"MACE – METADATA FOR ARCHITECTURAL CONTENTS IN EUROPE"

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ABSTRACT

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 previous projects as well as from existing architectural design communities. MACE will provide a framework for community based services such as finding, acquiring, using and discussing about e-learning contents that were previously reachable only to small user groups. The project builds on top of several projects about e-learning and architecture. Content and technology of these projects constitute the base for developing the MACE services. Additional content will be acquired by project partners who have access to a large number of content providers or are themselves universities dealing with architecture and design. Metadata is the key for searching, finding and using all kinds of content. Poor or no metadata hinders the public to find and use content and to benefit from existing knowledge. MACE develops and uses several types of metadata for tagging contents: content metadata, context metadata, competence and learning process metadata, usage related metadata and social metadata. Enriching and processing this new created metadata, MACE will enable the access to various repositories spread all over Europe. The project addresses the multicultural and multilingual issues resulting thereof and creates working solutions for sharing contents across borders.

KEY WORDS

Architecture, e-learning, metadata, content, enrichment, knowledge network, community

INTRODUCTION

The digital era has radically changed the way of designing and studying architecture within shortest time. Students prepare their projects and seminar papers already naturally with computers. Teachers have been developing digital learning materials like tutorials and presentations for online teaching and there is an increasing number of digital didactic systems like 'T-Labs' of the Faculty of Architecture of the University IUAV of Venice (e.g., Spigai et al. 2007). Knowledge and learning content which is produced during workshops and courses can be stored and shared among students and teachers. 'T-Labs' offers a 'virtual classroom' with personal pages and space for the own sketches, texts, images, corrections, bibliographies etc. This large amount of valuable digital learning contents is unfortunately not shared across school boundaries with other schools of architecture. In general this is due to technical problems like missing tools for federated search and access or missing common standards in knowledge structuring and exchange. At least the different content languages create one of the barriers that limit the impact of high quality architectural content on the huge potential user basis in the academic and professional sector. The MACE project aims at achieving full integration of these large set of contents already in place and to emphasize its impact over the large communities of university students in architecture and civil engineering, as well as professionals and public administration.

The MACE consortium consists of partners from academia and industry from five european countries. It builds on the experience gained in the WINDS project (Web based INtelligent Design tutoring System) and the experience from the ARIADNE projects which

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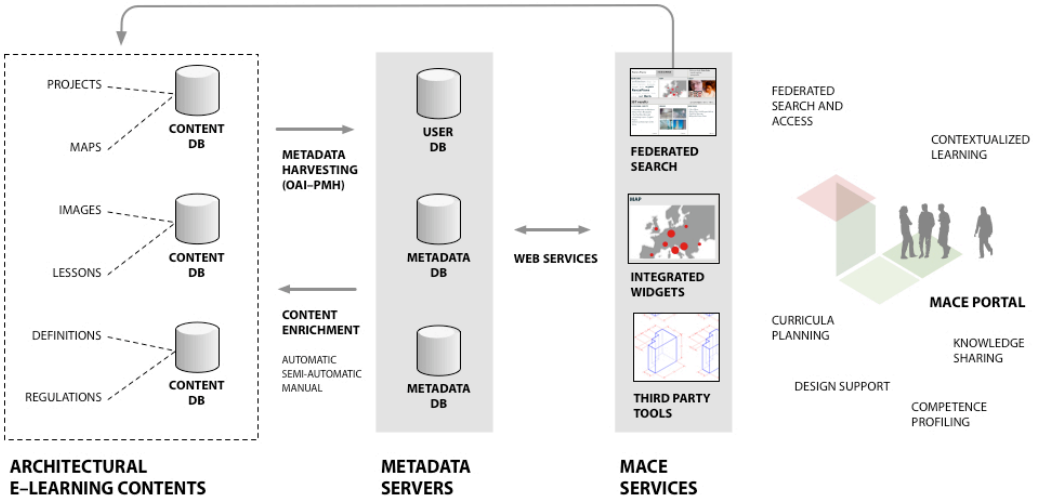
created tools and methodologies for producing, managing and reusing computer-based pedagogical elements. Architectural content is provided by Fraunhofer IRB through several databases, and by K.U.Leuven through DYNAMO (Dynamic Architectural Memory On-line), which contains documentations of architectural projects.

INTENDED INFRASTRUCTURE

The project is creating an infrastructure for accessing architectural content distributed across Europe. Methodologies and processes are currently developed to enrich the contents. With these available, users will be able to search for and acquire content in different languages by using one single access point, preferably a web-based portal. A first idea of the envisioned infrastructure is shown in figure 1.

Figure 1: MACE infrastructure overview



The MACE infrastructure consists of four layers: Content, Metadata, Services and Infrastructure/Portal. The separation between Content and Metadata and the storage of metadata into repositories separate from the contents gives the project to a very flexible approach to customizing the project. It also allows for enriching contents without changing them directly – all that is needed is a URL (Uniform Resource Locator) to the location of the content. By using this method, MACE can incorporate large amounts of online content without the content providers having to modify anything in their repositories. Their content repositories should only offer an interface for harvesting. That means transferring metadata from the respective repository into the central content metadata repository. Harvesting the metadata is done through interfaces at each content repository implementing the Open Archive Initiative Protocol for Managing Harvesting (OAI-PMH). The central content metadata repository also offers an OAI-PMH interface so that interested content metadata providers can retrieve eventually enriched metadata suitable for their learning objects.

Once the interface has been established, metadata from content providers can be harvested into the MACE metadata repository. As the way of structuring data in every repository is individual the central metadata repository has to set a common standard. MACE uses the Learning Object Metadata standard (LOM) to formalize the description of educational content. The LOM-standard has been extended for the purposes of the project with categories which derived from the requirement analysis in an early phase of the project. In the meantime first experiences have been made with mapping metadata from project partner repositories to the LOM-based MACE application profile, an individual defined set of

metadata fields. The application profile has shown flexibility and its suitability for the description of the learning objects: The architectural project as well as the single digital objects connected to this project can be represented in just one application profile (e.g., Neuckermans et al. 2007).

OBJECTIVES OF THE PROJECT

INTEGRATION OF MULTIPLE SOURCES OF ARCHITECTURAL CONTENT

MACE integrates multiple sources of architectural content from e-learning as well as from professional sources. Several partners have structured curricula for architectural education in use already; these will be used as core of the MACE content base. MACE integrates the existing repositories into a common infrastructure and provides a common interface for querying all available data.

ENRICHING A CRITICAL MASS OF DIGITAL HIGH QUALITY CONTENT WITH METADATA

As a very important objective, this one aims to enrich the integrated content sources with metadata in a common standard. MACE is currently developing these types of metadata for tagging contents:

- Content metadata through semiautomatic content indexing: The currently available indexing facilities in the project WINDS and the database DYNAMO are a solid basis for connecting a semantic layer and the content layer. MACE gives the opportunity to analyse existing metadata sets on their validity and uses indexing techniques for automatic metadata completion. This is supported by indexing and text mining techniques for semiautomatic meta-tagging and content analysis.
- Usage related and social metadata: In MACE, annotation techniques are integrated with learning content management systems to explore new ways for visualization and social navigation interfaces. Student's annotations, discussions, and metadata together with social recommendation techniques improve individualized learning.
- Contextual metadata: To follow approaches from contextualized learning, contents are enriched with context metadata. This allows for a variety of different access methods and structuring approaches. Especially in architecture and design, approaches for connecting content to physical space promises a highly sophisticated support of learning material in context. Metadata of this class is already present for some contents in the WINDS repository.
- Competence and learning processes metadata: Creation of competence ontologies provides a basis for dynamic personalized courses. This restructuring and integration of content layer, semantic layer, and competence layer is based on the close cooperation with the project TENCompetence (developing and using infrastructure to support individuals, groups and organisations in lifelong competence development).

DISCOVERING MULTILINGUAL & MULTICULTURAL CONTENTS

Enriching huge amounts of digital contents with metadata will create sooner or later the problem, that there are single learning objects about the same subject but maybe in a different media type and in a different language. To enable the usage of architectural contents across borders, MACE wants to create a system that can handle the following scenario: All contents, metadata, search terms - whatever comes into the system - will be automatically translated internally into a common language (English for example) which is then used for querying. While this might not yield perfect translation results for full texts, it would enable a German user to search for "Stadtplan für Florenz", an English user to search for "City map of Florence" and both would be successful, although the city map is actually meta-tagged with "Firenze" (Italian) as keyword.

IMPROVE KNOWLEDGE ACCESS AND DISCOVERY BY INTERACTIVE VISUALIZATION

The integration of multiple content sources and the variety of available metadata demands for sophisticated access methods. In order to ease access and navigation in an enormous mass of potentially interesting content items, interactive visualizations can reduce cognitive load and make the relevant information pre-attentively available. Since the architectural domain has very specific needs, the project develops domain-specific visualizations in order to provide optimal access to the available data and thus foster knowledge discovery. MACE experiments both with visualizations for specific types of metadata as well as integrated tools for content discovery by cross-repository interconnection.

BUILDING A SUSTAINABLE ARCHITECTURE AND DESIGN CONTENT COMMUNITY

The enrichment and the integration of content and the appropriate navigation and visualization tools are only first steps for bringing contents into use and building new services. Several universities of design and architecture are included in the MACE consortium who will work as a first distributor. Second, EAAE (European Association for Architectural Education) - via the partner Department of Architecture at KU Leuven - is a multiplicator among lots more of universities across Europe. Next, there are several industry partners in the MACE consortium whose main task is to make MACE known and used in the professional communities in Europe.

UNDERLYING DATA AND SOURCES

The MACE project builds on the technological, content, and knowledge results of the WINDS project. It will add large content corpuses of the European Association of Architectural Education, Fraunhofer IRB, ARIADNE and DYNAMO. This will be complemented by resources from additional partners and open content repositories. The project is structured in an open way that makes it possible to integrate additional content from interested parties at a later time in the project. Table 1 shows the core content for MACE, which is brought into the project by the content partners:

Table 1: Core content for MACE from project partners

Content Source	Partners	Objects	Metadata	Metadata level
WINDS	IUAV, UPC, UNIVPM, POLIMI	5529 compound objects, 10542 single content blocks (text, image, multi-media)	1744 index terms (text)	3521 of 5529 objects enriched with content metadata
ARIADNE	KUL	5000+ objects, of which several hundreds can be used for MACE	technical metadata, keywords, annotations	almost all objects have mandatory technical metadata, some content metadata, no context and a few social metadata
DYNAMO	EAAE	544 architecture projects, 7351 files (text, image)	1944 index terms (text)	High level of content metadata
ICONDA® Bibliographic BAUFO® FORS® MONUDOC®	IRB	Literature references from a bibliographic database and full-text information about research projects and the preservation of monuments	bibliographic description, Index terms, abstracts	All units with index terms based on intellectual indexing

WINDS CONTENT

The WINDS data model with two alternative structures – hierarchical course and concept network – enables learner centred education via more navigational control and personalized adaptive learning. WINDS currently consists of 21 courses about architecture, containing 5529 learning objects of which 3521 are currently enriched with metadata. There are 10542 single content blocks and 1744 keywords (index terms). Most of the content is written in English, although in some cases there are also alternative language versions available. The authors come from various countries: Italy, Spain, U.K., Switzerland, France, and Slovenia.
Most of the surveyed teachers perceived the WINDS system as a plausible alternative to traditional teaching and would like to use it in their future courses. The experience shows that students can benefit from the usage of online courses (especially if they complement traditional teaching).

ARIADNE CONTENT

The ARIADNE Foundation is one of the early pioneers on a vision of "share and reuse" for education and training. The distributed ARIADNE Knowledge Pool System has been operational since early 1997 and currently includes more than 5000 learning objects with detailed descriptions. Although all disciplines and domains are represented, only a small part of the objects focus on architecture. Through the GLOBE (Global Learning Objects Brokered Exchange) network, ARIADNE has concluded partnerships with other research projects and provides access to several tens of thousands of additional objects, of which several hundreds are relevant for the MACE context. This large amount of heterogenous content objects makes ARIADNE a good environment for trying things out like Federated Search and connection of distributed content repositories.

DYNAMO CONTENT

The Dynamic Architectural Memory On-line (DYNAMO) was developed in order to stimulate and support architects' life-long process of learning from previous design experience. DYNAMO currently serves 930 registered users (mainly architecture students and teachers) with 544 built and unrealized projects that are documented by 7351 files (sketches, plans, photographs, texts, bibliographies, etc.) and labelled by 1944 keywords (index terms). The interface and indices are in English, the material documenting the projects is multilingual. Users cannot only consult the collection, but also contribute to it in various ways.

DYNAMO takes shape as a multimedia platform filled with a permanently growing collection of concrete design projects (i.e. records of concrete design experiences), offering students and professionals a rich source of inspiration, ideas and design knowledge. Especially in the early, conceptual stage of the design process, concrete design projects provide grist for some decisions to be made.

FRAUNHOFER IRB CONTENT

Fraunhofer Information Centre for Planning and Building IRB, established in 1941, offers since the Seventies databases for online utilisation. Today the range of databases is divided essentially into three categories. Bibliographic databases include technical literature up to the level of journal articles. The documentation units are edited bibliographically (often with an abstract) and indexed intellectually. The references are increasingly linked with the appropriate electronic full text sources. Full text databases cover focal topics (preservation of historical buildings, building pathology, technical approvals) and are accessible by full text retrieval. Research project databases with descriptions of current and completed research projects in field of building research and urban planning complete the offer of Fraunhofer IRB.

EAAE CONTENT

EAAE is involved in the project via the Department of Architecture at KU Leuven. While EAAE already contributes the results of the DYNAMO project, it also counts more than 100 Active Member Schools in Europe from the Canary Islands to the Urals, representing almost 5.000 faculty members and more than 100.000 students of architecture from the undergraduate to the doctoral level. There are 1500 schools from all over the world in a common mailing list. From the work of EAAE, it has become clear that many educators have developed digital materials, courses, exercises, tools, paradigmatic cases and illustrations. EAAE together with the teachers plans to discover and open the contents 'hidden' in local school repositories. These contents will get a plus value when they are disclosed all together in MACE and linked with each other and contents from other repositories. As the exact amount of content that will be available cannot be estimated at project start, some of the first activities will be to scout for content and gather some statistics. EAAE will also contribute logistic-pedagogical content like the EAAE guide of European schools of architecture and a database of schools of architecture in Europe.

EXPECTED RESULTS FROM THE PROJECT

INTEGRATION OF A HUGE AMOUNT OF CONTENT FROM VARIOUS SOURCES

MACE combines a lot of content from very different sources, making it available through a single access point which does not exist at present. Acquiring new content will be done by project partners through the whole project and the amount of contents available will increase significantly.

INCREASE IN USAGE OF CONTENT

The MACE approach provides unique EU-wide federated search and knowledge discovery facilities in the area of Architecture and Design. Integrating MACE services into existing content networks will hugely increase content acquisition and usage across repositories. It is expected to see a steady increase in content usage over the duration of the project and also afterwards.

EMERGENCE OF AN EU WIDE PORTAL FOR ARCHITECTURAL CONTENTS

By creating flexible and attractive methods for user contributions, MACE provides the infrastructure to create a sustainable, dynamic knowledge network. Dissemination and community building work ensures the growth of an active user community connecting professional and academic experts across Europe.

CONCLUSION

This paper presents the objectives of the MACE project (www.mace-project.eu), which aims to give E-learning about architecture a new quality. Large amounts of digital learning contents about architecture will be accessible on the European level. This is possible through the use of metadata, which describe the contents and which enable to search, to find and to use these contents. The project currently sets up a framework for theses activities. Users of MACE will be able to create and edit metadata and will form with other users a network of architectural design knowledge.

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