Civil Engineering Communication – Obstacles and Solutions

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Abstract. Communication is what is giving value to information, and is thus crucial in any engineering decision making. But although Information and Communication technology (ICT) has improved enormously, civil engineering communication has by far not used its huge potentials. In the paper we are identifying some reasons for the slow introduction of emerging ICT in AEC sector; we emphasize some emerging technologies, their potentials, and implementation attempts, and then present a set of activities, which could improve the current situation.

1 Introduction

Communication plays a very important role when people have to solve a problem together. Collaboration and thus communication is a normal way of working in civil engineering. Before computers were introduced, all information in a construction project has been communicated either in printed form, as text and drawings on paper, or by voice communication between actors. The only way of transmitting information was by carrying paper from one person to another, therefore centralised hierarchical organisation has been a necessity to ensure effective decision making.

Telephones made communication possible on long distances and fax machines did the same for text and drawings on paper, but no significant improvement in communication patterns has been introduced. In civil engineering communication has not been systematically improved even by the introduction of computers, or by any other information or communication technology. It is still following the same traditional hierarchical patterns although it could become much more flexible and dynamic.

Various reasons are causing the delay in application of information technology and are preventing the quantum leap in ICT based communication. According to our experiences the main reasons are the lack of ICT innovation and standardisation, lack of R&D cooperation in AEC industry, and deficiencies in civil engineering education.

Some companies are trying to apply the ICT potentials in a higher extent, like in Japan, where the Daito Trust Construction Company developed a large-scale mobile computing system called the DK Network [1]. But problems occur when trying to use advanced technology in projects with other partners, who have implemented ICT on different levels. This can lead to even more complicated communication in joint projects, where different technologies and forms are used for information representation, then in projects where no sophisticated ICT is used at all. Experiencing such problems certainly discourages AEC companies from further investments in ICT related

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innovation. Another discouraging fact is that research and development in Construction IT has not lead to any significant improvement in efficiency of construction projects.

Some important efforts were done in higher education with student projects that were related to the AEC industry ([2], e-site project described in [3]), but no significant break through could be noticed either. Our conclusion is that all these efforts would bring much more effect if they would become harmonized, and if innovation would become an indispensable process in every AEC company.

2 Civil Engineering Communication

Regarding innovation we believe a more open approach to new ways of performing business should be considered. Typically the AEC sector is bound to traditional ways of thinking and doing and has quite limited resources for ICT related innovation. Appearance of personal computers, fax machines, mobile phones, PDAs, IP telephony, instant messaging have all went by without being noticed by the management, and have typically been used by individuals first and systematically accepted much later, if at all.

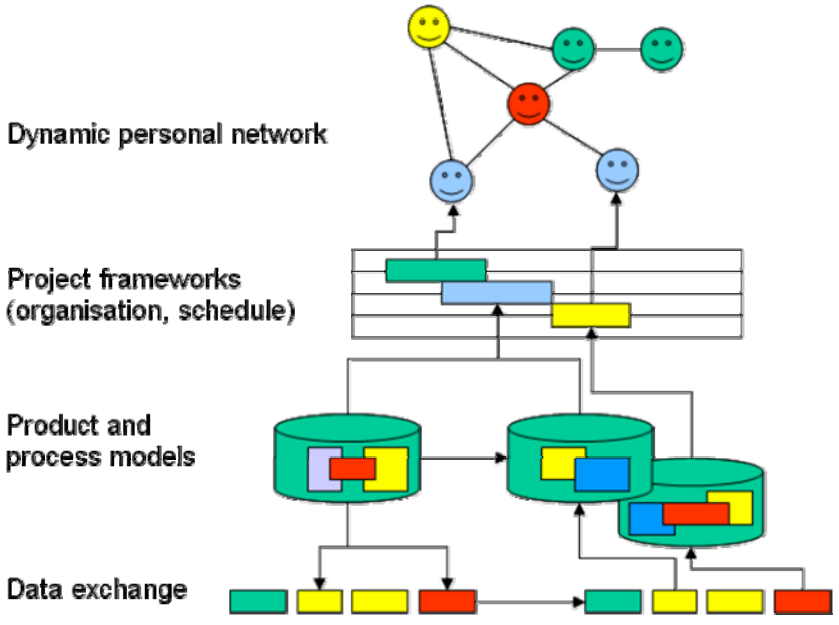

Fig. 1. Dyce architecture is enabling user tailored context sensitive access to information as well as communication with contacts, which assures optimal decision making support.

Mobile and ubiquitous computing are proven to become a very important technology for the AEC sector, since they are extending the information systems to construction sites [3][4]. More sophisticated integrated communication systems with hidden complexity are already emerging [5], which shall finally free the humans from the limited modes of using computers, and assure creative collaboration and sharing of ideas.

With mobile computing location of the user can become vital information in an information system, delivering a new context parameter to the system [6]. Being overloaded with input, users need context sensitive systems to work effectively and to be able to communicate efficiently [7]. Development of DyCE, the dynamic communication system [8] (Fig. 1 is presenting the architecture of the system), has not only proven the effectiveness of context sensitivity, but has also shown, that new, more efficient organisational patterns are now possible, since information for decision making can be brought to any actor in the organisation. A network organisation (in opposite to hierarchical) is assuring better use of knowledge and expertise, and a higher level of innovation and co-operation.

3 A New Profile for Managing Information in Construction

In most of current organisations in AEC sector managers and engineers are not able to recognize and to turn to advantage the full potentials of ICT and are generally not aware of achievements in the area of construction informatics. Froese [9] is suggesting to introduce a new profile, a project information officer, who would focus on efficient flow of information in construction projects and assure the effective technology to support it. Of course such profile needs a solid background in civil engineering knowledge as well as the knowledge in the field of computer and information science.

Certainly civil engineers have some knowledge in the area of computer and information science, but by far not enough to be able to decide about applying ICT in a construction project. In our opinion there is some space for improvement in civil engineering curricula, if related subjects would emphasize more on information and communication aspects of construction objects and processes. The lack of such knowledge is causing neglecting of data structures and flows, whereby functional aspects of systems are overemphasized. This in turn is causing problems in integration attempts and leaves us with most of those automation islands from the previous century.

But this would still not be the knowledge a project information officer (or manager) would need. Therefore we have suggested a postgraduate program intended to educate a new engineering profile to focus on project information management (including information integration). In 2001 a consortium of seven universities has started to develop such a program, which is being offered to civil engineering graduates since 2004. The program and the teaching and learning environment are further described in [10], and it's location in [11].

The accreditation process of a joint study program 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 IT in Construction (ITC) related courses. The initial ITC course pool has started to accept courses developed in the ITC Euromaster project. However, 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 program, since the pool is based on reciprocity (Fig. 2). Any unbalances in students and courses will be regulated by the steering committee. One way of balancing is for example by requesting further supporting staff from a partner that has a significantly higher number of students in a specific course given by another partner.

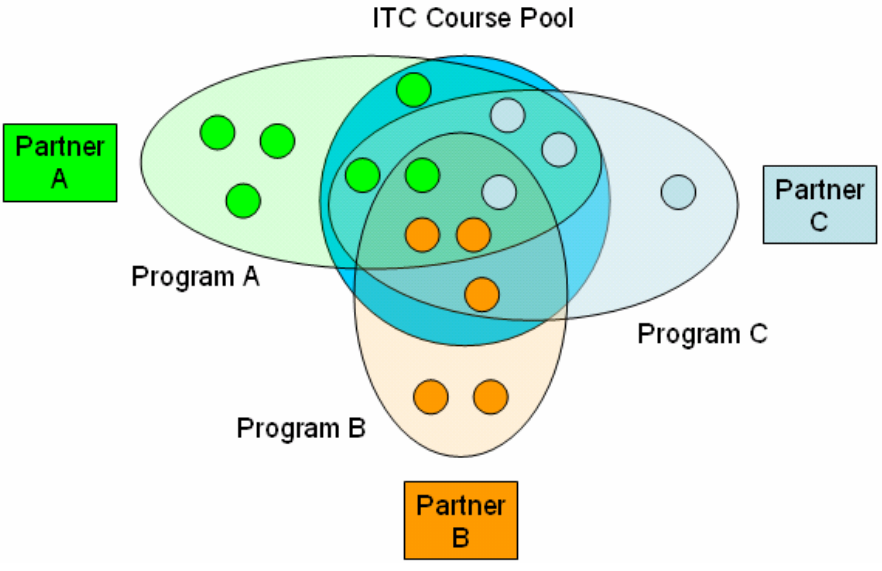

Fig. 2. The ITC Course pool concept.

From the technical viewpoint joining the ITC course pool is easy. The agreement is available at the ITC@EDU network web page (www.itcedu.net). The appendix of the agreement consists of the template of the Accession declaration to the ITC Course Pool, which includes the institution wanting to join, the offered courses, and nomination of the steering committee member. Once the document is accepted by the steering committee the courses are at disposal for all members. The acceptance procedure shall among others include the quality check of the offered course materials.

The ITC course pool will need a strong support from collaborating institutions. The experiences in the current ITC Euromaster program showed that much effort is necessary to prepare high quality e-learning materials, to become familiar with the on-line communication, to manage and further develop the e-learning system, and to coordinate the whole program. But even in the short term the investments give a high return. 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 only by themselves.

4 Conclusion

Engineering communication is crucial for the efficiency of AEC industry. Not only to support decision making in a project, but also to support innovation. To improve civil engineering communication we suggest a concerted set of actions:

- introduction of a new engineering profile, project information officer, to focus on project communication support,
- higher education shall offer the relevant profile,

- organisational changes should support the possibility to make more effective decisions, on site and in time,
- AEC industry shall start, together with universities, more courageous experimenting with new technologies.

To support these actions, a prototype construction company, a laboratory, could be established, to systematically select and use solutions proposed by researchers in the field of construction informatics. It would certainly accelerate the innovation process in the AEC industry.

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