

EDITORIAL - TECHNOLOGY STRATEGIES FOR COLLABORATIVE WORKING

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In recent years there has been a growth in information and communication technology (ICT) investments within architecture, engineering and construction (AEC) organisations. Research from industries such as aerospace and manufacturing has confirmed that increased investments in ICTs have very little impact on organisational productivity unless coupled with good management practices. In the AEC sector, the project context raises additional issues of interoperability for the organisations and temporary project organisations collaborating across dynamic boundaries. Adopting technologies to achieve business targets requires (major) changes in organisational culture, current practices, systems, processes and people. Whether or not such changes should be imposed on people (top down) or emerge from the needs of the workforce (bottom up) remains an intriguing question. Changes need to be coupled with appropriate management practices and strategies to maintain competitiveness, while addressing various project characteristics. The six papers contained in this special issue, with authors representing institutions in Australia, Canada, UK, and the USA provide a number of insights into the role of technology strategies for collaborative working.

A range of ICTs are used by AEC stakeholders to process, capture, store, share, integrate and archive knowledge at different stages in a construction project's lifecycle. As ICTs continue to be integrated in the design and management of construction projects; and assist teams to work in virtual, collaborative, electronic environments; they invariably impact on the generic skills of design professionals. There are inevitable operational differences inherent in these environments, which impact on the generic skills of design professionals. This forms the basis of the first paper by Sher *et al*, which argues that without such investigations it is likely that advanced ICTs that allow teams to collaborate 'virtually' may have a deleterious effect on teamwork. The second paper by Zhou *et al* on the other hand, focuses on the utilisation of 4D CAD during the planning stage. They highlight that the current commercially available project planning toolkits (e.g. Microsoft Project and Primavera Project Planner), support individual planners for task specification, but not workplace identification and robust logical sequence generation. Suggesting that 4D models are utilised more as planning review tools, rather than an integral part of the construction planning process that supports

multidisciplinary collaborative construction planning. They target this issue by proposing a novel approach of interactive definition through a distributed environment that allows interactive collaboration to create the construction plan and the subsequent 4D simulation directly from the unique 3D model.

In the third paper, Forgues *et al* present the results of an ethnographic research that uses technology as a boundary object to induce transformational learning in practices related to integrated design. This research suggests an alternative to process reengineering for driving collaborative working. They argue that the efficiency of collaborative teamwork depends on the teams ability to exchange knowledge for continual learning and to develop shared mental models. Within the construction context, integrated design teams are coalitions of firms with mental models firmly bounded within their specialised practices. By using cases that compare practices in the aerospace and construction industries, this paper emphasizes the importance of context in the adoption of technology. Practices in the aerospace industry are much more process oriented, and have many loosely bounded bodies of knowledge. For example, software engineering has adopted and evolved methods and tools from system engineering and project management which later were used to evolve bodies of knowledge in these two disciplines. They therefore argue that approaches derived from social learning theories to change practices and not processes may therefore be more appropriate in the context of improving the performance in collaborative design work in construction. Also, technology has not to be at the centre of the transformational learning process, but can be one of the instruments to induce this process.

In the fourth paper, Keraminiyage *et al* explore the potential of global, collaborative research that is possible via a Virtual Research Environment. They argue that the current 'global' trends combined with advancements in ICTs, together demand and enable national/international collaborative research. Within this context, they focus on how Virtual Research Environments could address some of the complex challenges associated with such collaborations and report on the findings of this investigation.

In the fifth paper, Peña-Mora *et al* acknowledge that the multi-diverse nature of global teams makes the process of collaboration complex and difficult to manage and warn that there are diverse issues related to bridging temporal, cultural, and organisational barriers for construction teams to make a successful change from 'local' to a 'global' construction environments. They therefore suggest that globally dispersed teams should set the bounds of their interaction space. The interaction space Peña-Mora *et al* present addresses elements of communication, co-location, co-ordination and collaboration and is made up of three key components including organizational processes (e.g. trust building, team culture, meeting processes, team processes and team members' behaviour), information technology (e.g. audio/video conferencing systems and computer supported communication processes) and spatial setup (made up of the intersection of physical space comprising of meeting room layouts, office environments, and workspaces with the digital space comprising of collaborative application spaces, team web sites and collaborative software applications).

In the final paper to comprise this special edition, Brewer and Gajendran investigated the evolving use of ICTs in construction projects in Australia. Using a Delphi methodology and Blackboard, the authors were able to tease out a number of pertinent issues relating to four key areas, namely; competitive advantage, extent of technology integration, leadership and process integration. The paper contains some important considerations for project participants, regardless of where they happen to practice, with the authors concluding that

clear leadership on ICT could foster supply chain integration, but only if the potential for all stakeholders to improve their profitability is demonstrated.

From our perspective as guest editors, it has been fascinating to see the wide scope and different methodological approaches adopted by the authors. To a certain extent this reflects the continual evolution of our efforts to better understand collaborative working in temporary project environments and also reflects the continual development in the technologies that facilitate effective and efficient interaction. Most encouragingly we see within this body of work an appreciation of the interaction between people and technologies and its affect on working practices, learning, research and profitability.