InPro training environment – training platform for BIM based collaborative working

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Abstract

InPro project is European initiative which is developing a model based and collaborative way of working in early design phase in construction. The InPro project recognizes the importance of dissemination of newly developed knowledge not only via research papers, professional organizations and media but also via formal university education and life-long education of current and future professionals. Introduction of ICT in business processes create redundancies in unqualified administrative services. These employees will need to upgrade their knowledge to new and highly qualified work tasks related to the technology systems. The project devoted over 60 person months for development of requirements posed on engineers, architects, administration, etc. to work in a model-based collaborative environment. To achieve ambitious goal of construction industry transformation, targeted tasks were dedicated to development of training programs for higher education as well as for professionals at all levels. The educational content which is delivered via InPro training environment is direct result of the project research work. The training environment will facilitate knowledge distribution across the industry in different forms. Individuals could learn by means of self-paced tutorials, articles about new working methods and descriptions of projects. Teaching material could be used for internal courses organized by business entities from SME's to large companies and integrated into existing university curricula. However, besides making knowledge available in written form on the Internet, the training environment also provides the means of live course delivery via its e-learning platform following principles of distance education.

Keywords: education, training, business courses, university curricula, model based working

1   Introduction

Construction industry and related research constantly tries to overcome traditional and deeply rooted methods of work and to replace them with novel principles introduced by information society. In this way, the industry tries to keep the pace with other industries and increase its competitiveness and flexibility. The efforts are evident in research strategies (Hannus, 2003; Samad, 2007) and many specific research projects that can be followed through construction IT related conferences like CIB W78 or ECPPM and can be tracked back more than 10 years ago. In all these efforts, we can recognise at least one common topic. That is model based approach to construction. This approach should introduce novel processes based on up to date information and knowledge.

Despite this rich body of research and knowledge and consensual acceptance of the fact that model based approaches bring many benefits to project stakeholders, construction industry processes are still

mainly based on 2D drawings and poorly handled data exchange among the participants. The situation results in segmented design and construction processes, extensive data exchange problems and loss of information.

At his point, we could say that IT for construction industry is there, but the same industry should start using it. One alternative to make the step forward in tightening the gap between research and the industry is certainly education of practitioners. Such efforts can be recognised in projects back to SCENIC (Hannus, 2007). Fruchter (Fruchter, 1999) reported on combined research and curriculum development for multidisciplinary, geographically distributed architecture / engineering / construction (AEC) teamwork. Other successful attempts were reported from different research networks (e.g. Elspass and Hollinger, 2004). Authors of this paper also contributed to the subject via development and operation of Euromaster program (Rebolj, 2008; ITC Euromaster, 2009), which is the basis for InPro training environment described here. To better understand InPro training environment principles and organization, Euromaster background is briefly described in the following chapter.

InPro training environment is a deliverable of InPro project performed under EU 6th framework programme for research and development. The project recognises the importance of dissemination of newly developed knowledge not only via research papers, professional organisations and media but also via formal university education and life-long education of current and future professionals. To achieve ambitious goal of construction industry transformation, targeted work packages are dedicated to development of training programmes for higher education as well as for professionals at all levels plus extensive dissemination activities. Educational content which is delivered via InPro training environment is direct result of the project research work.

2   InPro training platform background

2.1   Euromaster project

InPro training platform builds on foundations of ICT Euromaster programme (ITC Euromaster, 2009). The programme complement existing university courses because during undergraduate studies, subjects are typically available that introduce computer science, elementary programming, office and CAD software. The students are supposed to master skills so that they can use computers in the assignments given in the professional, engineering courses, often based on particular software. A European Masters curriculum in ITC complements the existing portfolio of teaching programs. It tries to advance construction IT education, introduce more holistic perspective of IT in construction industry and integrate the fragmented profession.

The accreditation process of a joint study program performed by several universities proved to be a problem, since different rules are in power in such many different countries and universities. To overcome formal obstacles and to open the program to the global community we have decided to form an open pool of ITC related courses. Once the new partner institution is accepted by the steering committee, the institution can include any number of existing courses in its own programs, since the pool is based on reciprocity. Having a whole pool of courses at hand certainly gives each partner a strong background to form a whole new program and to offer their students specialized knowledge and skills which they could possibly never be able to offer by themselves.

2.2   InPro project

InPro (InPro, 2006) is a European cooperation between 19 construction sector companies, IT companies, consultants and research organisations from 8 countries. The project runs from 2006 to 2010. As stated in the project's Description of work:

»The InPro project will completely transform the Early Design phase of a building (new or renovation) project. At this influential phase, which represents only a fraction of the lifecycle of a

building, decisions are made that determine over 70% of the total lifecycle costs. The Early Design phase also has a direct impact on the building's added value for all stakeholders, as well as on the construction sector's efficiency and sustainability.«

The project develops strategies and business models for a new building design process which enforce open cooperation between project partners and consider the building's whole lifecycle. New business concepts and processes are defined that provide incentives for model-based working and open collaboration between all stakeholders. From technology point of view, smart, fully semantic ICT platform and tools are developed or specified enabling exchange, sharing and reuse of information throughout the building lifecycle.

The main output of InPro will be the "Open Information Environment" - an advanced system of Early Design processes, supported by radical business concepts and ICT solutions that integrate four crucial and closely interlinked aspects of Early Design: (A) Open and flexible collaboration between all stakeholders of the building value chain, (B) Design from a lifecycle perspective, based on 3-dimensional Building Information Models, (C) Decision support to make "informed choices" based on knowledge of each decision's consequences on the building lifecycle, (D) Early planning of build and operation processes based on computer enabled simulation of smart digital prototypes.

To support this radical change in the industry and to facilitate the industrial transformation, project has strong focus on curricula and materials for training and education of management, architects, engineers, and construction workers, as well as university students. The need for education and further developments is covered both for the initial transformation of the industry, but also for the long term development of architecture and engineering sciences.

2.3   Training strategy

Training strategy used in development of InPro training content is based on InPro project communication strategies that foresee industrial transformation on three levels: project, company and industry level. It also identifies stakeholders involved in this transformation such as policy makers like the European Commission and national governments and standardization bodies, developers of new knowledge such as universities and research institutions and important participants in the early design process such as clients (both public and private), architects and designers, contractors and construction companies.

The training and education strategy for the business pull focuses on the benefits for the main drivers of change in the sector, that is make them aware of the need for change and create desire to support and participate in the change. On the technology push side, the training and education of the organization on processes, methods and tools will transfer the knowledge how to manage model based working methods.

InPro training platform broadens the scope of Euromaster in a sense of target audiences. Beside universities, courses for building industry are developed. On the other hand, InPro learning content is more focused. It covers methods of work and IT tools related only to Early Design processes of construction projects.

3   Learning platform

To support collaboration and implement learning courses on such a broad scale it is inevitable to base learning platform on technically effective e-learning system. The platform should support wide array of teaching, lecturing and collaboration activities and tasks. Our experiences from Euromaster show that technical infrastructure is a vital part of the system.

When designing the system architecture, we set scalability, modularity and interoperability as the most important requirements. The system should consist of well established and open software tools

that can be combined into overall system and that can be eventually replaced by competing products without too much effect on other parts of the system.

E-learning platform should be able to support preparation, storage and distribution of learning materials, implementation of self-study courses, online lectures, blended learning, student evaluation and assessment. Course planning and course management, student enrolment and study programme management should be supported as well. Beside traditional teaching activities, collaboration among participants, both student-lecturer and peer to peer are vital, therefore functionality like discussion groups, forums, blogs and wikis are necessary.

Since InPro training environment content covers both teaching about new methods of working and learning about software tools that enable new way of working it is necessary to combine hands on learning following constructivist approach, with tutorial and group learning.

From above mentioned requirements, system architecture was developed and is presented in Figure 1. It shows three vital parts of InPro e-learning environment, which are video/web conferencing tool, course and content management system and BIM laboratory. Based on our experiences and market research we decided to implement proposed architecture with open source portal based software tool Moodle - Modular Object-Oriented Dynamic Learning Environment (Moodle, 2009) as the LCMS tool, Adobe Connect Pro (Adobe, 2009) is included as video/web conferencing environment and BIM laboratory is based on Share-A-space BIM collaboration hub developed by Eurostep (Eurostep, 2009).
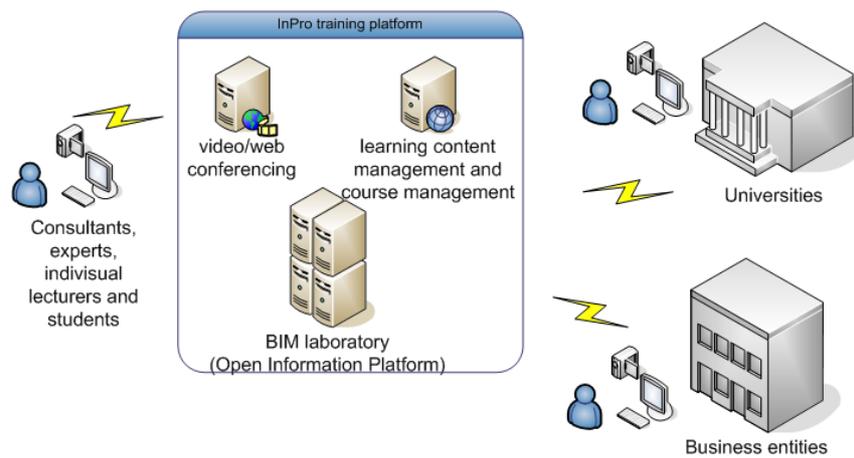

Figure 1, InPro training platform architecture

4 Learning content

Learning content is developed as a set of learning modules which should cover knowledge necessary to understand and to be able to work in "the InPro way". The modules are structured in such a way that enables integration of InPro modules into existing and future university curricula. At the same time and to avoid duplicate work, the modules should also fulfil the needs of business courses targeted to industry professionals.

4.1 Structure and use of learning modules

The main source of knowledge for new learning modules is project research work which has been mainly structured around identified early design key processes (KPs) of construction project. Direct focus on KPs is however not suitable for organization of learning modules, because KPs does not provide broader context of concepts of model based working. KPs are very good source of knowledge that has been used in formulation of learning modules, however additional mapping is needed. This

additional mapping brings InPro knowledge in context of existing state of the art and practice, which is necessary to make learning modules and new ways of working understandable by the students.

To meet specific needs and different levels of proficiency (existing and needed) the learning modules should be structured in several levels of detail and our proposal is that each module contains three levels of detail, which could be studied in sequence or independently.
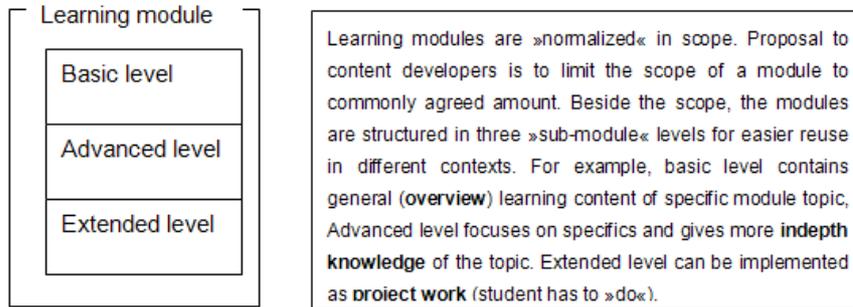

Figure 2, Three level structure of the learning modules

In such a way it is possible to use the same learning modules in variety of contexts. For example a university can integrate two InPro modules into an existing curriculum as described in figure 2.3.
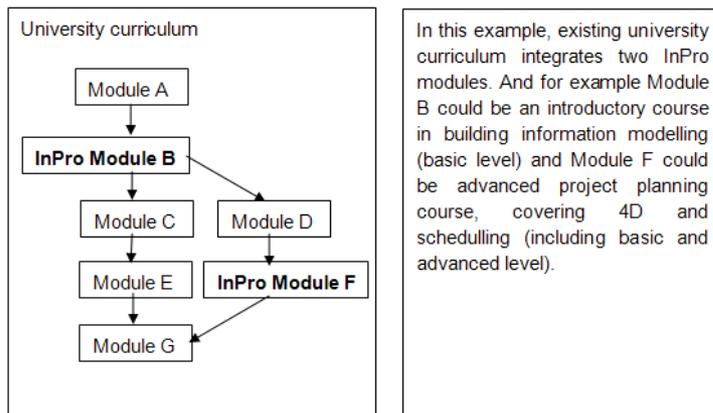

Figure 3, Example of use of InPro learning modules in university curriculum

At the same time, some construction company can use the same Module F from previous example - extended level only - for their experienced project planners that are already familiar with basic 4D concepts and during the course they will work on a real project learning the use of BIM server technologies and advanced 4D tools.

4.2   Module content

Content of the learning modules focuses on early design processes of construction project from both methodological and technological points of view. Learning modules cover topics such as:

Life-cycle design process and business models
- Model based energy analysis and design
- Decision making frameworks
- IFC topics for end users and IFC object versioning
- Model based scheduling

- InPro Open Information Platform and Share-A-space collaboration hub
- Client requirement processing
- Collaboration and approval workflows
- Cost management

5   Conclusion

In the context of information society, construction industry has been trying to adopt and take advantage of new collaborative software environments. For such fragmented industry like construction, computer mediated collaboration have great potentials. Flexibility in setting up project environments, knowledge sharing among project partners and making informed decisions from the very beginning of the project could be organised in new ways and be well supported by IT tools. Technology of Building information models and related work habits try to break through all the difficulties to become everyday construction project praxis.

To support and somehow enable this big transformation of construction industry by spreading InPro principles into everyday project life, we are launching InPro training environment. Training environment brings together and shares the knowledge on model based working methods and supportive software tools. It is e-learning environment that provides on demand and location independent learning experience. Development of the environment takes into consideration integration of courses into existing and future university curricula as well as sharing of knowledge and best practices with business entities and construction professionals. Important part of the training environment is BIM laboratory, which provides problem oriented learning, where students and professionals can get hands on experiences with state of the art work methods and tools.

References

HANNUS, M. et. al., 2003. Construction ICT Roadmap, *ROADCON project deliverable report D52*, European project, IST-2001-37278

SAMAT, A. et. al., 2007. Strategic Roadmaps and Implementation Actions for ICT in Construction, *STRAT-CON project final report,* STRAT-CON consortium.

HANNUS, M., 2007. *SCENIC project*, Available online: http://cic.vtt.fi/projects/scenic/workpack.html, Last accessed: December 2009.

FRUCHTER, R., 1999. A/E/C Teamwork: A Collaborative Design and Learning Space. *Journal of Comp. in Civ. Engineering*, vol. 13, p.p. 261-269.

ELSPASS, W.J. and HOLLINGER, C., 2004. Design education via collaboration in an advanced knowledge environment - The changing face of design education. *Proceedings of the 2nd International Engineering and Product Design Education Conference, TU Delft, Delft.* Available online: http://www2.io.tudelft.nl/iepde04/Proceedings.html, Last accessed: May 2009.

REBOLJ, D., 2008, Postgraduate Distance E-Learning Programme on IT in Construction, *Innovative Techniques in Instruction Technology, E-learning, E-assessment, and Education*, Springer Netherlands, p.p. 98-101.

ITC EUROMASTER, 2009. *The Euromaster programme portal*. Available online: http://euromaster.itcedu.net, Last accessed: December 2009.

INPRO, 2006, *InPro project web site*, Available online: http://www.inpro-project.eu, Last accessed: December 2009.

MOODLE, 2009, *Moodle - Modular Object-Oriented Dynamic Learning Environment, The Moodle homepage*. Available online: http://moodle.org, Last accessed: December 2009.

ADOBE, 2009, *Adobe ConnectPro web conferencing tool*. Available online: http://www.adobe.com/products/acrobatconnectpro, Last accessed: Debember 2009.

EUROSTEP, 2009, *Eurostep Share-A-space collaboration hub*. Avalable online: http://www.eurostep.com/global/solutions/--share-a-space-server-solution.aspx, Last accessed: December 2009