti, Università degli Studi di Parma, visited the laboratory for a week to work on his Tesi di Laurea on Mediterranean Cooking Wares. Visiting

researcher Georgia Kordatzaki, from the University of Crete visited the laboratory to work on Petrography of Late Middle Minoan pottery from a Peak Sanctuary in Crete. Visiting researcher Tiziana Pisciotta of the Universita degli Studi di Palermo visited the laboratory to work on Archaeometry of Iberian mills as a part of his Tesi di Laurea. Visiting researcher Daniela Pagliarello of the Universita degli Studi di Palermo visited the laboratory to work on Archaeometry of clays and pottery from Sardinia. Visiting researcher Gabriela Guiducci of the Universita degli Studi di Parma visited the laboratory to work on Late Roman Pottery on Sardinia. Visiting researcher Massimo Rinaldi of the Universita degli Studi di Parma visited the laboratory to work on Late Roman Pottery on Sardinia and Elisa Panero and Carlota Bassoli to work under the bilateral Spanish-Italian action within the national programme of mobility and formation of the young researchers.

The fellow has been visiting researcher for six months at the Department of Logic, History and Philosophy of Science of the University of Barcelona during the period February-July 2009 within the Italian mobility support programme for post-doc researchers. During this period he has collaborated with the ERAUB research group on the application of AI techniques for the analysis of archaeological data, and this experience has been crucial for the definition of a common research line whose objectives have inspired the present proposal.


**B3 RESEARCHER (maximum 7 pages which includes a CV and a list of main achievements)**

**Curriculum Vitae**

**Personal Data**
Name: Alessandro Mosca; ID/Passport no: YA0082346; Place and Date of birth : 14/03/1975, Milano (Italy);   Gender: Male; Nacionality: Italy; Address: Via Serafino dell'Uomo, 2 - 20129 Milano (Italy); Contacts: (Italian) Mobile Phone: +39396800244
(Spanish) Mobile Phone: +34644352880; *e*-mail: ale.m@disco.unimib.it


**Education**
- 2006: Ph.D. Computer Science (Dept of Computer Science, Systems and Communication, University of Milano-Bicocca, Italy); Thesis: *A Theoretical and Computational Inquiry into the Compounding Problem.*
- 2002: MA Computer Science for Humanities (Dept of Computer Science, Systems and Communication, University of Milano-Bicocca, Italy).
- 2001: BA Philosophy (Faculty of Letters and Philosophy, University of Milano, Italy); Thesis: *Quantifiers as Modal Operators.*


**Further Studies And Trainings**
- 2003: ESSLLI,*15$^{th}$ European Summer School in Logic, Language and Information* (Kurt Gödel Society, c/o Institut für Computersprachen -Technische Universität Wien, Institute for Algebra and Computational Mathematics - Vienna University of Technology, Austria).
- 2003: *Soft Computing: Theory, Techniques and Applications* (Dept of Electronics and Information, Politecico di Milano, Italy).
- 2002: IV Summer School in Logic (Italian Society for Logic and Philosophy of Science SILFS, Italian Association for Logic and Applications AILA Associazione Italiana di Logica e sue Applicazioni (A.I.L.A.), Cesena, Italy).
- 2000: IV Summer School in Logic (Italian Society for Logic and Philosophy of Science SILFS, Italian Association for Logic and Applications AILA Associazione Italiana di Logica e sue Applicazioni (A.I.L.A.), Cesena, Italy).


**Scientific Experience**
- Jan 2006-Dec 2007: Postdoc Researcher (Dept of Computer Science, Systems and Communication, University of Milano- Bicocca, Italy).
- Jan 2008-Present: Postdoc Researcher (Dept of Computer Science, Systems and Communication, University of Milano- Bicocca, Italy).

• Feb 2009-Jul 2009: Visiting Researcher (Dept of Logic, History and Philosophy of Science, Univesity of Barcelona, Spain).

**Personal Affiliations**
• Member of the Scientific Committee of the *Center for Interdisciplinary Studies in Economics, Psychology and Social Sciences* (CISEPS), University of Milano-Bicocca, Italy.
• Member of the *Complex Systems and Artificial Intelligence Research Center*, University of Milano-Bicocca, Italy.

**Participation In Projects**
• 2007-Present: *SilkRoDE - Silk Road in the Digital Era* (University of Milan-Bicocca, Institut Francais d'Etudes sur l'Asie Centrale, International Research Center for Japanese Studies, Universitat de Barcelona, Harvard University, UNESCO – Tashkent office); Directed by: Dr. Sebastian Stride; Dr. Bernardo Rondelli.
• 2007-2008: *PoBASYN - Po Valley and Bronze Age Settlment Dynamics* (University of Milano-Bicocca, University of Milano, University of Bologna); Directed by: Prof. Stefania Bandini, Prof. Maurizio Cattani, Prof. Raffaele De Marinis.
• 2007: Terra Modena 198 (University of Milano-Bicocca, I-TEA S.r.l.); Directed by: Prof. Stefania Bandini, Dr. Sara Manzoni.
• 2004-2005: CO2*PC - Mobile sensor data correlation in Pervasive Computing environments (University of Bologna, Italian Ministry for Education, Universities and Research - M.I.U.R.); Directed by: Prof. Stefania Bandini.
• 2002-2005: *P-Truck* (University of Milano-Bicocca, Business Unit Truck of Pirelli Tires S.p.A.); Directed by: Prof. Stefania Bandini.
• 2002: *Smart Plan* (Complex Systems and Artificial Intelligence Research Center - University of Milano-Bicocca, Area Tecnica s.r.l.); Directed by: Prof. Stefania Bandini, Dr. Paolo Mereghetti.
• 2001-2004: *SAMOT - System for Automatic Monitoring of Traffic* (University of Bologna, Project Automation S.p.A., Società Autostrade S.p.A.); Directed by: Prof. Stefania Bandini, Dr. Davide Bogni.

**Professional Activities And Services**
• Member of the Program Committee of the "24-esimo Convegno Italiano di Logica Computazionale " (CILC-09), Italian Association for Logic Programming, June 25-26, 2009, Department of Engineering, University of Ferrara, Italy.
• Co-chair for the workshop "Intelligent Agents and Services for Smart Environments", hosted by the Annual Conference of the Society for the Study of Artificial Intelligence and the Simulation of Behaviour (AISB), April 1-4, 2008, Aberdeen, Scotland.
• Member of the Organising Committee for the "First Workshop on Game Theory", March 7-8, 2008, Center for Interdisciplinary Studies in Economics, Psychology and Social Sciences (CISEPS), University of Milano-Bicocca, Italy.
• Member of the Organising Committee for the workshop "From the technological Transfer to the Multidisciplinary Research: Towards a new computational approach to Archaeology", March 8, 2007, Department of Archaeology, University of Bologna, Italy.
• Member of the Organising Committee for the "Second Workshop on Ontology, Conceptualizations and Epistemology for Software and Systems Engineering (ONTOSE-2008)", June 2007, Department of Computer Science, Systems and Communication, University of Milano-Bicocca, Italy.
• Member of the Organising Committee for the "IX Congress of the Italian Association for Artificial Intelligence", September 20-23, 2005, University of Milano-Bicocca, Italy.
• Member of the Selection Committee of the "Master In Computer Science For Humanities", Department of Computer Science, Systems and Communication, University of Milano-Bicocca, Italy.
• Member of the Organising Committee for the workshop "Knowledge Management: The Role, Contributions And Perspectives Of Artificial Intelligence", Working Group on Artificial Intelligence in Companies, Italian Association for Artificial Intelligence (AI*IA), November 29-30, 2001, University of Milano-Bicocca, Italy.

- Member of the Organising Committee for the workshop "Competitive Innovation And Knowledge Management: Representation And Sharing of Added-value Competencies", Working Group on Artificial Intelligence in Companies, Italian Association for Artificial Intelligence (AI*IA), November 20-21, 2002, University of Milano-Bicocca, Italy.
- Reviewer for the "Journal of Zhejiang University Science A", ISSN 1673-565X, Zhejiang University, Springer.

## Teaching Experience
- 2008: Computational models in artificial intelligence
- 2002-2007: Programming languages
- 2005-2007: Knowledge representation and reasoning
- 2006-2008: Artificial intelligence
- 2003-2008: Computational models for communication
- 2002: Master in computer science for humanities
- 2002: Master in computer science technologies for the new economy

## Thesis Supervisor
- BA Thesis: Gallo Marco, *Definizione di componenti riusabili per interfacce grafiche in un sistema CBR* (A.A. 2006/2007, University of Milano-Bicocca).
- MA Thesis: Calloni Marco, *Studio e implementazione di un sistema basato su algoritmi genetici per la firmulazione chimica* (A.A. 2005/2006, University of Milano-Bicocca).
- MA Thesis: Roberto Garrone, *Analisi del problema della formulazione chimica: formalizzazione, modellazione ed implementazione* (2003/2004, University of Milano-Bicocca).

## Invited Lectures
- *Modal Logics for Games and Information*, January 24, 2008, workshop on "Theory of Individual Decision Making", CISEPS, Dept of Economics, University of Milano-Bicocca, Italy.
- *Evolutionary Realism meets Analytical Archaeology: Formal and Computational Contributions*, June 23, 2007, research workshop on "Evolutionary Economics", Schloss Wartensee, Switzerland.
- *The Material Culture As Expression of Rules And Processes*, May 8, 2007, Workshop "From The Archaeological Records To Computer Simulation: The PO-BasYN Project", CSAI Research Center, University of Milano-Bicocca, Italy.
- *Ontology and Ontologies*, March 8, 2007, as part of the course on "Research Methods In Prehistory", Department of Archaeology, University of Bologna, Italy.
- *The Archeoserver Portal and Its Web-GIS*, hosted by the one day Workshop on "Bronze Age in North Italy: 4048 Years ago, A Pile-dwelling Has Been Built", Institute of Prehistory and Protohistory, Archaeological Museum of Bergamo, University of Milano, Italy.
- *Seminar Course on "Ontology and Knowledge Representation"*, Dept of Computer Science, Systems and Communication, University of Milano-Bicocca, Italy.
- *The Growth Models Of Science In K. Popper, T. Khun, I. Lakatos, and P. Feyerabend*, Artificial Intelligence Lab, Dept of Computer Science, Systems and Communication, University of Milano-Bicocca, Italy.

## Journal And Series Papers
- Bonomi, A., Mosca, A., Palmonari, M., Vizzari, G., *Integrating a Wiki in an ontology driven Web site: approach, architecture and application in the archaeological domain*. In Proc. of the 3rd Semantic Wiki Workshop, co-located with the 5th European Semantic Web Conference (ESWC). CEUR Workshop Proc., ISSN 1613-0073, http://ceur-ws.org/.
- Bonomi, A., Mantegari, G., Mosca, A., Palmonari, M., Vizzari, G., *A system supporting users of cultural resource management semantic portals*. In AI*IA 2007: Artificial Intelligence and Human-Oriented Computing, Lecture Notes in Computer Science, Springer-Verlag, Vol. 4733, pp. 757-764, 2007.
- Mosca, A., Palmonari, M., *Action based abox update: an example from the chemical compound formulation*. In Proc. of the 20th Description Logic Workshop (DL 2007). CEUR Workshop Proc., ISSN 1613-0073, http://ceur-ws.org/, 2007.

- Bonomi, A., Mosca, A., Palmonari, M., Vizzari, G., *NavEditOW – A system for navigating, editing and querying ontologies through the web.* In Knowledge-Based Intelligent Information and Engineering Systems, Lecture Notes in Artificial Intelligence, Springer-Verlag, Vol. 4694, pp. 686-694, 2007.
- Colombo, G., Mosca, A., Sartori, F., *Towards the design of intelligent CAD systems: an ontological approach.* Special issue on Ontology and Epistemology of Systems and Software Engineering, ADVANCED ENGINEERING INFORMATICS Journal (AEI), Elsevier, Vol. 21-2, pp. 153-168, 2007.
- Bandini, S., Mosca, A., Palmonari, M., *Commonsense spatial reasoning for information correlation in pervasive computing.* Applied Artificial Intelligence, Taylor&Francis, Vol. 21/4-5, April 2007.
- Bandini, S., Mosca, A., Palmonari, M., *Model-based chemical compound formulation.* In L. Magnani and Ping Li (Eds.), Model-Based Reasoning in Science, Technology, and Medicine. Series: Studies in Computational Intelligence, Vol. 64, pp. 413-430, Springer, 2007, ISBN 978-3-540-71985-4.
- Bandini, S., Mosca, A., Palmonari, M., *Intelligent alarm correlation and abductive reasoning.* In L. Magnani (guest editor), Logic Journal of IGPL, Oxford University Press, Vol. 14, pp. 347-362, March 2006.
- Bandini, S., Mosca, A., Palmonari, M., Vizzari, G., *Integrating MMASS with a hybrid commonsense spatial logic.* In L. Magnani (ed.), Model-Based Reasoning in Science and Engineering, pp. 311-331, King's College, London. 2006.
- Bandini, S., Colombo, G., Mosca, A., Palmonari, M., *Commonsense spatial reasoning: an informational perspective from pervasive computing.* European Computing And Philosophy (E-CaP), MDH University, Sweden, 2-4 June 2005, TripleC Journal.
- Bandini, S., Mosca, A., Palmonari, M., *A hybrid logic for commonsense spatial reasoning.* AI*IA 2005: Advances in Artificial Intelligence, 9th Congress of the Italian Association for Artificial Intelligence, Milan, Italy, September 21-23, 2005, Proc.. Lecture Notes in Artificial Intelligence, Springer-Verlag, Vol. 3673, Pages 25-37, 2005.
- Bandini, S., Bogni, D., Manzoni, S., Mosca, A., *ST modal logic approach to alarm correlation in monitoring and control of Italian highways traffic.* In Moonis Ali, Floriana Esposito (Eds.): Innovations in Applied Artificial Intelligence, 18th International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems, IEA/AIE 2005, Bari, Italy, June 22-24, 2005, Proc.. ISBN 3-540-26551-1, Lecture Notes in Computer Science, Springer-Verlag, Vol. 3533, 2005.
- Bandini, S., Mosca, A., Palmonari, M., *Commonsense spatial reasoning for context-aware pervasive systems.* Location- and Context-Awareness, First International Workshop, LoCA 2005, Oberpfaffenhofen, Germany, May 12-13, 2005, Proc.. Lecture Notes in Computer Science, Springer-Verlag, Vol. 3479, Pages 180-188, 2005.
- Bandini, S., Mosca, A., Palmonari, M., Sartori, F., *A conceptual framework for monitoring and control system development.* In Luciano Baresi, Schahram Dustdar, Harald Gall, Maristella Matera (Eds.): Ubiquitous Mobile Information and Collaboration Systems, Second CAiSE Workshop, UMICS 2004, Riga, Latvia, June 7-8, 2004, Revised Selected Papers. Lecture Notes in Computer Science, Springer-Verlag, Vol. 3272, Pages 111-124, 2005.

### Refereed Conference And Workshop Papers
- Mosca, A., Codecasa, D., Manzoni, L., *HyLMoC – A model checker for Hybrid Logic.* In Proc. of the 24th Italian Congress on Computational Logic (CILC-09), June 24-25, 2009, Ferrara, Italy.
- Colombo, G., Mosca, A., *Training and computation: artificial environments for learning* (in It.) In Proc. of the 6th International TICE Méditerranee Conference (TICEMED 2009), May 28-29, 2009, Milano, Italy.
- Mosca, A., Palmonari, M., *Modeling spatial reasoning for context aware agents.* In Proc. of the 1st International Workshop on Logics for Agents and Mobility, part of the European Summer School on Logic, Language and Information (ESSLLI), Hamburg (Germany), August 4-8, 2008.
- Mantegari, G., Mosca, A.,. Rondelli, B., Vizzari, G., *A semantic based approach to GIS: the PO-BASyN project.* In Proc. of the 36th Annual Conference on Computer Applications and Quantitative Methods in Archaeology (CAA 2008), 2-6 April 2008, Budapest, Hungary. Bonomi,

- A., Colombo, G., Merico, D., Mosca, A., Palmonari, M., Vizzari, G., *Sharing the NEUROWEB ontology through the Web: the NavEditOW approach*. In G. Armano, M. Schaerf, and G. Semeraro (Eds.), Proc. of the Workshop "MultiAgent Systems & Bioinformatics 2008", 10th Symposium on Advances in Artificial Intelligence of the Italian Association for Artificial Intelligence, Cagliari, Italy.
- Mosca, A., Rondelli, B., Mantegari, G., *Integrating a knowledge-based system and a geographical information system for the study of the archaeological material culture*. In G. Armano, M. Schaerf, and G. Semeraro (Eds.), Proc. of the Workshop "Artificial Intelligence in Cultural Heritage", 10th Symposium on Advances in Artificial Intelligence of the Italian Association for Artificial Intelligence, September 11-13, 2008, Cagliari, Italy, pages 84–91.
- Soares Correa da Silva, F., Vizzari, G., Mosca, A., *Coupled MMASS: A formal model for non-deterministic multi-agent simulations*. In Proc. of the AISB 08 Symposium on Logic and the Simulation of Interaction and Reasoning, Aberdeen, UK, 2008, Published by The Society for the Study of Artificial Intelligence and Simulation of Behaviour, pp. 11-15.
- Bandini, S., Mosca, A., Palmonari, M., Vizzari, G., *A perception oriented MAS model with hybrid commonsense spatial logic*. In Proc. of the AISB 08 Symposium on Logic and the Simulation of Interaction and Reasoning, Aberdeen, UK, 2008, Published by The Society for the Study of Artificial Intelligence and Simulation of Behaviour, pp. 32-40.
- Mantegari, G., Mosca, A., Cattani, M., *Formal knowledge representation and automated reasoning for the study of archaeological stratigraphy*. In W. Borner (Ed.), Proc. of the 12th International Congress "Cultural Heritage and New Technologies", Vienna, Austria.
- Colombo, G., Mosca, A., Palmonari, M., Sartori, F., *An upper-level functional ontology to support distributed design*. In Proc. of 2nd International Workshop on Ontology, Conceptualization and Epistemology for Software and System Engineering (ONTOSE), 2007, Milano, Italy.
- Bandini, S., Mosca, A., *Mereological knowledge representation for the chemical formulation*. In R. Cuel and R. Ferrario (Eds.), Proc. FOMI-06 Workshop Proc., Laboratory for Applied Ontology, ISTC-CNR, 2006, Trento, Italy.
- Colombo, G., Mosca, A., Palmonari, M., *When ontology meets epistemology: the case of functional ontology in engineering design*. In Proc. of the 1st International Conference on Computing and Philosophy (I-C&P), 2006, Laval, France.
- Colombo, G., Mosca, A., Palmonari, M., *Artefacts need functional ontology: Lessons from engineering design*. Proc. of the European Conference on Computing and Philosophy (E-CaP), 2006, June 22-24, Trondheim, Norway.
- Bandini, S., Mosca, A., L. Vanneschi, *Towards the use of genetic algorithms for the chemical formulation problem*. In S. Manzoni, M. Palmonari, F. Sartori (Eds.), Proc. of the 9th Congress of the Italian Association for Artificial Intelligence (AI*IA), Workshop on Evolutionary Computation (GSICE), September 2005.
- Frisoni, G., Colombo, G., Mosca, A., Sartori, F., *Exploiting experiential knowledge for enhanced CAD design*. In Proc. of the International Conference on CAE and computational Technologies for Industry (TCN-CAE), 2005, October 5-8, Lecce, Italy.
- Bandini, S., Manzoni, S., Mosca, A., Sartori, F., *Intelligent alarm correlation*. In Proc. IEEE of International Conference on Systems, Man and Cybernetics, Washington, 2003.

## Other Publications
- Mosca, A., Bernini, D., *Ontology-driven Geographic Information System and dlvhex Reasoning for Material Culture Analysis*. In online Proc. of the Italian Workshop RiCeRcA 2008, co-located with the 24th International Conference on Logic Programming (ICLP 2008)., Udine, December 12-13, 2008.
- Mosca, A., Gentile, I., Codecasa, D., Manzoni, L., *Hybrid Modal Model Checking*. In online Proc. of the Italian Workshop RiCeRcA 2008, co-located with the 24th International Conference on Logic Programming (ICLP 2008)., Udine, December 12-13, 2008.
- Dopfer, K., Mosca, A., Rondelli, B., Stride, S., Bandini, S., *The Samarqand's cultural landscape: a rule based approach*. Presented at the Regional Conference of the Central Eurasian Studies Society (CESS-2008), August 4-7, 2008, Issyk-Kul, Kyrgyzstan.

## Forthcoming Publications

- Mosca, A., Palmonari, M., Sartori, F., *An upper-level functional ontology to support Knowledge Management in SMEs-based E-Manufactoring.* The Knowledge Engineering Review (KER), Cambridge University Press (September 2009).
- Maksudov, F., Mosca, A., Rondelli, B., Stride, S., *Arqueologia en Àsia Central: Rescatar, accedir i compartir* (*Central Asian Archaeology: recover, access and sharing*). Tribuna d'Arqueologia. Departament de Cultura de la Generalitat de Catalunya, Servei d'Arqueologia. Barcelona.
- Cavani, V., Mosca, A., Rondelli, B., *Rappresentazione della conoscenza e classificazione ceramica* (*Knowledge Representation and artefact classification*). Ipotesi di Preistoria (Online Journal), CIB Centro Inter-Bibliotecario, Università di Bologna, ISSN 1974-7985.
- Mosca, A., Rondelli, B., Stride, S., *Silk Roads in the Digital Era (SilkRoDE): A Knowledge Management Perspective*. In Proc. of the 7th European Conference on Computing and Philosophy (E-CAP 2009), July 2-4, 2009, Barcelona, Spain.

**Research results: major achievements**

The major achievements of the fellow can be summarised as follows: (i) The creation of a computational model, integrating KR and evolutionary computation techniques, for the automatic formulation of chemical rubber compounds. The resulting ontology has been exploited to drastically reduce the search space and to make feasible its exploration by means of a genetic algorithm. (ii) The developed methodology for the logic-based representation of the expert ontological knowledge has fostered the achievement of further scientific results in the field of the Knowledge Management for Small and Medium Enterprises. (iii) The experience of the fellow in the field of the logical studies has allowed the creation of a new research line on KR and Reasoning (KR&R), Spatial and Temporal Reasoning, Ontologies and Semantic Web formal tools at the AI Lab of Milano-Bicocca. The research on KR&R have never been among the research specialties of the lab, and no teaching KR&R was offered by the Dept of Computer Science, Systems and Communication, before the effective integration of the fellow in 2002. The fellow has showed skills in giving lectures, organizing seminar activities, and workshops on these topics, often crossing the disciplinary boundaries of his department, and supporting the creation and the development of new academic collaborations and multidisciplinary project initiatives.

**Independent thinking and leadership qualities**

Alessandro Mosca is a young researcher. His curriculum studiorum reflects a sense for initiative, independent thinking, and creativity. He participated and had an active role into several projects with academic as well as industrial and commercial partners in Italy and abroad. Besides his research activity, during the last six years he designed and personally delivered a number of university courses about symbolic artificial intelligence, knowledge representation, automatic planning and search algorithms, and his contribution was important for the design of the new Theory and Technology for Communication master's degree at the University of Milano-Bicocca.

He has also always show good interpersonal and teamwork skills, and this provided him with the ability to achieved scientific results mixing his competencies with those of his colleagues as the list of his publications confirm.

**Match between the fellow's profile and project**

Alessandro Mosca has a long experience in the application of AI techniques and formal tools to the representation of expert knowledge. He defended a doctoral thesis on the application of formal logic to the representation of expert knowledge about the industrial production of chemical compounds. Starting from 2006, the research activity of the fellow has crossed the archaeological discipline, and the evolutionary studies. His background in Philosophy will help him to identify a common ground for working at a multidisciplinary level with colleagues from humanities, on one hand, and for keeping on his study on human knowledge about artefacts manufacturing, on the other. His profile and his background experience in science are perfectly in line with the present multidisciplinary project, and at the same time represent a warrantee for the future achievement of its objectives.

**Potential for reaching a position of professional maturity**

Although the fellow has worked in several projects, and showed that capability of coordinating small group of people involved in common research activities, his participation in a Marie Curie project represents a invaluable chance to stronger these skills, and to provide the fellow with scientific and management of science and communication abilities that he still never has. The possibility to being constantly in contact with specialists and scholars from a number of different countries and universities around the globe will enlarge his scientific experience and his ability to confront and collaborate at a trans-national and trans-European level. All this will offer him the opportunity to propose and develop new international projects in the future, and gain professional maturity. The development of a genuine multidisciplinary project, dealing with the *e*-Science commitments and technological requirements, may offer him the possibility to consolidate his curriculum and to cultivate a professional figure that will be ready to cope with the complexity and the issues of the new ways of doing science in the future.

**Potential to acquire new knowledge**

The potential to acquire new knowledge in this project for the fellow is clear. The fellow does not have a consolidated experience neither in the fields of archaeological and archaeometrical analysis of artefacts nor in the fields of raw material study and study of mechanical and thermal properties. Nevertheless, his curriculum and his past activity in multidisciplinary and interdisciplinary fields of research represent a solid (theoretical and applicative) background for the rapid acquisition of this new knowledge, and the autonomous re-elaboration of it. The curriculum of the fellow shows that he has a great ability to acquire new knowledge from different fields of study (from mathematical and philosophical logic, to AI and KR, to the economics, and archaeology, in the light of a multidisciplinary study of human knowledge on present and past artefact production), and to exploit it to improve his scientific results. Following his CV, new knowledge acquisitions have been always came with an increasing in value of his background knowledge and experience in science, and this has improved the ability of the fellow to design research paths crossing disciplines and competencies, and provide original problem solving approaches.

**B4 IMPLEMENTATION (maximum 6 pages)**

**Quality of infrastructures/facilities and international collaborations of host**

Many years of experience of the Host Institution in the fields of Archaeology and archaeometry will guarantee the quality of the project results.

The host organization and the supervisor scientist has participated in many projects at national and international levels. In particular the research unit has participated in  such as the EU funded projects GEOPRO, CERAMED and Progetto Classe working in the World Heritage site of Ravenna. In the GEOPRO TMR Network collaboration was established with Bristish, Greek, German and Italian partners., University of Sheffield, University of Nottingham, NCSR Demokritos (Athens), Università degli Studi di Palermo.

In CERAMED (INCOMED programme), collaboration was establish with Turkish, Greek, Tunisian collegues . International collaborations are due also in the following projects run by Prof. Cau:

- Archaeological research at the Roman City of Pollentia (Alcudia, Mallorca). Collaboration with Italian experts on Geophysics and C. Morange for Geomorphology. Also collaboration with American group ArchaeoSpain.
- Poblamiento y cerámica durante la antigüedad tardía en las Islas Baleares el caso de Mallorca (HUM2004-00663/HUM2005-00996/HIST). Collaboration with the University of  Sassari (Sardinia, Italy).
- Spanish-Italian Integrated Action HI2005- 0067, Archaeology and Archaeometry of Late Roman Cooking Wares in the Western Mediterranean: the Sardinian case, Ministerio de Educación y

Ciencia. From: 30/12/2005 To: 30/12/2008. Collaboration with the University of Parma and University of Palermo.

- Archaeological excavation of San Severo,Classe, Ravenna World Heritage Site, European Commission (Culture 2000). From: 01/11/2005 To: 01/11/2006. Italian-Spanish-British-Hungarian excavation.
- Responsible for the Archaeometry of Vandal and Byzantine ceramic materials, archaeological excavation of Althiburos (Tunisia) (EXCAVA2005), Generalitat de Catalunya. From: 03/07/2006 To: present. Collaboration with Tunisian colleagues.

The Equip de Recerca Arqueomètrica de la Universitat de Barcelona and Prof. Cau are in permanent contact and relationships with many European universities and research institutions such as Laboratoire de Ceramologie de Lyon (France), Maison des Sciences de l'Homme (Aix-en-Provence), Laboratory of Archaeometry (NCSR "Demokritos") (Athens), CFTA of the Università degli Studi di Palermo, Università degli Studi di Sassari, Università degli Studi di Parma, Università di Siena, Department of Archaeology of the University of Sheffield, University of Nottingham, University of Leicester, University of Southampton, among other centres. This gives the research unit an European experience difficult to find in many other research groups within Humanities.

Members of the ERAUB (Equip de Recerca Arqueomètrica de la Universitat de Barcelona) are now part of an international network of pottery specialists coming from a number of different countries. The network is effectively engaged in the establishment of an *European Research Network* with the following main objectives: (i) the creation of a *Centre of Excellence on Roman to Late Antique Mediterranean Material Culture Studies* hosted in Barcelona; (ii) the standardisation of methodologies and an inter-calibration programme for laboratories working on the pottery chemical characterisation; (iii) the creation of and international-national partnership with Tunisia and Turkey for the full characterisation of ARS, Çandarli/PRS and CRS/Southern Anatolian wares and production sites; (iv) the creation of an *Encyclopedia of Mediterranean Pottery for the Roman and Late Antique periods*[12]. The partial overlapping between the objectives of the international network and our proposal is evident, and represents a strong groundwork for its development.

Furthermore, the UB is connected to the *Anella Científica* with a 1000 Mbps bandwidth capacity. Anella Científica is the high-speed communications network created by the Fundació Catalana per a la Recerca i la Innovació (FCRI) in 1993 and managed by CESCA. The network is connected to RedIRIS, the state research network managed by Red.es. Through RedIRIS, it reaches the most advanced international research networks: the pan-European Géant2, the American Internet2, the Canadian CA*net-4, etc. The Anella Científica represents an important opportunity for the project with respect to the effective implementation of the international network of information sources, and for the accommodation of the VRE into a high-performance infrastructure.

**Practical arrangements for the implementation and management of the project**

Prof. Cau will supervise the project. Prof. Cau is intending to follow up the research done by the fellow very closely by continously sharing information and by a weekly follow up meeting and a monthly team meeting. The fellow will not work isolated but fully integrated as a part of the team sharing spaces and projects apart from the proposed in this proposal. Prof. Cau is willing also to share responsibilities with the fellow in the management of scientific projects as a part of the formative process. Also communication skills will be developed in all the aspects (oral, poster presentation, public understanding of science and attracting external funding) as Prof. Cau consider these aspects as a fundamental part of the scientific discipline. In this sense the fellow will be asked to develop his research but also to keep an open mind regarding other initiatives undertaking by the research unit. All this is considered as the formative programme as Prof. Cau considers that it is not only important the development of the project proposed but also the formation of the young scientist to become a leader in his field.

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[12] http://www.esf.org/activities/exploratory-workshops/humanities-sch/workshops-detail.html?ew=6667

**Feasibility and credibility of the project, including work plan**

The project consists of 6 Work Packages and the methodology already presented in Figure 1 (Section B1: p. 8):

**WP-1**
**MULTIDISCIPLINARY DATA SET DEFINITION**

- DBs IDENTIFICATION AND PHYSICAL LOCALIZATION
- DBs ER-DIAGRAMS RECOVERY AND ANALYSIS
- ARTEFACT-CENTERED DATA RECOVERY AND SYSTEMATIZATION w.r.t.:
  A) CHRONOLOGY
  B) TYPOLOGY (MORPHOLOGY, MEREOLOGY, DIMENSIONALITY)
  C) PROVENANCE[a,b] ([a]: FINDING CONTEXT; [b]: PRODUCTION CONTEXT)
  D) TECHNOLOGY
  E) GEOLOGICAL ORIGIN OF RAW MATERIALS

**WP-2**
**EXPERT KNOWLEDGE ACQUISITION FOR DATA INTEGRATION AND ANALYSIS**

- DESCRIPTIVE, ANALYTICAL, AND EXPERIMENTAL KNOWLEDGE
- MORPHOLOGICAL AND STRUCTURAL KNOWLEDGE FROM TRADITIONAL POTTERY PRODUCERS
- STATE-OF-THE-ART REVIEWS ON:
  A) ICT APPLICATIONS FOR DATA INTEGRATION AND VISUALIZATION IN ARCHAEOLOGY
  B) INTELLIGENT SYSTEMS FOR POTTERY CLASSIFICATION

**WP-3**
**ASP BASED INFORMATION INTEGRATION SYSTEM**

- UNIFIED ONTOLOGICAL VIEW DEFINITION AND IMPLEMENTATION:
  A) INTRA-DISCIPLINARY INFORMATION INTEGRATION MODEL
  B) MULTI-DISCIPLINARY INFORMATION INTEGRATION MODEL
- ONTOLOGICAL VIEW AND INFORMATION SOURCES MAPPING IMPLEMENTATION
- QUERY-ANSWERING PERFOMANCES EVALUATION

**WP-4**
**ASP BASED MULTI-DIMENSIONAL ANALYSIS AND CLASSIFICATION SYSTEM**

- MULTI-DIMENSIONAL ARTEFACT CHARACTERISATION MODEL DESIGN AND IMPLEMENTATION
- BACKGROUND MEREOLOGICAL THEORY IMPLEMENTATION
- MULTIDISCIPLINARY CLASSIFICATION HEURISTICS IMPLEMENTATION
- EXPERIMENTAL TESTING AND FIRST EVALUATION

**WP-5**
**VIRTUAL RESEARCH ENVIRONMENT DESIGN AND IMPLEMENTATION**

- HARDWARE AND TECHNOLOGICAL INFRASTRUCTURE REQUIREMENTS SPECIFICATION
- INTEGRATION OF THE SYSTEMS DEVELOPED IN WP-3 AND WP-4
- GIS-BASED GEOVISUALIZATION MODULE DESIGN AND IMPLEMENTATION
- EXPERIMENTAL TESTING AND FIRST EVALUATION

**WP-6**
**FINAL EVALUATION AND RESULTS DISSEMINATION**

- VIRTUAL RESEARCH ENVIRONMENT FINAL EVALUATION:
  A) UNIFIED ONTOLOGICAL VIEW AND QUERY-ANSWERING PERFOMANCES EVALUATION
  B) MULTIDISCIPLINARY ANALYSIS AND CLASSIFICATION SYSTEM EVALUATION
  C) GEOVISUALIZATION MODULE EVALUATION

The host institution, and the international network of scientists in which it is involved, will offer to the fellow all the necessary expertise, knowledge, and technological instruments that are needed by the project. In particular, the technical staff and the coordinator have a consolidated experience in the archaeological and archaeometrical study of LRCW in the Western Mediterranean and this will guarantee a practical training and support to the fellow.

The following figure shows the time schedule for the different WPs in the project. The progress of our work will be monitored by means of a dedicated report activity: (i) at the end of the WP-2 a first report will be written on the results obtained on the data and expert knowledge recovery and systematization; (ii) at the end of the WP-4 a second report will be written on the progress of the development of the query-answering functionalities and of the analysis and classification system; and (iii) at the end of the fellowship a Final-Report has been scheduled.
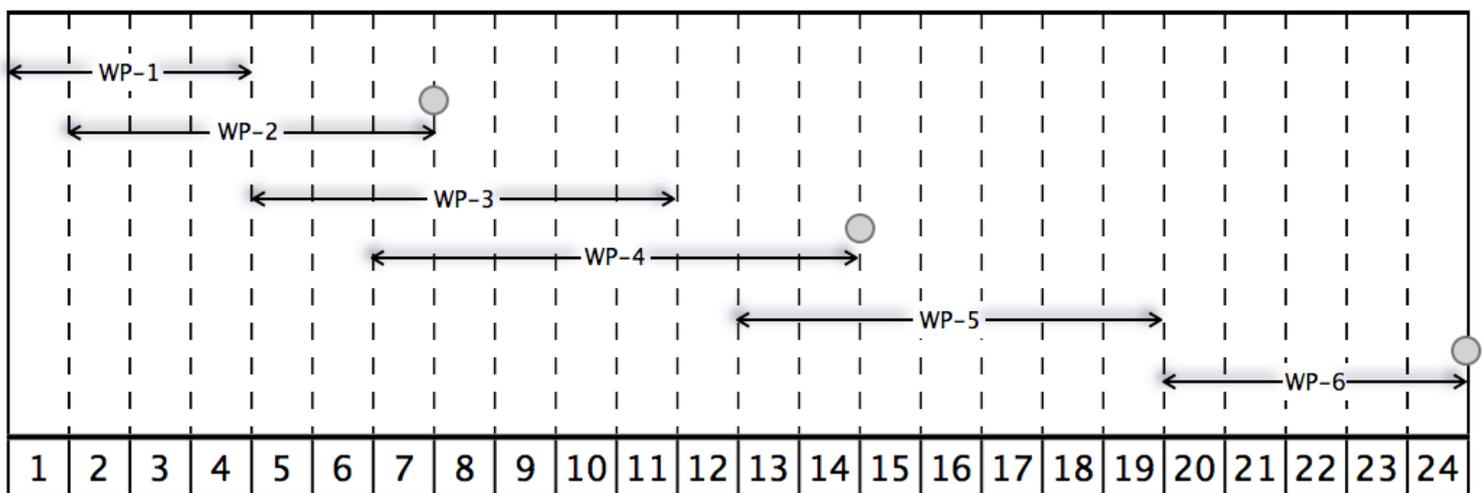


**Practical and administrative arrangements and support for the hosting of the fellow**
The administrative part of the project will be guaranteed by the European Research Projects Office (OPER) at the University of Barcelona (UB). The fellowship will be managed by the University Foundation so called *Bosh i Gimpera* (c/ Baldiri Reixac, 4-8 - Parc Científic. Torre D - 08028 Barcelona; Tel. +34934039900 - Fax. +34934489434) which will guarantee the contract arrangements and the follow up of the fellow by the responsible of the Marie Curie Actions. The director of the European Projects Dept (Oficina de Projectes Europeus de Recerca - OPER) at the Foundation *Bosh i Gimpera* is **Xavier Gutiérrez** (Tel +34934035385 - email: xgutierrez@fbg.ub.es), and he is responsible for the administrative, legal advising and the legal management of the International Projects . Personal arrangements at arrival will be easy due to the experience of the already mentioned units. Also the Research Unit ERAUB has a long experience receiving EU fellows within the programmes TMR and INCOMED as previous foreign researchers have already worked for the unit. All this will endure the correct management of the fellowship. The fellow will also have at his disposal the secretarial staff of the department of Prehistory, Ancient History and Archaeology of the University of Barcelona. He will of course have the entire infrastructure at his disposal and personal space to develop his research consisting in a table, ergonomic chair, computer as a basis research point.

The UB will also provide with all the help needed with the local administration, and facilities to manage family related issues. The UB's Language Services also offer visiting and non-Catalan-speakers a wide range of opportunities to learn Catalan, including free Catalan courses for the

fellow and the chance to sign up at the Services' Language Exchange Program, and Spanish courses also provided in this University.

## B5 IMPACT (maximum 2 pages)

### Potential of acquiring competencies
The multidisciplinary curriculum of the fellow is grown around the study of mathematical and philosophical logic. This led him to obtain a PhD in Computer Science with a thesis in KR, where logic was exploited to formally represent expert knowledge about the production of industrial artefacts. After that, he started working on a generalization of this approach to the archaeological study of past material culture and, in particular, of ceramic artefacts. The possibility of being in a host institution that is a leader in the archaeological and archaeometrical study of LRCW will give him the invaluable possibility to expand and deepen his knowledge on the methodologies and the scientific practices of this field of research. This will also give him a broaden background to develop a genuine multidisciplinary research project that is coherent with his past academic career, on one hand, and that may significantly improve the scientific relevance of the results he already achieved in the study of manmade artefact design and production, on the other.

The present proposal aims at providing a methodological and technological improvement that is expected (and several experts agree on this) to contribute to the creation of new research lines still insufficiently developed. To actively promote, develop, and manage a similar project will not only reinforce the professional maturity and diversity of the fellow, but will also offer him a privileged way to fully maximize his previously achieved competencies in view of the creation of new professional figures and scientific skills. The paradigm shift promised by the *e*-Science, that is the emergence of new research methods that exploit advanced computational resources, data collections and scientific instruments, already requires such a new kind of scientific curricula.

### Contribution to career development or re-establishment where relevant
The developing of the project will reinforce the capability of the fellow to carry out multidisciplinary projects that are more and more important at the research level. The research unit hosting the fellow is one of the most important units in Europe regarding the chemical and mineralogical characterisation of ancient ceramics. Also Prof. Cau and Prof. Reynolds, who is also part of the unit, are some of the important names in the study on Late Antique ceramics. All this should clearly benefit the candidate and reinforce his leadership and competencies in project management.

It is clear that the participation in the Marie Curie project will stronger the skills of the fellow and provide him with an important experience in a different European country and University. The fellow should also benefit from the contacts already existing in the hosting research unit and these can be of much help in the future development of his research career.

In general, his curriculum will be strongly reinforced, also because of the acquired leadership capacity, and formation in the management of science and projects, and communication skills. This will help to convert him in a leading scientist in an emerging multidisciplinary field of research and will give him the opportunities to develop new projects, and possibly gain places.

### Contribution to European excellence and European competitiveness
The understanding of the dynamics that characterize the complex system of feedbacks between the socio-political and the artefacts production subsystems is essential for a comprehension of a socio-economic reality, and the comprehension of past socio-economic systems can lead to a better understanding and management of the actual one. The Western Mediterranean played an important role in a crucial moment of transformation in the Mediterranean World. At the end of Antiquity, the fall of the economic structures of Rome, and the creation, among others, of the *Regnum Vandalorum* and the Byzantine Empire, played a significant role in the production, distribution and consumption of pottery. It is therefore a moment of change from an active long-distance trade network towards a more local/regional and self-sufficient economy. Late Roman Cooking Wares is one of the most frequently recovered classes of pottery in late Roman deposits,

meanwhile other types of ceramics progressively disappear from the archaeological record. The dynamics characterizing the re-organization of the production systems at the end of Antiquity represent an ideal historical example on how a number of populations may re-organize their socio-economic systems after the dissolution of the political and economic structures of a 'globalizing system'.

As for the technological improvements the project aims at providing, the design and implementation of a VRE for archaeological study of LRCW, together with the creation of a MDC based methodology for the analysis and classification, may represent a prototypical example that could be applied also by other specialists in the future in similar studies, and a model for future projects on similar issues. This proves that the significance of the proposal goes beyond the boundaries of the introduced case study. The new methodological approach and the creation of a computational infrastructure giving access to a large amount of information and supporting scientific investigation is a great opportunity for consolidating synergies among all the European research teams in the Mediterranean area involved in the study of ceramic artefacts and material culture in Late Antiquity and Early Middle Age. Since the project will benefit also from the expertise, information sources, and knowledge of several non-European research teams that are today engaged in the study of LRCW and ancient manufacturing technologies in the Mediterranean area (in particular, the *Dept Art History and Archaeology*, University of Missouri-Columbia, **United States**; the *Dept of History*, Université de Tunis El Manar, **Tunisia**; *Materials Science Institute*, Marmara Research Center - Istanbul, **Turkey**; *The Queen Rania's Institute for Sustainable Tourism and Cultural Heritage Management*, The Hashemite University - Amman, **Jordan**; *Faculté des Lettres et Sciences Humaines*, Université Mohammed I - Oujda, **Morocco**), it should have a significant impact in creating effective partnerships and collaborations crossing the economic and political boundaries of the actual European Union.


**Benefit of the mobility to the European Research Area**
The trans-national and trans-European dimensions of the project, and the creation of a technological infrastructure supporting free circulation of knowledge, contribute to the development of links and collaborations with national and international scientific partners. This will support European countries to benefit from the worldwide progress of knowledge and support the global development, which are two of the main objectives of the ERA initiative[13].

During the last fifteen years, the European Commission and the Members States have invested heavily in promoting *e*-Science and developing e-Infrastructures, including the pan-European research network GÈANT, *e*-Science Grids, data infrastructures and supercomputing. The vision supporting such an investment is that "research does not stop at national [and disciplinary] borders": the 2008 Ljubljana Council meeting highlighted that the new vision includes "free movement of knowledge", "sharing and using knowledge across sectors and borders"[14]; the 2007 Competitiveness Council invited Member States to "encourage public and private research institutions to make full use of the emerging distributed forms of research activity (namely *e*-Science) based upon international research networks"[15] and to promote the development of VREs.

Our project, including the development of a computational infrastructure based on a new multidisciplinary methodology for the archaeological studies of LRCW, is perfectly in line with the efforts the European Commission and the Member States are managing to foster a rapid transition towards a new paradigm of doing science: a paradigm shift that is crucial "to retain its competitive edge and to respond to society's expectations". The objectives of our proposal are also consistent with the recommendations introduced in the Research Agenda of the ***EPOCH*** (*European Network of Excellence on ICT Applications to Cultural Heritage*), the network of cultural institutions whose overall objective is to improve the quality and effectiveness of the use of Information and Communication Technology for Cultural Heritage (see, in particular, recommendations: 1.1; 1.2; and 1.3)[16].

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[13] *The European Research Area Partnership* http://ec.europa.eu/research/era/pdf/era-partnership-2008-initiatives_en.pdf (2008).
[14] http://register.consilium.europa.eu/pdf/en/08/st10/st10231.en08.pdf (2008).
[15] www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/97225.pdf (2007).
[16] *EPOCH Research Agenda for the Applications of ICT to Cultural Heritage*, Full Report, May (2008).

Finally, two European initiatives are worth being mentioned here in relation to our proposal. The first one is focused on the valorisation of the archaeological research together with its practices and methods of inquiry, and it refers to the foundation of the **ACE Network**[17]. The network has been established with the support of the *Culture Programme of the Directorate General for Education and Culture of the European Commission*, and it is composed of 14 partner institutions from all over Europe. The network recognizes the relevance of our understanding of the past for the future development of the European society and, in particular, the fact that archaeology provides a unique contribution to our knowledge of the history of ancient societies, their evolutions and connections, their material culture and their interactions with the environment. The second initiative, called **EUMECONNECT-2**[18], refers to the development of technological infrastructure for IP-based data-communication network in the Mediterranean region. EUMEDCONNECT-2 provides dedicated high-bandwidth, low latency connections between national research and education networks (NRENs) in 16 countries and connects with the pan-European GÉANT2 network. EUMEDCONNECT already supports a number of *e*-Science projects. Due to the relevance the presence of Mediterranean partners have in the development of our project and to the geographical boundaries of the case study, the project will take into serious consideration the possibility to benefit from the EUMEDCONNECT-2 infrastructure under the recommendations of the *e-Infrastructure Reflection Group* (e-IRG)[19] of the European Commission.

**B6 ETHICAL ISUUES**

The nature of the project, its outcomes, and the experimental testing will be performed do not imply any specific ethical issues. The project will make use of data, information and knowledge that will be freely provided by the ERAUB research group that will host the fellow, and by the members of an international network of specialists in archaeometrical and archaeological studies that already collaborate with the group. In particular, the involved analytical data are the results of scientific investigations conducted during the last years on the LRCW in the Western Mediterranean, and the most part of these has been already published in scientific journals and conferences proceedings. When necessary, data and information will come with the explicit legal permissions of the copyright owners in order to be used in the project and published online in the VRE.

Finally, no data about personal identity will be used in the project, no animal will be used to make experiments, and the project will not concern the research on embryonic stem cells in any respect.

## ETHICAL ISSUES TABLE

| | Research on Human Embryo/ Foetus | YES | Page |
|---|---|---|---|
| * | Does the proposed research involve human Embryos? | | |
| * | Does the proposed research involve human Foetal Tissues/ Cells? | | |
| * | Does the proposed research involve human Embryonic Stem Cells (hESCs)? | | |
| * | Does the proposed research on human Embryonic Stem Cells involve cells in culture? | | |
| * | Does the proposed research on Human Embryonic Stem Cells involve the derivation of cells from Embryos? | | |
| | I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL | * | |

| | Research on Humans | YES | Page |
|---|---|---|---|
| * | Does the proposed research involve children? | | |
| * | Does the proposed research involve patients? | | |

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[17] *Archaeology in Contemporary Europe*, http://www.ace-archaeology.eu/.
[18] http://www.eumedconnect2.net/.
[19] http://www.e-irg.eu/index.php.

| | | YES | Page |
|---|---|:---:|:---:|
| * | Does the proposed research involve persons not able to give consent? | | |
| * | Does the proposed research involve adult healthy volunteers? | | |
| | Does the proposed research involve Human genetic material? | | |
| | Does the proposed research involve Human biological samples? | | |
| | Does the proposed research involve Human data collection? | | |
| | I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL | * | |

| | Privacy | YES | Page |
|---|---|:---:|:---:|
| | Does the proposed research involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)? | | |
| | Does the proposed research involve tracking the location or observation of people? | | |
| | I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL | * | |

| | Research on Animals | YES | Page |
|---|---|:---:|:---:|
| | Does the proposed research involve research on animals? | | |
| | Are those animals transgenic small laboratory animals? | | |
| | Are those animals transgenic farm animals? | | |
| * | Are those animals non-human primates? | | |
| | Are those animals cloned farm animals? | | |
| | I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL | * | |

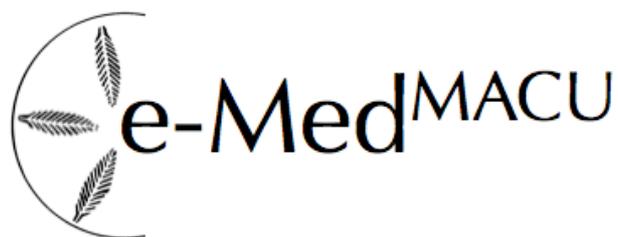| | Research Involving Developing Countries | YES | Page |
|---|---|:---:|:---:|
| | Does the proposed research involve the use of local resources (genetic, animal, plant, etc)? | | |
| | Is the proposed research of benefit to local communities (e.g. capacity building, access to healthcare, education, etc)? | | |
| | I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL | * | |

| | Dual Use | YES | Page |
|---|---|:---:|:---:|
| | Research having direct military use | | |
| | Research having the potential for terrorist abuse | | |
| | I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL | * | |

# ENDPAGE

PEOPLE
MARIE CURIE ACTIONS

**Marie Curie Intra-European Fellowships (IEF)
Call: FP7-PEOPLE-2009-IEF**

PART B



# A *Virtual Research Environment* for Multidisciplinary Based Typological and Chronological Studies on Late Roman Material Culture in the Western Mediterranean