Cross-disciplinary AEC teamwork supported by re-representation

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This paper studies the relation between activities, media and communication channels, and re-representation of AEC concepts in support of common ground building in cross-disciplinary, geographically distributed teams. AEC project team members determine the role of discipline-specific knowledge in a cross-disciplinary project-based environment. It is through cross-disciplinary interaction that the team becomes a community of practitioners. It is critical that team members build an awareness, appreciation, and understanding of the other disciplines. Our hypotheses are:

Significant sources of information behind decisions and request for actions are embedded within the dialogue in which participants use both informal and formal media to express their ideas. These communicative events represent the thought process towards decisions are not captured. Capturing this information supports common ground building and accelerates execution of action requests. Re-representations of concepts mediate and accelerate common ground building.

Systematic use of intra or inter disciplinary re-representations as part of the team work practice correlate with high team performance, i.e., effective team process and high product quality.

The central theoretical point of departure for this study is communication theory, in addition to learning theory and distributed cognition, design theory and methodology, and knowledge management. Communication is central to teamwork. The objective is to ensure that what was said by one member was understood by all the other members. In communication theory this is defined as the process of grounding, or common ground building (Clark and Brennan, 1991). It refers to the development of mutual knowledge, beliefs, and assumptions that is critical for communication between people. To build common ground the dialogue needs to have both the presentation phase and the acceptance phase (i.e., acknowledgement that what was said was understood). Clark and Brennan studied conversation dynamics and offer in common ground theory an instance relevant to our study, called grounding references. One of the techniques to achieve grounding references is through alternative descriptions. Our study builds on these concepts to analyze multimodal and multimedia communicative events in cross-disciplinary, geographically distributed teams.

Similar to the alternative descriptions technique defined by grounding theory and used in conversation dynamics analysis (Clark and Brennan, 1991), we identified the *re-representation* technique used by team members in multimodal and multimedia communicative events in cross-disciplinary, geographically distributed teams. In the context of our study we define *re-representation* as a sequence of representations of the same concept using different communication channels (e.g., speech, gesture, sketch) and media (annotation, diagram, drawing, 3D CAD, video) for diverse activities (e.g., explanation, problem solving, etc.). Re-representations determine the breadth and depth of the design process. Re-representations are used in intra- or inter-disciplinary communication.
We used AEC Global Teamwork course offered in 2008-2009 as the testbed to validate the hypotheses. It engaged 34 students organized in 5 AEC global project teams. We performed a longitudinal study of the 5 teams and collected data over 4 months January-May 2009 focused on weekly team meetings in the interactive workspace that were two hours long. Approximately 150 hours of multimedia digital data was collected using RECALL, digital pictures, and video.

We defined three lenses for data analysis: activity performed by the team members and purpose of the representations being used, media or channel of the representations being used, and whether or not concepts were being re-represented. We distinguished between episodes where the re-representations were intra- or inter-disciplinary. The schema for the activity analysis was defined as follows: clarification, explanation, exploration, problem solving, closed questions, feedback, presentation, negotiation, resolution, and other activities, e.g., technical, scheduling, etc. The activity analysis provided an overview of the transitions and process transformations of the teams over time as they moved through the three project phases (1) needs identification and the project specifications, (2) concept development when the teams explored alternatives, and (3) project development and delivery. The second lens focused on communication channel and media using the following coding schema: speech, gesture, diagram, annotation, highlight, draw/sketch, text, and writing. We integrated the communication channel and activity analysis schemas. The RECALL and video was broken into ten seconds segments. The results were further analyzed to identify re-representation episodes.

Figure 1. Example of RECALL screen shots of a re-representation sequence to build common ground during a cross-disciplinary explanation episode between engineer and architect of a global team. They discuss the impact of the architectural design on the structural behaviour, i.e., the large cantilevers that have different dimensions and are placed on two sides of the building. A better understanding of how, when, and why representations and re-representation of concepts are used, can provide insights into the complexity of the discourse in global teams and the relationship between communication process, activities, communication channels and media. Data analysis findings and studied interaction scenarios support the three hypotheses.

References