THE GENERALIZED MODEL OF DESIGN EXPERTISE

Defining Strategies in Building Information Modeling

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1. Emerging Phases in a BIM-enabled process

In architecture practice, design is understood to be a linear process where domain experts contribute to discrete phases. Traditionally the AIA defines five design phases; schematic design, design development, and construction documents, bidding, and construction administration. Feasibility studies and programming are sometimes understood as an additional phase, known as pre-design. However in BIM, design is compressed into a highly collaborative process, where a single data model is managed by all domain experts. This early participation of domain experts changes the process. NIST describes a compression of traditional phases into three emerging phases; design optimization, construction optimization, and construction orchestration. This restructuring includes the building operation phase.

2. Need for a Model of Expertise in a BIM-enabled process

A BIM-enabled process requires changing the process from individual contributions by expert users into an “integrated practice”. For the building to be built virtually, designers need to integrate various types of knowledge into a new kind of expertise. We examine a number of studies have been carried out to represent computational tool expertise and design expertise (Bhavnani and John, 2000; Cross et al., 1994; Cross and Clayburn Cross, 1998).

Design expertise has been the focus of design research. Schön (1983) identified the importance of ‘problem framing’ at an individual level. Problem framing occurs in the schematic and design development phases. Pahl and Beitz (1984) stressed on designing from ‘first principles’ in education and practice. Cross (2003) describes how first principles are identified and generated through problem framing, while also being embodied in design solutions to satisfy solution criteria. His study provides a basis for defining key strategies within design expertise. To understand design thinking, researchers have associated different levels of expertise
with sketching, as part of the low-level activities in schematic design phases (Akin, 1995; Ullman, 1990).

Bhavnani and John (2000) identified and analyzed efficient strategies for using computational tools to achieve an overall design task, in an area that they defined as the intermediate layer of knowledge. CAD expertise is needed to efficiently produce drawings, during design development, bidding, and construction documents. For Bhavnani and John, expertise lies in the intermediate layer of knowledge, where a task is decomposed and structured into a set of aggregation strategies.

We find that previous studies on expertise rely on traditional design phases, and new models are needed to represent expertise within the context of emerging phases.

3. Generalizing the Model

We conduct a protocol study to understand the integration of design and tools, necessary to define a model of BIM expertise. We observe the sequence of activities associated with different levels of expertise while using sketching and parametric modelling. The results yield three models describing the integration of a design strategy, a tool strategy, and a management strategy. We propose that this model of expertise for concept design could be generalized to include other design phases. Our generalized model describes high level strategies within the four emerging phases. We represent expertise as strategies architects may require according to their professional roles as owners, building technologists, or contractors.

References