KNOWLEDGE MANAGEMENT AND E-LEARNING FROM RESEARCH PROJECTS IN THE FIELD OF UNDERGROUNG CONSTRUCTION

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Abstract: The purpose of this paper is to describe a Knowledge management system (SGAC- Active Knowledge Management System) and an e-learning system that have been developed to manage the knowledge generated inside a research project, to transfer this knowledge from the research project to society and, moreover, to facilitate the e-learning tasks. This paper approaches the problem of knowledge transfer from a case study angle. The systems are implemented in "The Multidimensional City" which is a multi-disciplinary research project that promotes the development and implementation of Spanish technological innovation in underground construction. The SGAC system aims at achieving full integration of large set of contents created in research projects related to underground construction sites. Then, the project has developed several types of metadata for tagging and enriching contents. All this enriched information becomes the base of different e-learning courses in underground construction, promoting an updated education in this knowledge area and the dissemination of the results generated in the research project. These courses are accessible from an interactive e-learning platform.

1 INTRODUCTION

Currently, there are thousands of research projects running. The majority have a web page for the society to know about the project and an intranet for the partners to exchange documentation, planning and information. Once the project has finished, this information still remains in the web but it easily becomes old because nobody updates it. Moreover, normally the information is disorganised and difficult to retrieve.

This paper presents, on one hand, a tool developed to transfer the knowledge generated in a very big national research project: "The Multidimensional City". The objective is to create a starting point of generating knowledge and to carry on once the project is finished. This system is called Active Knowledge Management System (SGAC) and pretends, through a single access web portal, to promote the dissemination of the research results, to provide tools to make the knowledge management tasks easier along the lifecycle of the project and to provide useful and updated information to academics, researchers and industries in the underground construction field.

On the other hand, an e-learning platform is also presented in this paper. This platform has been developed inside the same national research project and is aimed at offering useful tools and up-to-date courses and educational contents in general, as well as at increasing the dissemination of the research results in another community of users, such us academics and industry professionals.

2 THE MULTIDIMENSIONAL CITY PROJECT

The Multidimenisonal City is a Spanish strategic

scientific-technological project from the Ministerio de Ciencia e Innovación PSE 10-2005. It is a multi-disciplinary research project that promotes the development and implementation of Spanish technological innovation in underground construction.

The Multidimensional City is a project endorsed by the "Plataforma Tecnológica Española de Construcción - Hacia el 2030: Innovación y cambio eficiente del Sector de la Construcción". It focuses on five strategic lines: Underground construction, Cities and buildings, Safety and Health, Sustainable construction and Cultural heritage, promoting an efficiency improvement of the productivity and safety and a significant reduce of environmental impacts.

The project´s partners integrate not only the on-the-field engineering experience and technical know-how of the industry, but also the research capabilities and conceptual innovation of the academic sector.

The Multidimensional City is fully committed to contributing to an increased quality of life by reducing construction time and cost of planned and future underground infrastructures.

3 THE ACTIVE KNOWLEDGE MANAGEMENT SYSTEM

3.1 Introduction

The Multidimensional City project, moreover, pretends to create a net of knowledge from all the results and knowledge obtained along all the research carried out inside the project. This net is managed by the Active Knowledge Management System (SGAC in Spanish terms), which is aimed at boosting an efficient exchange of knowledge and experiences inside the research project and the dissemination of the obtained results to all the underground construction community.

3.2 Objectives

The Active Knowledge Management System (SGAC) pretends to be an access web portal to all the knowledge generated inside the The Multidimensional City project:

- Promoting the **dissemination** of all the results.
- Providing tools to make the **knowledge management** tasks.
- Providing useful and updated information to academics, researchers and industries.

3.3 The SGAC System

3.3.1 SGAC Contents Classification

Currently, the SGAC contains all the knowledge generated along lifecycle of the project.

In order to assure efficient searches and to accomplish the users' requirements, all this information has been enriched with different kinds of metadata.

When analyzing the knowledge, the metadata to be incorporated in each information object (IO) was defined. With the aim to create an interoperable infrastructure with other possible databases, the system uses as a basis the LOM IEE 1484.12.1 Standard for Learning Object Metadata (IEEE, 2002). Some of the standard fields were adapted to the specific project needs. At the end, seven types of metadata were incorporated: Content metadata, Media metadata, Formal aspects metadata, Copyright metadata, Educative metadata, Users' metadata and Contextual metadata.

One of the most important metadata is the content metadata. This metadata contains different keywords related to the content of each IO. These keywords are included inside a concept map of the underground construction field. To develop the concept map, different classification methods such as thesaurus for underground construction were analyzed (AFTES, 1998, AETOS, 1989, CONNET 2008, ITA, 2005, ISTT, 2005, etc.). From this analysis, it was decided to design the thesaurus basing on the ITA thesaurus, always bearing in mind the project purpose.

Not only content metadata was organized in different classes and subclasses, but also media metadata. Media metadata contains keywords related to the type of information included in each IO.

Technically, metadata is stored in a relational database implemented in PostgresSQL. This database contents 35 tables. The physical support is a Dell Power Edge 1950 server.

3.3.2 SGAC Tools

The SGAC system is composed by two different tools, both of them accessible from the SGAC web portal (http://www.lcm-gac.es) with a previous user's validation: the Introduction of contents tool and the Search of contents tool.

The **Introduction of contents** tool enables the user, with a previous validation, to upload the desired IO to the system and enrich it with the defined metadata fields (12 from 30 fields are compulsory). These metadata fields are grouped in

the seven LOM standard categories (General, Lifecycle, Technical, Educational, Rights, Relation and Classification).

On the other hand, the **Search of contents** tool provides three different kinds of searches: Simple search, Filtered search and Conceptual search. The Simple search can search by title and/or description. The Filtered search filters the results by their source, the format, the language and the year of creation. And finally, the Conceptual search enables the search of contents through the different categories and subcategories of both Media thesaurus and Content thesaurus.

4 THE E-LEARNING PLATFORM

4.1 Introduction

As aforementioned, inside the research project The Multidimensional City, a big amount of research works in the field of underground construction is being carried out. All the obtained results not only are interesting from a scientific or technologic point of view, but also from an educational point of view.

For this reason an e-learning platform has been developed with the aim of taking profit of all the knowledge generated inside the research project, already introduced and classified in the SGAC system, to be included in e-learning courses for academics, researchers and industries in the underground construction field. Moreover, the preparation of these e-learning courses will highly contribute to the dissemination of all the research project results.

4.2 Objectives

The e-learning platform pretends to be a versatile educational and training tool for academics, researchers and industries in the underground construction field:

- Providing **e-learning courses** for different levels of competences, contexts of application and end users.
- Providing a wide range of **useful and updated information** in the field of underground construction.
- Providing different **user-friendly e-learning tools** and repositories to make the learning tasks easier (images repository, 3D models repository, interactive three-dimensional scenarios,..).

- **Disseminating** the results obtained in The Multidimensional City research project through the underground construction community of practice.

4.3 The e-Learning Platform

4.3.1 e-Learning Platform Contents

The e-learning platform contains some e-learning courses, a wide repository of images and videos, a repository of 3D models and a group of interactive three-dimensional scenarios, all of them related to the underground construction field.

The e-learning courses are addressed to a wide range of users and levels of difficulty. Most of their contents come from the knowledge already included and classified in the Active Knowledge Management System (SGAC), assuring the transmission of up-to date information and promoting the dissemination of the results obtained in the research project between the underground construction community of practice.

Currently, a basic tunnelling course is introduced in the e-learning platform and is being carried out by a wide group of engineering university students.

On the other hand, the e-learning platform provides a repository of images and videos. On the other hand, each image and video has its own description.

Moreover, the repository of 3D models is also available from the e-learning platform and it is pretended to be accessible from the SGAC.

And finally, the platform contains different interactive three-dimensional scenarios that consist of 3D visualisations where the student can select some of the objects and find out related information. These objects are called intelligent objects.

4.3.2 e-Learning Platform Tools

The e-learning platform is composed by four different tools, all of them accessible from the e-learning platform web portal, with a previous user's validation: the e-learning courses platform, the repository of images and videos, the repository of 3D models and the interactive three-dimensional scenarios platform.

The **e-learning courses platform** currently contains a basic course of underground construction.

The **repository of images and videos** contains a wide up-to-day images and videos in the underground construction field. All of them are classified in different categories and subcategories,

coming from the Content thesaurus developed in the SGAC.

Both the **repository of 3D models** and the **interactive three-dimensional scenarios** are also available and easily visualized in the e-learning platform, using a web system without any specific software. The interactive three-dimensional scenarios consist of 3D visualisations where the student can move in using the keyboard and interact with some of the objects that constitute the 3D model.

The **discuss forum** is a user meeting point for stakeholders of the Multidimensional City Projects Research.

5 CONCLUSIONS

Currently, the majority of the research knowledge is shared in face-to-face interactions (project presentations, meetings, etc.) and it is dispersed in different supports (paper based, on line, etc.). With the development of the Active Knowledge Management System (SGAC) all this knowledge is centralized and accessible for all the project community from a unique web portal. All this information has been analysed and codified with metadata to assure efficient searches and to accomplish the users' requirements. From the study of all this knowledge the users have realized that some of them are working in similar or complementary research areas. Therefore, the SGAC helps all project partners to know what is being done in other sub projects. On the other hand, the system is becoming a useful tool to manage all the knowledge generated in the project along its lifecycle.

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