Chapter 1

Systems and Enablers: 
Modeling the Impact of Contemporary Computational Methods and Technologies on the Design Process

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ABSTRACT

This chapter presents a conceptual model of the architectural design process, spanning from ideation to realization, but not focused on stages in the process. Instead, the model identifies four primary meta-systems in design (representational, proportional, indexical, and operational) that are connected through, and supported by, a range of enabling tools and technologies. The purpose of developing this model is to support a heightened understanding of the parallel evolution of the design process and of enabling technologies. Thereafter, the chapter introduces seven recent trends in computational design and technology, each of which serves to enable the design process. The seven developments are: Building Information Modeling (BIM), parametric design, generative design, collaborative design, digital fabrication, augmented reality, and intelligent environments. The chapter offers a critical review of proposed definitions of each of these technologies along with a discussion of their role as a catalyst for change in the design process.

INTRODUCTION

Historians generally trace the rise of the architectural profession to Ancient Egypt and specifically to the Third Dynasty (c2600BC). Records from that era suggest that, for the first time, an individual was granted the honorific title “chief builder” by the Pharaoh Djoser (Kostof, 1977). In the years that followed, many Pharaohs appointed a chief architect who, in turn, trained the next generation of designers in the arts and sciences of visualizing and constructing buildings. In this way, successive generations of architects, typically drawn from the same families, continued to serve the state and support the completion of major projects. While the Ancient Greeks and Romans also maintained that the role of the architect included the strengthening of existing structures and the construction of
fortifications and machines (Vitruvius, 1914), the primary role of the architect has been, and remains to the present day, the visualization of a design and the communication of this intent, in such a way as to support the construction of a building. While this, the architect’s overarching role, has not changed substantially since the Renaissance, the mechanics of the design and construction process have evolved in countless ways. In particular, the tools and technologies that once simply supported the design process have, more recently, begun to alter the way in which architects work.

This chapter commences with the presentation of a new model of the architectural design process and traces how it has changed over time. Rather than being a conventional “design as process” model, the new model is focused on the relationship between the meta-conditions of design (representation, proportion, information, operation) and the tools, devices and technologies that enable these conditions to be met. Thus, this is a framework recording the relationship between conceptual systems and practical enablers and therefore could be described as a system-enabler model of the design process.

Conventional models are concerned with the stages that occur in a design process; typically including conceptualization, sketch design, developed design, documentation and reflection (Figure 1). These stages have been presented, with variations, in many different works (Schön, 1983; Cross, 1997; Lawson 2005) and while they offer a reasonable facsimile of a design process, they say relatively little about the primary conditions placed on a design, or the methods, techniques and technologies that support the process. The new model is loosely founded on the traditional design process, not only identified in architecture but also in engineering, interior and industrial design (Miller 1995; Dorst 1997: Cross 2000), but with several key differences. First, it is a comparative model; its purpose is to chart changes in design practice and process. Second, its focus is on the shifting relationship between the meta-issues in

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*Figure 1. A traditional design process model*
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