MACE *e*Content*plus* Project: Metadata for Architectural Contents in Europe

Alba Fuertes[1], Miquel Casals[1], Nuria Forcada[1], Alberto Giretti[2], Mario de Grassi[2], Stefan Apelt[3] and Markus Eisenhauer[3]

[1] Technical University of Catalonia. Department of Construction Engineering, C/Colom 11, Edifici TR-5, 08222 Terrassa (Barcelona) Spain
alba.fuertes@upc.edu, miquel.casals@upc.edu, nuria.forcada@upc.edu
[2] Università Politecnica delle Marche. Dipartimento di Architettura Costruzioni e Strutture. Facoltà di Ingegneria, via Brecce Bianche, 60121 Ancona, Italy
a.giretti@univpm.it, m.degrassi@univpm.it
[3] Fraunhofer Institut FIT, Schloss Birlinghoven, 53754 Sankt Augustin, Germany
stefan.apelt@fit.fraunhofer.de, markus.eisenhauer@fit.fraunhofer.de

Abstract. The MACE project sets out to transform the ways of e-learning about architecture in Europe by integrating vast amount of content from diverse repositories created in several previous projects as well as from existing architectural design communities. Therefore, MACE provides a framework for community based services such as finding, acquiring, using and discussing about e-learning contents, which are previously enriched with useful social, contextual and competence metadata.

Keywords: Metadata, learning objects, architectural design, content enrichment, technology enhanced learning

1 Introduction

In Architecture sector a large amount of information is created in different types of medias: written documents, images, photos, sketches, drawings…, which are in general hard to index and find. On the other hand, most of the times this information resides in the people related to this discipline and the transmission of this knowledge becomes informal rather than formal. This context makes more difficult the task of tracking, sharing and exchanging not only knowledge but also information. For these reasons, non-expert designers and students spend a lot of time searching large number of cases similar to their actual situation, to get cues and suggestions on how to proceed.

Currently there are a lot of projects concerning architecture and e-learning. In addition to these projects, universities, companies and other parties have created databases for architectural content which have, in some instances, started to enrich them with metadata in order to make easier its classification and search. Despite the shared domain, all these architectural content repositories are only lightly connected to each other and the integrated access to their contents is not realized at present. This is due to the different approaches in knowledge structuring (no common methodology or standards are employed) as well as the different content languages used.

2 Background

As aforementioned, different architecture-focused web-portals have been developed. A possible classification by categories could be: e-learning platforms, visual collectors, software resources, vertical portals, projects databases, topical search engines, materials databases and architects' sites. [1]

All of them have their own importance in the architecture sector bearing in mind that each portal provides different kind of information contained in different kinds of media (image, video, documents,…), as well.

On one hand, Visual collectors and Project databases are important in architecture sector because they own databases rich in images. However, they aren't usually very structured. While Visual Collectors take on the figurative, formal, perceptive and spatial dimension of architecture, the Project databases take on the spatial organization of dimension and typology. Architecture Gallery (0III) [2], architypes.net [3] and VIEW [4] are some examples.

On the other hand, Material Databases have interesting and useful documentation regarding products, architecture related materials and the latest technologies in the building field available. Therefore, Material databases bring the material and technological dimension of architecture and help professional designers and students to link products-materials-technologies to buildings in order to understand the materials and technological solutions adopted in their performance. Materia [5] and Material ConneXion [6] are some examples.

Software Resources orient the students, teachers or professionals in choosing which software is most suitable for his/her work or study's need. Moreover they also guarantee constant updating regarding the latest CAD and CAM photographic touch up, photo composition, rendering and video creation software products. CumInCAD [7] and CGarchitect.com [8] are some examples.

Besides possessing a rich image repertory, Vertical portals contain critical essays and document the development of the contemporary debate on architecture. This critical dimension/part complements the project and image repertories of Visual collectors and Project databases, which would otherwise remain mute. ArchNet [9] and Arcandpro [10] are some examples.

And finally, Architects Web-sites are important because they make constantly updated material available.

3 Limitations in searching information

Most of these already mentioned architecture-focused web-portals use search tools to allow users to acquire, in an easier way, the information that he/she is interested in. However, as a consequence of the existing gaps in accessing information, not always this search solves the users' needs. Therefore, the search tools used in most of the web-portals present some limitations related to the access to the information, their structure and their operability [11].

When talking about Access limitations we refer to Integration of information, Polysemy in keywords, Information overload and Non optimal ranking aspects. Integration of information aspect refers to the fact that search engines are general purpose, therefore they present results in a loosely arranged listing without arranging results in a structured and well integrated manner. On the other hand, Polysemy aspect is related to the problem caused by the many keywords in architecture that are shared with other fields, and that a traditional search engine is unable to distinguish. Information overload aspect refers to the long lists of irrelevant items related to a topic that hides the few interesting ones. And finally the Non optimal ranking aspect, related to the lack of ranking or description regarding to the type of content provided.

On the other hand, Structure limitation is classified in two aspects: Categorical search and extended search limitation. Categorical search limitation refers to the impossibility to include subcategories of a topic in a single search and Extended search limitation is related to the impossibility to extend the search topic to related subjects in order to provide further cues for improving comprehension.

And finally, Operability limitation is differentiated between Context awareness and Language aspects. Context awareness refers to the fact that searching is usually performed without any information relative to the user's operative context, what implies poor ranking and displaying. And Language aspect is used to state that despite the fact that current search engines provide support for multi-language search, in architecture there are many idiomatic words that require specialized thesauri.

2 MACE Project

Metadata for Architectural Contents in Europe (MACE) is a project co-funded by the European Commission inside the eContentplus Programme, a multiannual Community programmed to make digital content in Europe more accessible, usable and reusable. The MACE project sets out to transform the ways of e-learning about architecture in Europe. It will integrate vast amounts of content from diverse repositories created in several large projects in the past and build a framework for providing community based services such as finding, acquiring, using and discussing about e-learning contents that were previously not reachable. (See Figure 1 [12])

The MACE consortium consists of ten partners from academia and industry. It builds on the WINDS project (Web based INtelligent Design tutoring System, an EU-funded e-learning platform containing 21 courses spread over Europe), in the ARIADNE Foundation, in the ICONDA (Fraunhofer IRB, hosting 650.000 references and referencing 300 journals monthly) and DYNAMO (K.U.Leuven, complemented with 5000 learning objects from many different universities worldwide through ARIADNE and the GLOBE network of learning object repositories).

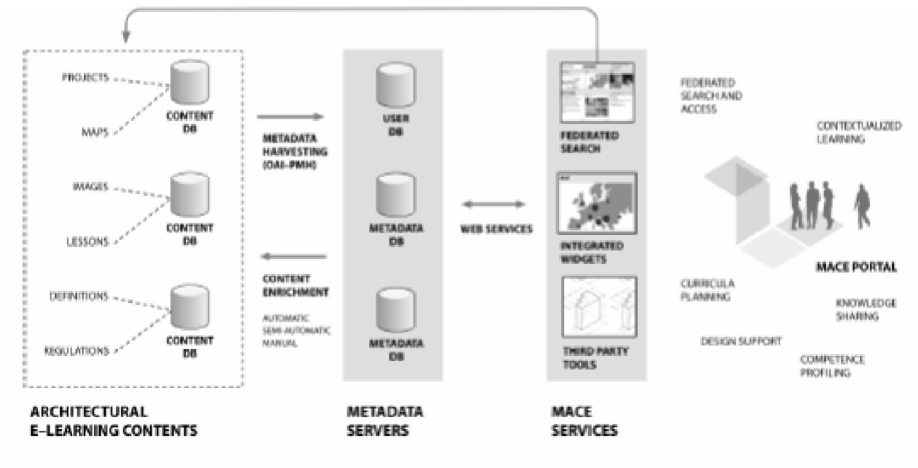

Fig. 1. MACE infrastructure overview

2.1 Objectives

The objective of MACE is to create a conceptual and technical infrastructure to:

- connect contents via metadata,
- connect existing communities,
- provide federated search and access and finally,
- create a sustainable knowledge network

On the other hand, this infrastructure is addressed to two kinds of user groups:

- Academic: Schools and universities of Architecture, Students and teachers and Researchers.
- Professional: Architects, architectural companies, Information brokers and Travel companies.

Basically, the idea is to provide convenient and effective ways to network the already existing repositories enriching their contents with new metadata, making connections between contents accessible to the user, thus enabling inter-repository navigation paths, and finally providing a search interface that allows users to benefit from multiple types of metadata for content retrieval (See Figure 2).

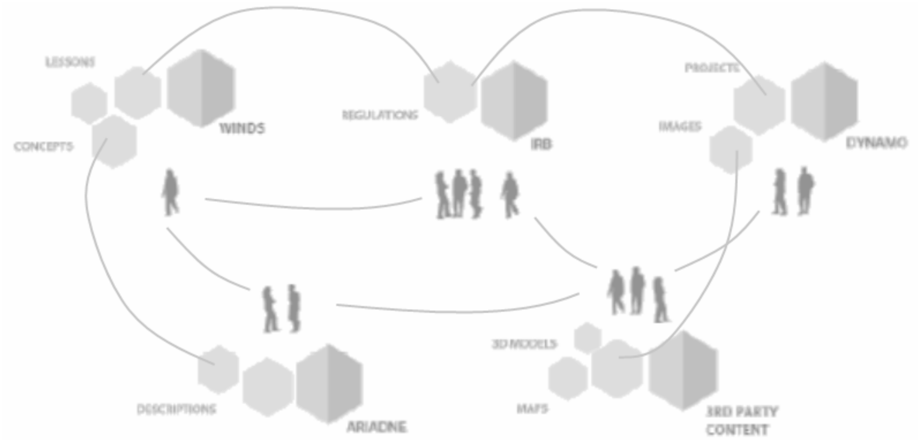

Fig. 2. MACE network

2.2 MACE infrastructure

The MACE infrastructure is aimed on opening up the already existing Learning Objects Repositories (LORs) in order to enable the access of Learning Objects (LOs) through MACE tools. Therefore, MACE infrastructure could be understood as a hybrid combination of harvesting metadata from and federating searches to existing content repositories. Moreover, learning objects are enriched with new metadata in order to make the learning objects in all repositories jointly searchable and retrievable [13].

In reference to the federated search of contents, the technical infrastructure allows searching over the contents of all content repositories based on metadata. The enriched metadata store supports a search facility that provides references to available and suitable learning objects. In order to access the learning object, the user accesses the learning resource directly at the provider through the respective mechanisms of each provider.

This metadata store is composed by the collected metadata of the already existing and now connected repositories. The metadata harvesting is based on the Open Archive Initiative Protocol for Managing Harvesting OAI-PMH, what means the transfer of content metadata from the providing repository into central content metadata repository on a regular basis. By this way, only the metadata describing the learning objects is transferred and the learning objects themselves stay in the repository and thus, in control of their owner without changing the access conditions.

To summarize, in technical terms, the MACE infrastructure pretends to open up the existing LORs to enable the access of LOs through MACE tools, collecting their metadata and federate searches. Moreover, it enables the enrichment of LO descriptions with metadata about their usage including contexts of use, necessary competencies, etc. making the LO in all repositories jointly searchable and retrievable (See Figure 3 [12]).

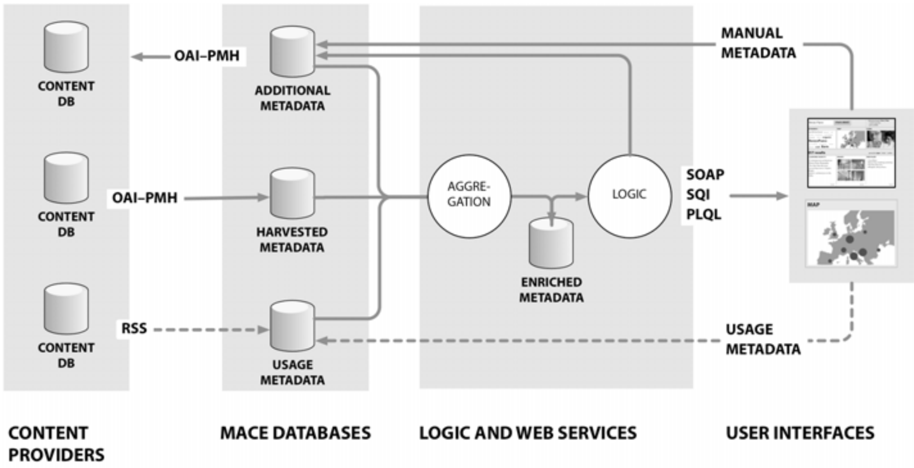

Fig. 3. MACE technical infrastructure

2.3 LOM and metadata in MACE

Bearing in mind that MACE is mainly focused on architecture engineering and construction education, one of these standards used is the Learning Object Metadata (LOM) [14] standard, used to describe MACE educational resources. Learning objects are defined here as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning, and Learning Object Metadata, a data model used to describe a learning object and similar digital resources used to support learning as well.

The purpose of this learning object metadata is to support the reusability of learning objects and the improvement of the interoperability between different Learning Objects Repositories (LOR). This metadata can be enriched manually or automatically and is classified as content and domain metadata, context metadata, competence and process metadata and usage related/social metadata.

Content and domain metadata contains information about the learning object and its content: domain of the learning object, what the content is about and the technical properties of the object. In MACE, learning objects are classified according to various different descriptions and rely on LOM standard to capture these descriptions.

Context metadata is used to define the context related aspects of the overall taxonomy to be used in MACE, the corresponding metadata schema and its relation to LOM. Contextual metadata will provide a categorization of entities with respect to similarities in their context metadata and enable more advanced search than traditional keyword search can offer. Even though the MACE system will deal with the digital contents describing real world objects and not the objects themselves, it makes sense to distinguish between two categories because they have different metadata associated with them. Fortunately, the LOM standard allows for more than one metadata record per content object. MACE will make use of that by having different LOM records linked to each other, one for real world and one for digital content. The different context metadata included in MACE are classified as: architectural context, physical context, social, usage and role context and technical context.

On the other hand, Competence and process metadata are used to specify the competences that education should aim at and to tag contents in order to make them reusable and retrievable for educational purposes. Competence metadata describes abilities a student needs before starting a particular course and Process metadata describes suitability of particular content to perform certain instructional functions in a course.

And finally, Usage related/social metadata describes what users actually do with learning objects: explicit user feedback captured through annotations, e.g. from folksonomies and blog/wiki comments, the context, in which a learning object has been deployed, searched and used activities of users, to support personalization and recommendations.

2.4 MACE Tools and Services

On the other hand, different scenarios, which are a step-by-step description of a hypothetic MACE user behavior, are developed to identify and understand the interaction between the system and the user and the required knowledge processing. In this way, the scenarios are the basis for the development of the guidelines for the definition of MACE system specification and for the identification of a set of information that could support the operations relevant for architectural education. The analysis of these scenarios points that the whole set of user-system interaction concerning access to digital info can be essentially reduced to two types: contextualized searching/ browsing processes, that concern the access to information through a categorized set of keys; and focused application or application components (widgets), that are small thematic applications aimed at visualizing and structuring information according to the requirements of specific tasks.

Therefore, in MACE, all functionality for end users is made available in specialized widgets. For different metadata types or service functionality a dedicated widget can be used to visualize metadata values, edit metadata, filter searches and navigate contents. Moreover, MACE widgets can be embedded into existing web portals, thus making MACE functionality and contents available directly to portal owners and their users.

In MACE different MACE widget types can be distinguished: Basic widgets to handle basic user management and navigation tasks (a login widget, a simple search box or a link list widget), Content presentation widgets to display content collections from the repositories (related pictures for a given article, a list of search results or a single content item) and Metadata widgets to visualize metadata values and aggregations of metadata values (so-called metadata profiles). Additionally, they allow editing of metadata as well as meta-data based navigation, search and filtering [15].

On the other hand, a combination of widgets can be used for searching, browsing and filtering in a facetted search application (See Figure 4).

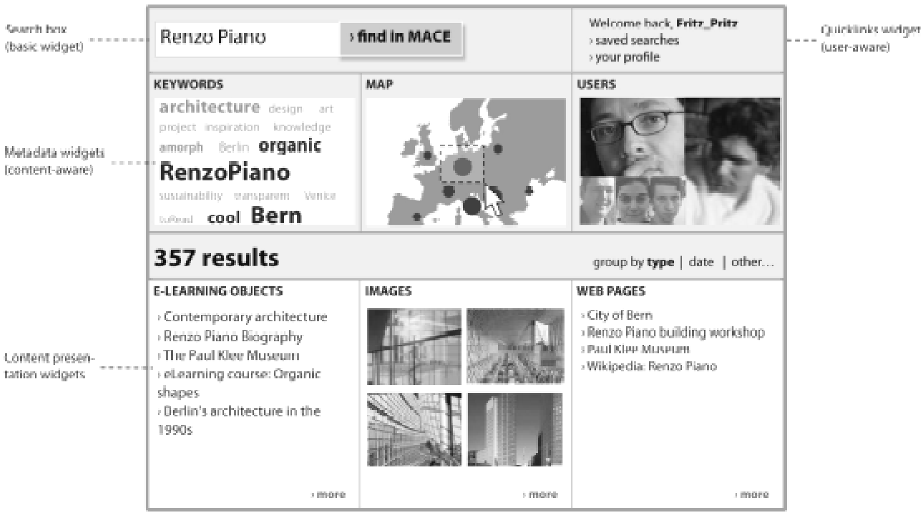

Fig. 4. Combination of widgets

Another application of MACE widgets is to edit metadata in place in order to allow experts and other users to contribute in the meaningful information of contents. Generally, the aim is making interaction with metadata not only as easy as possible, but also as open as possible (See Figure 5).

Fig. 5. Editing metadata with MACE widgets

On the other hand, MACE widgets are used to present related metadata values and contents directly on the content pages, in order that users can not only understand the nature and relevance of the presented contents, but also directly navigate to related items or query the MACE database for further contents based on metadata values. By this way, by presenting a variety of metadata fields, MACE enables multi-facetted navigation - not only on a semantic, but also a social and contextual level.

3 Conclusions

To conclude, this paper presents MACE, a European initiative aimed at enriching and connecting existing architectural domain portals and their contents, providing a unique single access point or interface that contribute enormously to the learning experience.

One of the important applications of MACE is the capacity to enrich contents with various types of metadata, enabling multiple perspectives and navigation paths, effectively leading to experience multiplication in technology enhanced learning about architecture and design. By this way, MACE creates an open system and provides incentives for actively enriching and sharing knowledge.

On the other hand, MACE establishes connections between concepts across repositories in order to relate items and improve the user's understanding. Following the same objective, MACE displays metadata values directly in place supporting a better judgment of the relevance and context of a single piece of information.

And finally, MACE is used to search concepts in an intuitively way enabling directed search and browsing of contents with respect to features relevant for architectural knowledge in a unique combination. The underlying weighted activation model fosters understanding how metadata values and/or search terms relate to each other.

Actually, the MACE consortium is creating a first prototype, which will be revised and improved. For this reason it is obviously too early to assess the impact of MACE, and to measure its added value compared to the services offered by individual repositories.

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