RIGOROUS CREATIVITY

Ubiquity, Parametrics, Tectonics

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Architects frequently understand and experience design and creativity as a personal and lonely activity. However, there is, increasingly, a need to collaborate with others in the design and construction of buildings. Digital technology is intricately intertwined with the creative and social aspects of the emerging practice world. A prime example is the use of digital fabrication technology and building information models to directly transfer information among architects, contractors, fabricators and consultants. At the same time, the discipline and practice of creative design is increasingly seen as a valuable cognitive skill, to be emulated, tapped, and understood by other disciplines in various settings. Fields outside of architecture and governmental granting agencies have shown strong interest in understanding, rationalizing and importing the creative design process that architects engage in. The obstacle, however, has been that architects and designers are rarely able to explain their processes in a manner understood by others. The advent of digital tools and social computing further complicates the issues of how designers design with such tools and how designers design with others (Lawson, 2005). Our aim should be to define a discipline of collaborative digital design with clear conceptual frameworks, methodologies, and epistemologies. The goal is two-fold: 1) to formulate a discipline of digital design based on sound theoretical and pragmatic underpinnings, and 2) to elucidate the processes of digital design so that we can better communicate them to other disciplines and thus engage more effectively in interdisciplinary research.

A discipline of digital design requires further definition and refinement; this can be achieved through a focus on a three themes consisting of: 1) Ubiquity, 2) Parametrics, and 3) Tectonics. In simpler terms, a discipline of digital design should concern itself with *people*, *rules*, and *things*.

Ubiquity

The first foundation, *ubiquity*, refers to the fact that digital information is rapidly becoming embedded in our daily lives. It enables collaborative interactions. Collaboration starts with simple casual interactions such as asking a question. It develops further within an organization through intra-disciplinary work – such as a team of architects and designers working together on a project. For larger and more complex projects, we often witness inter-disciplinary collaborative and coordinative processes among individuals with various backgrounds and training. Especially in the field of architecture and urban design, we also witness the users of and stake holders in these projects get involved in what is usually called participatory design. Ron Wakkary, for example, has emphasized this aspect in his research by using the term *everyday designers* (Wakkary, 2005). He argues that all of us contain innate design abilities that allow us to participate collaboratively in the formation of a project that affects our daily lives. Ubiquity enables synchronous and asynchronous collaboration. It can take place in the same location (co- located) or at different locations (dispersed) – aided by real-time communication technologies and persistent databases. The physical, ergonomic, and social settings of collaborative work have a direct relationship to the type of work being done. Lastly, in a collaborative process, it is useful to analyse the individuals/players involved, the tasks they perform, and the artefacts they produce and study.

Parametrics

The second foundation, *parametrics*, concerns itself with the rules governing the design process. “Parametric design is a process based on algorithmic thinking that enables the expression of parameters and rules that, together, define, encode and clarify the relationship between design intent and design response” (Jabi, 2013). Starting from George Stiny’s *Shape Grammars* research (Stiny & Gips, 1972) and evolving through the newly found interest in parametric design (Woodbury *et al*, 2010) and generative algorithmic processes, parametrics is increasingly becoming not only a method, but a design philosophy (Schumacher, 2009), but more interestingly as a way of thinking (Oxman & Gu, 2015). A parametric understanding of the design problem has opened the possibility of investigating the deeper conceptual as well as tectonic structures of our proposals and has offered users and clients a realm of possibilities rather than a dictated solution. The field of parametrics has also allowed us to re-visit and discover the geometries of previously built works and more rigorously understand their design and construction rules (Jabi & Potamianos, 2007).

Tectonics

The third foundation of digital design, *tectonics*, is concerned with the relationship of *process* to *product*. It advocates the view that architecture will always be embedded in its tradition of attention to material, assemblage, and detail (i.e. the tradition of *making*). The term *digital tectonics* (Leach *et al*, 2004) expands this traditional notion into the current digital environment; thus making an argument that, while perhaps earlier computer-based work has ignored the architectural tradition of making, digital tools and technologies are not incompatible with a concern for materiality and craft. Indeed, they facilitate a powerful reformulation of design processes through parametrically constrained digital fabrication models and bring their own poetics to the equation. Architects have started using parametric and digital fabrication technologies to exert precise control over their design intentions through investigations that intersect the boundaries of algorithms, form, performance, material, and technique. A digital fabrication model can be used to more effectively investigate the impact and sequencing of production and assembly in the field and can communicate the above boundaries directly to others. A precise digital fabrication model can be transferred and translated digitally thus avoiding interpretation errors as it frees us of the need for representational annotation.

Several interwoven theoretical approaches must be employed to fully explain this research agenda and expand our understanding of digital design. In a vibrant research programme, one would expect to witness the following streams of concerns. Dialogs among those pursuing them and a collaborative atmosphere would further ensure that a discipline of digital design is formulated in a rigorous and collective manner:

- A humanistic approach (a concern for technology's role in and effect on human praxis)
- An algorithmic/rule-based approach (parametrics, generative, novel software systems)
- A social/collaborative approach (HCI, ubiquitous computing, CSCW)
- An artefact-based approach (digital fabrication, digital/analogue, digital tectonics, building performance analysis)
- An academic/pedagogical approach (studio culture, inter-disciplinary design studios)
- A practice-oriented approach (building information modelling, workflow strategies, liability, legal and practice issues).

In summary, we should aim to discover a rigorous set of guidelines and a framework for the issues involved in the formulation of a discipline of digital design. It is hoped that this framework will encourage us all to be more explicit in our discussions and descriptions of digital design. This

agenda can be pursued by using the three themes identified above that study individuals and how they work together with the aid of ubiquitous collaborative technologies, the rules and parameters they invent and apply in their design processes, and the tectonic artefacts they design, produce, and share. The maturity of this research agenda will enable us to better communicate *what we do* and engage in more meaningful interdisciplinary research.

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