

Challenge of Instruction in ICT for Construction Managers

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Abstract

A project between Higher Education institutions, construction companies and the European Commission during three years funded project management firms from five European countries. The main goal was to provide education and training in the use of Information and Communication Technologies in Construction Management. The results were used to carry out a course of the final year degree of future Construction engineers. The format and results of the course implementation during one semester are presented and analyzed. Future developments and scenarios in this area are presented with recommendations.

ICT in Construction

Technological developments have been influencing daily life at an unexpected rate and with tremendous changes in the areas of engineering design and construction. The tools and means used for communication and for exchange of information have been playing an influential and crucial role in changing the format and amount of information in the activities of construction management. These changes and prospective scenarios are sufficient reasons for an initiative to research and investigate the possible improvements and benefits in these construction sectors.

The activities of construction and of management are both using information on a large scale and that becomes more evident when the area is construction management. It is an activity where data about the construction project and assessment of the implementation are being manipulated intensively. This is the essence of the material handled in construction management. On the other hand the communication tools are the support for the information retrieval, analysis, filtering and dissemination. That is why ICT developments and possibilities have a major role in the area of construction management.

ICT uses frequently electronic media to allow the access to resources that otherwise could not have been done at a lower cost and in a shorter period of time. Consequently engineers, technicians, administrative staff and other type of personnel involved in construction have to address this rapid change in the management system. These changes involve, for instance, the communication channels, the databases to handle the work habits, the administrative procedures and the qualification of the staff in terms of competencies and skills.

On the other hand and in general, technical staff is not aware of the capacity of the of the Internet or of the Web, does not know the interface modes between users and tools available and is not trained on the efficient use of construction management techniques in ICT. There are also significant changes in the communication structures, that could be, in certain cases, the shift between a vertical structure, typical in a conventional construction organization, and an horizontal and informal management structure of a matrix type of organization based on communication and on information.

The developments in the Information and Communication Technologies (ICT) have been increasing within the last few years. The Construction industry is by nature highly dependent on the adequate and proper flow of communication between the different sectors and the detailed planning of phases in the construction process. The efficiency of Construction Management (CM) activities is based, in particular, on the quality and on the timing of data used. On the other hand the universities, in general, have been very active in the acceptance and utilization of ICT for research, teaching and training.

A major issue for future Construction Managers is to properly instruct the future construction managers on using ICT. The approach was based on the analysis of case studies with special emphasis to a pilot project done by universities and construction companies working together on this issue. This pilot project on ICT applications to Construction Management, described later, was a two-year project about technology transfer and training in ICT provided by universities for construction companies.

The cooperation on the training and education was intended to provide assistance in the Information Management area of the construction companies by using the experiences from universities to address the changes of job profiles in the CM area. In comparison to the construction industry, in particular with reference to the field of construction management, certain higher education institutions universities are more advanced in applying ICT to their current training programs. The project tried to address needs for training and transfer of research results while establishing co-operation between universities and companies.

Pilot Project on ICT - Atelcoma

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The current generalized access to information sources and to the use of the new technologies has been adding a new dimension to engineering and especially to CM. The relationship between the new information and communication technologies with the transformations and improvement of

CM are analyzed through a case study involving several European management offices, contractors and universities. The case study was composed by the application of the ICT to the activities of CM through experimentation in case studies. The testing of the possibilities was supported by researchers and by the specific training of the staff involved in the usual tasks of the construction engineering firms.

The project involves a European partnership between Industry and Universities on tele working in Construction Management (CM). It lasted for a two-year period between September 99 and June 2001. The website of the project is www.fe.up.pt/atelcoma. The project was subsidized by the European Union under the framework of the program Leonardo and had eleven partners from Finland, Ireland, Portugal, The Netherlands and United Kingdom. These partners were from the higher education area and from the contracting and designing area with about even representation. The cost of the project was about 185000 Euros (170,000 US dollars) with a public financing from the European Union of about 60%.

The partners of Atelcoma provided different levels of expertise in ICT and ODL and all of them could gain experience in international projects. The project tries to address several needs:

- a) To exchange good national practices in Tele-working and in Construction Management;
- b) To overcome the costs of physical mobility and to ameliorate the busy schedules of construction professionals;
- c) To respond to the internationalization of building projects within the European Union;
- d) To create a richer pool of CM Tele-courses with European level which are accredited by industry and universities;
- e) To increase the level of ICT and ODL use in a conservative branch like construction industry.

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The concerns resulting from these foreseeable changes are shared by construction firms, by management offices and by the research centers at universities. This is a fact that is not local or regional and addresses organizations globally without definition of borders or of countries. The construction firms and the management offices are concerned with these issues because of performance and productivity rates and the research centers are interested in teaching and in curriculum. There have been attempts to address these transformations and are generally resulting from association between these different organizations due to the dimension and scope of the studies carried out and to the goal defining guidelines for future reference.

Case Study of Last Year Undergraduate Civil Engineers

As a result of the project development a final conference was held in Eindhoven, The Netherlands with project participants and representatives of the industry. After this forum a CDROM was produced with the major results and other support documentation. These materials were the main learning materials for a course held at the University of Porto, College of Engineering for Civil Engineers addressing the use of ICT in CM.

The course adopted as main testing scenario a residential and office building with six stories high and an area of approximately hundred thousand square meters. Other sites were also used depending on the activities being tested and the required degree of completion. To have a better understanding of the issues the related documents, like drawings and specifications, were placed on a web-site for consultation and, in some cases, translation.

The first phase of the course consisted in the identification of the operations in management construction where it was possible and advantageous to use ICT. This phase consisted of debate between the students and taking in consideration the different working habits and conditions. The following phase was the detection of training requirements for the personnel involved and the production of these training materials. The third step was the implementation of these ICT modifications. The last step of this first phase consisted in the objective evaluation of the benefits of the proposed changes. This ended the collective work performed in the analysis of the project documentation and of other existing materials.

The students chose their final project based on the documents that they analyzed, on the several sites found on the web related with the course theme and on their personal preferences. The most relevant final projects are of variable scope. These range from the definition of minimum training and educational requirements for future Construction Managers to the proposal for proper management of subcontractors using ICT. Others were the definition of a protocol for communication between engineers and architects in construction and an ICT based model for documentation handling during the whole construction process. All projects were placed in the discipline web site allowing discussion and sharing of experiences between the students. It was interesting to experience the participation from other students from other disciplines in the discussions.

Recommendations

The main advice is related with the attitude from the tutor towards the course development. The attitudes of students towards ICT have revealed, in general terms, a very relaxed and confident participation in the learning process than in other learning environment where the instructor has been involved for the last 26 years. The knowledge about the possibilities of ICT was in certain cases deeper than that of the instructor providing opportunities and solutions that were far beyond the expected outcomes. It was a surprising reaction from the students concerning dedication to the course and contribution to the quality of the final projects.

The role and tasks of the instructor also changed quite significantly from traditional face to face lectures. Schedules were open since communication by email between learners and instructor was effective providing almost immediate reactions and discussions. The main provider of motivation became the outputs of the pilot project that comprehended the judgements from the professional area and the findings of the researchers and of the teachers. It had an added value of international experience with the curiosity of different construction cultural scenarios and technological methods. It was a very rich and promising experience that is probably a significant model for future learning environment in Construction Management.

The traditional grading and evaluation schemes used in the construction engineering firms were also adapted to take into account the particular nature of these type of courses. The evaluation considered the usual outputs of the course like the final exam; the homeworks and the WebPages produced by each student. Other aspects considered important accounted for thirty five percent of the grade and included the participation in the discussion, the capacity of handling information, the innovation introduced in the procedures and the professional application of the materials. These criteria were discussed with the students in the beginning allowing them to define their priorities in terms of involvement in the course.

It is certainly an experience that portrays a possible learning model allowing the combination of knowledge acquisition, practical experimentation, and skill development and competence achievement. The richness of having a project environment emerging from the combination of professional exercise with applied research was certainly a major factor in the apparent success of the course outcomes. Other similar educational or training actions may contribute to the definition of more general rules that will allow an improvement of the learning outcomes.

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