ITC-Euromaster Course Pool for AEC Engineers

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Abstract—**The paper describes the ITC-Euromaster Course Pool. It is a concept that powers e-learning environment for conducting an international Master's level programme in information technologies for Architecture, Engineering and Construction (AEC). The e-learning environment integrates resources (units of study, learning management system, virtual classroom, teachers and students) from five European universities. In the paper following aspects of the system are presented: concept and methodology of the Course Pool, technology for e-learning and evaluation results.**

Index Terms—**Architecture, Engineering and Construction, course pool, electronic learning, information technology, Master's programme.**

I. INTRODUCTION

European Master's programme in Information Technology in Construction (ITC-Euromaster, http://euromaster.itcedu.net, [1]) is one of the most unique master degree programmes offered to AEC Architecture, Engineering, Construction) bachelors. ITC Euromaster's model of education is based on a course pool and participation of academic institutions being course providers and/or course consumers. Currently, ITC-Euromaster delivers over 10 courses jointly developed and offered by academics from five European universities (University of Maribor from Slovenia, University College Cork from Ireland, Dublin Institute of Technology / CITA from Ireland, University of Ljubljana from Slovenia and University of Technology Graz from Austria), which cover a wide area of IT in AEC. Courses in the pool are e-learning courses maintained in a LMS (http://lms.itcedu.net) and supported by virtual classrooms. The main function of the LMS (Moodle) is to enable access to teaching and learning material repository as well as other relevant functions (e.g. forums) and information (e.g. teacher and student list, timetables, grade book, etc.). The virtual classroom (Adobe Connect Pro) enables teachers to conduct virtual lectures through the use of participant list, chat, audio and video control, web links, document sharing, application sharing and a whiteboard.

The curriculum is focused on students who have finished their undergraduate studies with a university degree in civil, building or structural engineering as well as architecture. Graduates represent a unique profile (Master's degree on Construction Information Technology) of an ITC specialised Civil Engineer that is increasingly recognized and demanded by the AEC sector. The need for such new profile has already been recognized. We are convinced that the civil and building industry will need more engineers with profound IT understanding and knowledge in the e-society of tomorrow.

The main objective of the ITC-Euromaster project is to organize the knowledge in the field of IT in AEC and to develop an effective environment to support ''collaborative learning scenarios'' with distributed teachers and students. The establishment of a ''community spirit'' bears at least the same importance for the success of the developed programme as the implementation and configuration of the e-learning environment. Integrated e-learning environments will become the basis for a virtual university, linking together teachers and students of multiple nations and continents. For this reason, we will continue to develop new content for the ICT-Euromaster course pool and improve management patterns for the ITC-Euromaster network.

II. UNIQUE ITC PROGRAMME

The main objectives of the programme are to accelerate the transfer of knowledge in IT in construction to the profession, but also accelerate the research and development in the field; to further develop the ITC network and enable better cooperation between participating institutions. Furthermore, construction business is getting extensively internationally oriented and strongly linked with the developing e-business, requiring engineers who are well prepared for these purposes. Therefore the development of ITC education must be seen as an integral part of the e-society where continuous professional development and lifelong learning are vital to individual and organisational success [2]. Since adequate human resources and experiences in ITC are scarce, the forces have been joined to develop an international multi-institutional postgraduate programme [1], [3].

In relation to the development of e-learning usage patterns (survey by [4]), the ITC-Euromaster obviously has made the right choice of an e-learning mechanism to overcome the problem of dispersed students and teachers. According to the survey about distance, online and e-learning, practitioners and researchers from Europe, Australia, and Asia reported participation in twice as many forms of the learning environments compared to those originating from the continent of North America. For almost a decade ITC-Euromaster is one of the most unique master degree programmes offered to civil engineering bachelors. During that time the ITC-Euromaster has been developing a model of education based on a course pool and participation of academic institutions being course providers and/or course consumers. Specialized courses, offered by five European Universities

(University of Maribor from Slovenia - UM, University College Cork from Ireland - UCC, Dublin Institute of Technology (CITA) from Ireland - DIT, University of Ljubljana from Slovenia - UL and University of Technology Graz from Austria - TUG), cover a wide area of IT in Construction. Graduates represent a unique profile of an ITC specialised Civil Engineer that is increasingly recognized and demanded by the AEC sector.

The modules of the ITC-Euromaster Course Pool were initially developed by academics from nine European universities as part of a EU-funded Socrates Erasmus project between 2002 and 2005. The main purpose of the project was to develop a curriculum on IT in Construction to give students the possibility to extend their knowledge in research, development, and application of computer and information science in civil and building engineering. The result, a European Master's curriculum in Construction IT, complements the existing portfolio of teaching programs and should meet the growing demand for such skills. In the case of those institutions already offering ITC courses, the project is providing the added value of a European dimension for their existing programmes.

III. METHODOLOGY: THE COURSE POOL, COURSE PROVIDERS AND CONSUMERS

Currently, ITC-Euromaster delivers over 10 Post-Graduate courses jointly developed and offered by Academics from 5 European Universities in Slovenia, Ireland and Austria. To open the program to the global community we have decided to form an ITC course pool, which includes all courses developed in the project. The pool organization is based on reciprocity. Any institution with knowledge in the ITC field is welcomed to offer a course to the pool. Once accepted by the steering committee, the new partner institution can include any number of existing courses in its own curricula. Organization of the program was another exciting and important task. Students enrol at each university, but they enter a single virtual class, with teachers coming from all partner universities. The same concept is used on the level of a single course. Based on an early draft of the curriculum and on the results of a skill audit and review of existing courses at partner institutions, as well as market research and analysis, an initial course structure has been developed consisting of 12 courses for the period between 2005 and 2009: The role of construction informatics, Data structuring and databases, Information modelling and retrieval, Modelling and visualization, Software engineering, Knowledge management, Engineering Artificial Intelligence, Computer mediated communication, Mobile computing in construction, Computer integrated construction, Virtual enterprises and eBusiness. A responsible partner has coordinated the development of the content and teaching material of each course. Teaching materials have been prepared in digital form to conform to the e-learning standards.

Since then the course pool has been modified and adapted as shown in TABLE I. The table shows that: (a) 4 universities (UM, UCC, UL and TUG) are course providers, (b) 4 universities are course consumers and (c) altogether 8 courses are in the pool. The course pool complements around 10 existing obligatory and elective courses at partner universities.

The curriculum has been developed in such a way that courses can be offered from several universities, mainly as

TABLE I.
COURSE POOL: COURSES, PROVIDERS (=1) AND CONSUMERS (=2)

Course\University	UM	UCC	DIT	UL	TUG
The Role of Construction Informatics	2			1,2	
eBusiness in Construction	2	1,2			
Automation in Construction	1,2	2	2		
Computer Mediated Communication	2	2	2	1	
Applied Knowledge Management	1,2	2	2		
Software Engineering	1,2	1,2			
Interoperability and BIM	1,2		2		
Computer Aided Facilities Management		1,2			1

e-learning courses, which makes the programme widely accessible and gives students the possibility to tailor the programme to their own needs.
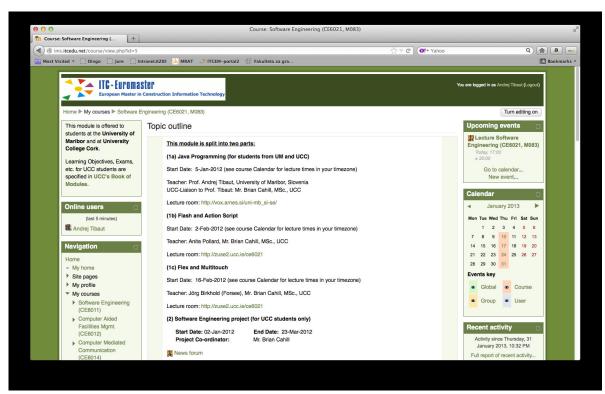
The curriculum is focused on students who have finished their undergraduate studies with a university degree in civil, building or structural engineering as well as architecture. The program graduates earn an academic Master's degree on Construction Information Technology, which shall enable them to continue with the relevant PhD study, or immediately start to work in the industries as civil engineers with a specific focus on IT. The need for such new profile has already been recognized. We are convinced that the civil and building industry will need more engineers with profound IT understanding and knowledge in the e-society of tomorrow.
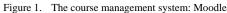
IV. TECHNOLOGY: A ROBUST E-LEARNING ENVIRONMENT

E-learning models are based on the high quality, participation and productivity. With the help of productivity, moving the processes into the e-ambient and saving up the expenses, objectives of e-learning can reach to the level of the basics of modern e-learning. According to our experiences a robust technical infrastructure is a vital part of any e-learning system. So far we have gathered experiences with different e-learning environments where audio or videoconferencing (HorizonLive, VCON, CUSeeMe, ClickToMeet, Adobe Connect Pro) and different web based content delivery systems have been used (Blackboard and Moodle). Our experiences, enriched with those of many researchers in the field of using IT for education, led to ideas of an ideal environment to effectively support open distance teaching and learning.

The current ITC Euromaster e-learning environment consists of two components: the course management system Moodle (CMS, also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE)) together with file repository in DropBox, which is the entry point to the program and a Virtual classroom Adobe Connect Pro. The main function of the first is to enable access to teaching and learning material repository as well as other relevant functions (e.g. forums) and information (e.g. teacher and student list, timetables, grade book, etc.) from any location on the Internet. The course management system (Figure 1. is based on the Modular Object-Oriented Dynamic Learning Environment (Moodle). The Virtual classroom is supported by Adobe Connect Pro, which enables teachers to directly communicate with their students. A participant list, chat, audio and video control, web links, document sharing, application sharing and a whiteboard are the basic parts of the virtual classroom (Figure 2)

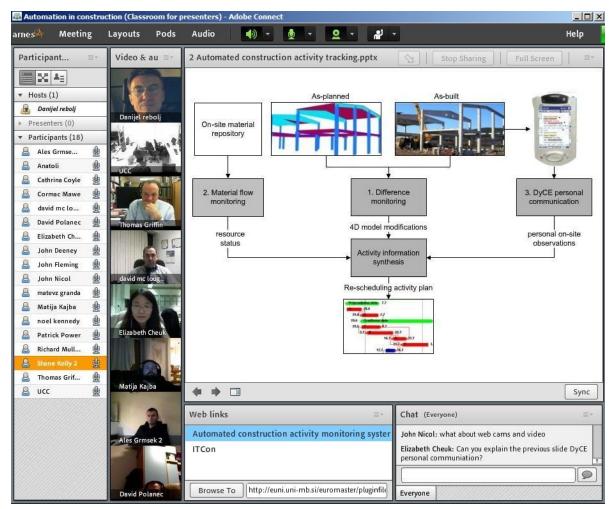Figure 1.   The course management system: Moodle

Figure 2.   The Virtual Classroom: Adobe Connect Pro

V. EVALUATION OF THE ITC-EUROMASTER

To ensure the high quality of the ITC-Euromaster programme external examiners carry out evaluation of different course (subjects, modules) elements within a study year. Latest evaluation in 2011 can be summarized as follows:

Evaluation of examination papers, timeliness, presentation and standard of questions: The assessment strategy used for all modules was 100% coursework. The nature of the coursework varied from semi prescriptive requirements to more open approaches. The presentation of the students work was excellent and the course team is to be commended on their use of innovative technology to manage student's submissions. The drop box approach was effective and allowed the external examiners access to the entire range of student work submitted.

Structure, organisation and marking of elements of the examination/coursework: The course team has a challenge ahead in terms of assessment design, on the one hand the course philosophy is that innovation is encouraged through the imaginative application of technology to real world problems and assignments have been set which are relatively open in approach when compared with the more "traditional" style of coursework. This does however create difficulties in developing and applying common assessment criteria for the assessment of the cohorts' coursework. The issue is exacerbated by the effort that students put into their assignments; they rose to the challenge within the coursework and, in a lot of cases, exceeded the expectations of the course team. The course team should reflect upon the outcomes of this first and attempt to develop a robust framework for assessment of the project work which retains the open and innovative nature of the assignments however ensures that the criteria for the coursework assessment are clear, transparent and uniformly applied across the modules. All modules had a clear coursework brief and deadlines were set which took account of the workload on other modules. The students appreciated the flexibility in extending the deadlines for some of the coursework however there was some concern expressed by some students that an unfair advantage had been gained by those who had been granted additional time. It is suggested that the coursework timetable is non negotiable in future and that extensions are only given in exceptional cases. The marking of the assessment was consistent between the modules and within the modules, but there was a tendency to over reward quantity of work above quality. As a consequence of the students enthusiasm and application high module averages were evidenced. This should be monitored and I suggest that the course team adopt the requirement to have an exception report if module averages are above or below threshold percentages. This may cause module leaders to reflect on the marks they award in comparison with other staff involved. The challenge in this regard is that course providers (4 universities) have different norms for assessment. An approach to normalise the approach taken by each of the universities may be to circulate exemplars of student work for mock assessment, staff "assess" the work and then attempt to get a common agreement on approach to and level of marking.

Overall performance of candidates in relation to their peers nationally and internationally: The performance of the candidates was excellent and compares favourably with work of other postgraduate students in traditional master's programmes. The students from the ITC-Euromaster were enthusiastic, complimentary and felt that the programme has given them a new perspective on how technology can be used to improve the design and construction process. The students appreciated the access to staff's research interests and felt that they could leave the programme and act as a catalyst for change in the organisations they work for. This should be reflected in their individual research work in the dissertation module.

Academic standard achieved by candidates: The students evidenced achievement of learning outcomes at a Master standard for all the modules that were reviewed.

Weaknesses evident in the programme/examination: The programme needs to ensure momentum is kept up with recruitment, the cohort appreciated the learning community spirit that had developed within them and if number were to drop it would be difficult to maintain this.

Overall recommendations to Programme Committee: Maintain the marketing effort for the programme, possibly use the students submissions as webinars to industry nationally and internationally to help raise awareness of the programme, look to use social media such as Twitter, Facebook and Linkedin.

The evaluation report included 25 students in one class year (2010/2011). Information on the throughput of students is that more than 50 students graduated from the programme (by Dec. 2011). More than 100 students have been enrolled in the programme since 2004.

VI. FUTURE PLANS AND CONCLUSION

Based on our decade-long international experience with ITC-Euromaster a Virtual University in IT in Construction with its underlying collaborative network of scientists and specialists from industry could be seen as the final goal of our efforts. On the way to achieve this goal the funding partners of the ITC-Euromaster are motivated to start a new international initiative at doctoral level. The initiative "PhD in ITC" wants to setup a network of excellent and similar academic institutions from all parts of Europe and Russia that want to (1) share their experiences and expertise on pursuing PhD in ITC programme, (2) further develop their PhD in ITC programme, (3) complement mutual further development of PhD in ITC programmes at partner universities, (4) develop competencies in ITC and (5) contribute to accreditation of joint degree "PhD in ITC" programme at partner universities.

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