ITcon
www.itcon.org - Journal of Information Technology in Construction - ISSN 1874-4753

# SHARING MEDIA AND KNOWLEDGE IN DESIGN PEDAGOGY

PUBLISHED: June 2010 at http://www.itcon.org/2010/22

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***SUMMARY****: Theories and methods of digital design can no longer be conceptualized as the merging of computational tools with conventional formulations of design knowledge in design. New media - and the evolution of digital design as a unique field of design knowledge, supported by new technologies, and producing unique understanding of designs is a phenomenon that is rapidly crystallizing in this decade. Among the significance of digital design for the design theoretical community is the way that this form of highly mediated design is beginning to evolve unique conceptual content. The clarification and meanings of conceptual relationships between models, concepts, systems, and their applications in precedents, appears to provide advantages in the formulization of novel bodies of knowledge and procedures. In this paper we first formulize a theoretical basis for the conceptual mapping of emerging knowledge from both praxis and theoretical resources. We than formulate a set of design models, concepts, relevant methodologies and precedents in digital design. The third step is to map and construct a network representation for this emergent knowledge. The fourth step is to accommodate and apply this representation as a new basis for pedagogical experiments in digital design.*

***KEYWORDS****: Digital Design, Design Theory, Design Knowledge, Network Structure, Conceptual Mapping, Education, Pedagogy*

***REFERENCE:*** *Oxman R (2010) Sharing media and knowledge in design pedagogy, Special Issue Advanced Digital Technologies for Built Environment Education and Learning, Journal of Information Technology in Construction (ITcon), Vol. 15, pg. 291-305 , http://www.itcon.org/2010/22*



## 1. INTRODUCTION

The evolution of digital design as a unique field of design knowledge, supported by new technologies, and producing unique understanding of designs is a phenomenon that is rapidly crystallizing in this decade. Among the significance of digital design for the design theoretical community is the way that this form of highly mediated design is beginning to evolve unique conceptual content (Oxman 2006). Theories and methods of digital design can no longer be conceptualized as the *merging* of computational tools with conventional formulations of design. The present condition of theory and design in an age of digital media presents the need to pioneer a new understanding of the *nature of designing* in relation to digital design media.

A new understanding of digital design as a unique set of design phenomena demands a theoretical and methodological formulation of the symbiosis between the product of design and the way it is now conceived, generated and modeled in digital media. The clarification and meanings of conceptual relationships between models, concepts, systems, and their applications in precedents, appears to provide advantages in the formulization of novel bodies of knowledge and procedures. These are accompanied by a high level of

theoretical content in the field of Digital Design which is currently developing its own discourse. Among the significant impacts of digital media for the design theoretical community is the way that this form of mediated design is beginning to evolve original and characteristic conceptual content.. Having created a body of novel precedents in emerging practices, new methods and processes of mediated design have reached the point of maturity in conception and practice that now demands a broad and general theoretical formulation.

## 2. THEORETICAL BASIS OF THE NEW RATIONALE

Early attempts to deal with digital design as an important theoretical threshold in architecture were realized by various theoreticians. *Folding in Architecture*, the special issue of the journal *AD* (Lynn, 1993) created an influential body of early theoretical sources and had an important impact in determining the constituents of an incipient digital design theory. Early contributions by Lynn (1999) provided introductions to potential philosophical sources, to studies of technological innovations, to descriptions of experimental projects, and to identity of their relevance in the formulation of a theory of the digital in design. This combination of diverse theoretical, philosophical, methodological, technical and professional sources has characterized the discourse of digital architectural design in its first decade. In parallel, emerging technologies began to influence central issues in design theory. From the mid 1990's digital architectural design became engaged with the exploration of complex geometries (Rashid, H. and Couture, L. A., 2002), with so called, 'free forms' (Pottmann ,2010 ) as well as with related materialization processes of fabrication and manufacturing technologies (Schodek et al., 2005; Sass and Oxman, 2006). These developments have begun to broadly exert significant influence on the theoretical, conceptual and methodological contents of design.

In parallel to the formulation and publication of a theoretical discourse, novel precedents were starting to challenge designers of to formulate the new knowledge and understanding associated with *practice gained theory*. Among such significant monographs on *digital theoretical practice* are UN-Studio, van Berkel and Bos (1999), Rashid and Couture (2002), Oosterhuis (2002), Zaero-Polo and Moussavi (2003), and Spuybroek (2004) each of which is a significant theoretical work promoting digital design as a unique set of processes. Furthermore, there was a growing impact of innovative experimentation in design and construction. In architecture, the Bilbao Guggenheim by Frank Gehry (1992-1997) was the most prominent catalyst of theorizing new formal directions and postulating new design methods (Lindsey**,** 2002). Other formative works that helped to generate theoretical discourse include the Greater London Authority Headquarters, (2002) and the Swiss RE building (2004) designed by Foster & Partners and Arup Associates etc.

Praxis and theory evolved simultaneously. New approaches and technologies were accompanied by new directions in design methodology. Since these first generation developments the field, the profession, now more confident in its understanding of the theoretical implication of emerging media technologies and design practices, has produced a wave of new writings and experimental projects (Reiser and Umemoto, 2006). We are now at the threshold of the need to pioneer a theoretical understanding of the *nature of designing* in relation to digital media.

The evolution of digital design as a unique field of design endeavor, motivated by its own body of theoretical sources, and a culture of discourse, is beginning to evolve unique ideology, methodologies and formal content (Liu, 2005, Oxman and Oxman, 2010) Works such as Pottmann, (2010) Kolarevic (2003) and Kolarevic and Malkawi (2005) provided a basis of methodological and technological content.

### 1.2 Indicators for the Emergence of New Issues

The awareness of change induced by conceptual conflicts between traditional and digital design are stimulating the need for a conceptualization of digital design foundations. Among these conceptual conflicts are encounters between certain root assumptions of modernist design and the contradictions that have emerged with digital design. Among these are the following:

- Digital design thinking is more than simply a set of formal preferences. It is the *abandonment of the modernist design ontology* that is predicated upon formal and typological knowledge (e.g. formal

languages, typological classes and generic design, etc.) It is non-typological and non-deterministic in supporting and preferring the differentiated over the discrete and the typological.

- There is emerging a *new symbiosis* between the digital product of design and the way it is conceived, generated and produced in digital media. These stages are fundamentally different from those of modernist design. It is the understanding and formulation of this procedural symbiotic relationship between conception, generation, production and the product itself that appears to be of high priority today.
- Digital technologies appear to have *freed the image from traditional concepts of representation*. We no longer represent discrete shapes in the conventional paper-based sense. This condition has enhanced the denial of classical notions of representational conventions such as static space, and has introduced new concepts of dynamic and responsive space and form that are producing new classes of designs.
- In many cases approaches to form generation exploit *emergence-based transformational processes* in which digital media are the enabling environment. This in many ways is *replacing the experimental visual nature of the paper-based sketching process*.
- Context in the modernist sense may possess iconic, stylistic, or configurative content that can implicate design through visual or formal content. Context in digital design is considered a *performative shaping force* acting upon shape and form.

### 1.3. Aims and Objectives

The objective of the research presented in this paper has been to address this evolving synergy and its theoretical imperative. The main question raised in this research was related to means by which we can capture and map this knowledge in order to define it and make it useful in design. Our approach to this task has been to access and define a formal structure in order to collect and map of the key concepts of this field.

Given the growing amplitude of issues and concepts in digital design as witnessed by practice, research and education, our approach in this research was to formulate a theoretical framework that is suitable to capture this knowledge and potentially provide a theoretical basis for the formation of digital design educational theory. In the following section we present the basis for the conceptual mapping employing semantic network formalism based on a theoretical approach of conceptual mapping (Sowa, 1991) and illustrate its application in making knowledge formulations.

## 3. FORMULATION OF DIGITAL DESIGN KNOWLEDGE

One of the recognized resources for design knowledge is the usage of precedents (Oxman, 1994; 2003). One of the distinctive problems in representing design precedents is the richness and complexity of their descriptive content. Each design contains many related chunks of information that are difficult to decompose. ICF is based on the cognitive theory of CBR. It was the first application to apply this theory to design precedents (Oxman, 1994). ICF was developed as a formalism composed of a tri-partite representational formalism which represents Precedent Knowledge Similar approaches were employed in applications ranging from the construction of libraries to pedagogy and didactics (Oxman, 2003, Tidafy and Iordanova, 2005). This formalism maps the relations between associated concepts in precedents in a way which captures the conceptual significance of the design precedent. This method for formulating knowledge derives from the analysis of precedents and the structuring of knowledge into a semantic net. Conceptual links in the semantic network can connect different precedents. This resulting structured representation of conceptual knowledge can later be accessed and expanded in the analysis of other media such as theoretical content in forms of discourse, or content, analysis.

The resulting network of concepts represents design knowledge as a conceptual network. Thus the semantic network structure, incrementally constructed, tends towards the characterization of the conceptual constructs of the body of works along with their associated discourse.

The goal of this work has been to employ this formalism and make a conceptual mapping of digital design thinking today and to identify the emerging body of novel design concepts in digital design in the domain of Architecture.

# 4. A CONCEPTUAL NETWORK OF DIGITAL DESIGN CONCEPTS

## 4.1 Introduction

Each historical period creates a distinctive focus in identifying the relations between theory and practice. In order to explore the particular theoretical implications and knowledge related to digital architecture we define and analyze the terminology which is associated with a particular precedent. While a selected body of theoretical and research writings provided the initial set of concepts, case studies in practice were employed for the analytical process of relating concepts to components of actual design precedents; and thus testing and re-structuring the original assumptions of the initial conceptual vocabulary.

## 4.2 The Network

In this section we describe the theoretical assumptions, the methods of knowledge acquisition and the process of network construction underlying a conceptual network. Following this, we provide an exegesis of selected examples of the key, or seminal, concepts of digital design that were identified. These key concepts provided the content for the analysis of precedents, and through this, the expansion and construction of the semantic networks. In the scope of this introductory article we provide an introduction to the idea of constructing a conceptual network as a basis for defining the theoretical foundations of a design discipline.

Theory formation is a dynamic and developmental phenomenon. The interpretation of theory as a body of knowledge in an evolutionary process of change and reformulation appears particularly relevant to the formalization of an emerging field of knowledge such as digital design. Given that one of our underlying assumptions is that designing in digital media is a new and unique class of design, we have attempted to identify the processes of conceptual structuring and their intellectual sources that have contributed to the formation of the field and its theoretical and methodological practices.

A broad literature survey of leading sources was selected from the body of general publication, the research literature (publications and conference proceedings), and the small number of journals that support publication of material in the field. The period studied was from the early 1990's to the present. A large body of publications were selected and analyzed according to taxonomical contributions. On the basis of this extraction of a body characteristic and important textual material, we attempted to identify key, or seminal, concepts. Key concepts, such as *morphogenesis,* or *material ecology* appeared to be one of those concepts that *formed a sub-discourse*. As such, it was possible to identify their body of related concepts and to graphically describe discourse as a *constellation of concepts*.

The theory of semantic networks (Sowa, 1991) is a method that supports the graphical representation of knowledge structures and cognitive processes. We have applied this method to define the conceptual network of digital design particularly from the point of view of the conceptual structure of its body of theory. In addition we are attempting to address in current work additional and conceptual levels of the contents of the field: Key Issues, Models, Methods; and Precedents. Eventually we will graphically plot the relationship of the conceptual levels of these conceptual structures in digital design.

The original experiment underling the knowledge acquisition and network construction process was carried on in an educational situation in which a team of student-researchers collaboratively constructed a generic knowledge base for the conceptual and methodological applications in a specific design library of theoretical material and case studies. The initial stage of the research was based upon the collection of theoretical materials as well as a systematic survey of relevant precedents employing the ICF formalism (Oxman, 1994; 2003).

## 5. DIGITAL DESIGN MODELS

These indications of conceptual change have emerged the formulation of design models, the conceptual content and vocabulary of digital design. A formulation through the identification of relevant early models of design has been developed by the author (Oxman, 2006). The classification of paradigmatic models include: CAD models, formation models, generative models, performance models and integrated compound models. This classification enables the definition of underlying current digital design models.

- CAD: Early CAD models marked an attempt to depart from paper-based media. They had little qualitative effect on design in comparison to conventional paper-based models. In traditional CAD the interaction with formal representations supports the a posteriori automation of design drawings and visual models. First CAD systems were mainly descriptive, employing various geometrical modeling / rendering software.
- Formation: In digital design the centrality of traditional concepts of paper-based representation are no longer valid conceptions for explicating the thinking and processes associated with digital design. Furthermore, in certain formation processes of digital design the formal implications of the concept of representation are negative and unproductive. Emerging design theory has transformed the concept of form into the concept of formation associated with topological, parametric and animation. Topological design is based on the exploitation of topology and non-Euclidean geometry. Parametric design is based on principles of parametric design (Bury, 1999). And generative components, Animation, morphing (Lynn, 1999) and other range of motion and time-based modeling techniques are based on the propagation of multiple discrete instantiations in a dynamic continuum.
- Generation: generative models of digital design are characterized by the provision of computational mechanisms for formalized generation processes. Here, as compared to formation models, shapes and forms are considered to be a result of pre-formulated generative processes. Currently there is a rich theoretical body of research-related applications of generative models. Two main distinct current sub-approaches are shape grammars (Knight and Stiny, 2001) and evolutionary models (Frazer, 2002).
- Performance: performance-based models are driven by performance and potentially integrated with formation and generative processes. Forces in a given context are fundamental to form-making in digital design. External forces may be considered as environmental forces including structural loads, acoustics, transportation, site, program etc. Information itself is also considered as an external "force" that can manipulate the design (Oxman, 2009).

## 6. DDNET

Semantic networks and our proposal of enriching this formalism through describing the meaning of conceptual clustering and multiple levels of clusters have proven relevant as a tool of discourse analysis. They help to clarify important semantic relationships as well as identifying scientifically meaningful, as compared to the purely descriptive, terminology that is associated with ideology.

We have identified the significance of conceptual structuring as a method of discourse analysis. The clarification of meanings and conceptual relationships in the creation of complex semantic networks appears to provide various advantages in the formulization of emerging bodies of knowledge and procedures that are accompanied by a high level of theoretical discourse as is the new field of Digital Design. We have proposed that in design there is a highly conventionalized acceptance of the constituents of theories, models (important models of digital design such as *performance-based models*), and methods (important methodological/technological foundations for system development such as *parametricism*) and illustrative precedents. These levels interact in a conceptual structuring of the field. The proposed Digital Design Network (**DDNET**) - attempts to represent the conceptual complexity as well as the dynamism of the theoretical and knowledge foundations of the field.

DDNET approaches the building of a foundation for a theory of digital design by attempting to relate the body of theoretical constructs with the models, methods and technologies of the field. Once the mapping of the levels of

conceptualization is completed, we believe that the theoretical foundations of the field will emerge as a distinct body of theory and related design practices. Such clarified terminological and conceptual distinctions should also serve to ameliorate the effects of an ideologically charged interpretation that has characterized much of the design practice and not little of the research practice of this field.

### 6.1 Key Comcepts In Digital Design

Proposed *key concepts* and *sub-concepts* are those concepts which have emerged as central to a sub-discourse in digital design. The concept formation process and of the 4 conceptual levels are presented below (see Fig. 1).

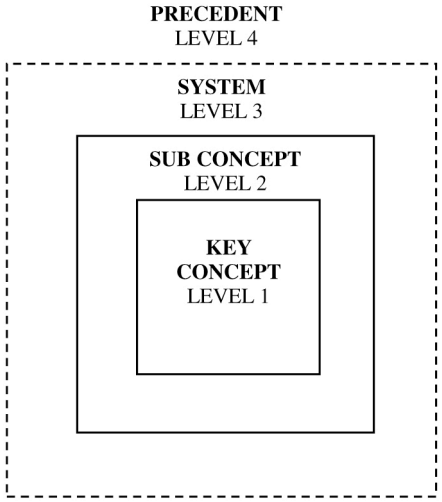


*FIG 1: Conceptual levels: key concept, sub-concept, digital system, precedent*

Each key concept is linked to one or more sub-concepts that define the meaning of a key-concept and may provide an underlying computational model. Sub-concepts are linked to one or more computational systems which are implemented on the basis of underlying computational technologies and techniques.

### 6.2 Free Form

The term, *free-form*, constituted what was in the early 1990's the new promise of an architecture freed from the constraints of orthogonal geometry and rational standardized construction.

Inexact as it is from both a geometrical and descriptive point of view, the term symbolized the relationship between architectural theoretical positions regarding form and the formal potential of new productive possibilities in *non-standard architecture* and through *mass-customization* and *fabrication*. Free Form thus illustrates the complexity of constructing a coherent approach to conceptual structuring. On the one hand it relates both to its means of modeling (e.g. *MESH systems* or *NURBS systems*) and production methods as well as to its knowledge sources (e.g. *complex geometry*) (see Fig. 2).

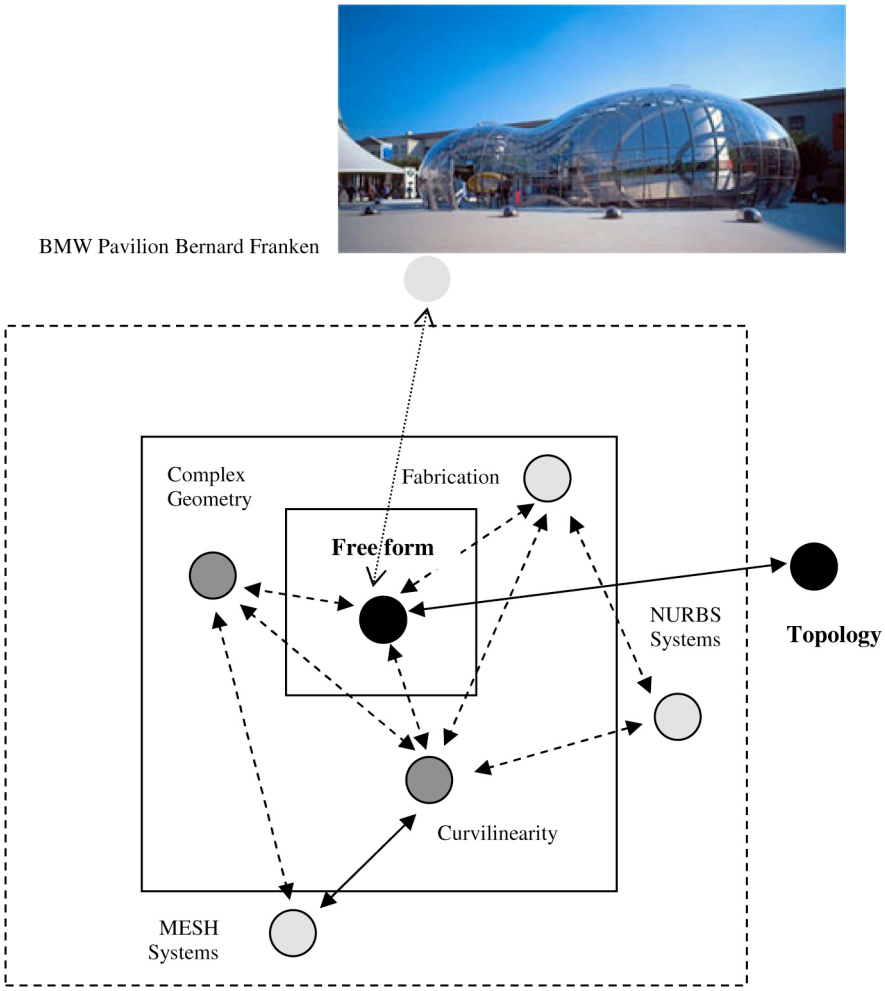


*FIG 2: Free form*

The term and the set of relationships have become an ideological position now, replaced by new and more exact terminology. The next related concept is deriving from conceptual associations with terms such as *Topology*.

### 6.3 Performance

Performance, or Performance – based Design is driven by simulations. Performance here is defined as the ability to directly act upon the physical properties of a specific design. In addition to quantitative properties, these classes of properties could eventually be broadened to include qualitative aspects such as spatial factors in addition to technical simulations such as structural and acoustical performance.(see Fig. 3)

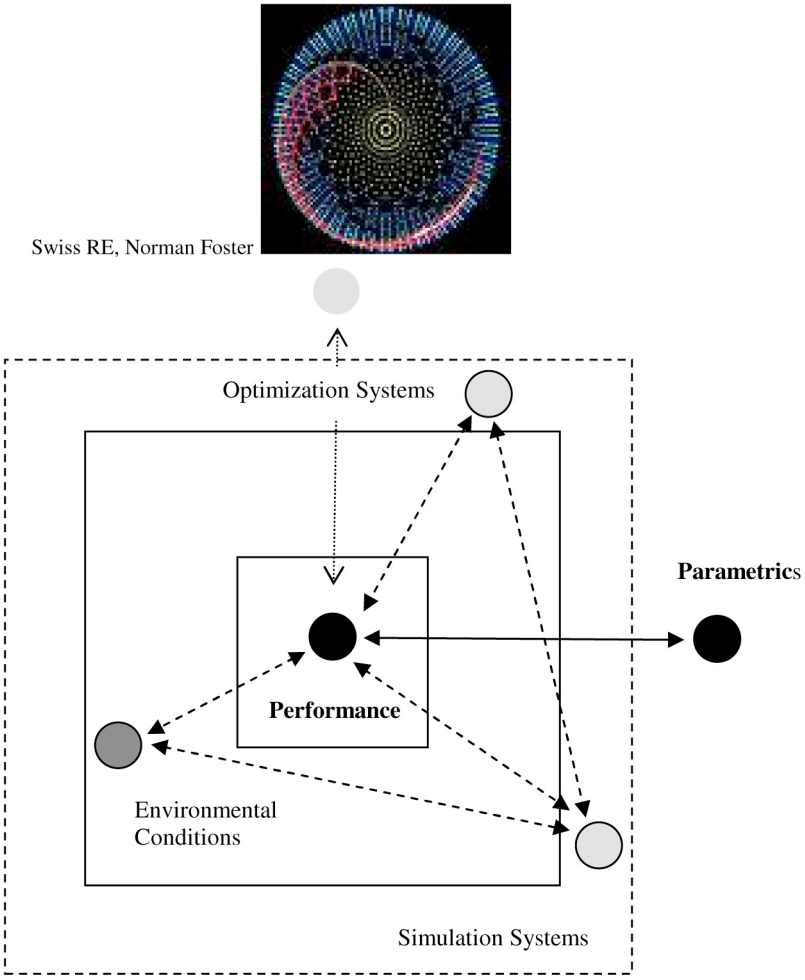


*FIG 3: Performance*

Today, there exist a wide range of digital tools for *simulation*, analysis and evaluation of performance aspects **(**Kolarevic and Malkaawi, 2005). Current theories and technologies of digital design suggest a shift from analytical simulation for evaluation to *simulation for synthesis and generation* (Oxman, 2008; 2009).

### 6.4 Parametricism

As an example of the dynamics of theoretical discourse, *Parametrics* and *Parametric Design* have now emerged as two key contemporary terms. Various designers and researchers (Burry and Murray, 1999) view parametrics and the related body of theoretical, modeling and methodological concepts as the seminal concept of current digital design and a distinguishing characteristic of a digital architecture Parametrics (Meredith, M., et alia, 2008) is essentially a design enabling technology. Coupled with other concepts such as *associative design*, it enables the exploitation of *topological diversity* and transformations. Furthermore, parametric design supports the existence of design models such as *generative components* that are among the foundation of important contemporary design technologies. (see Fig. 4).

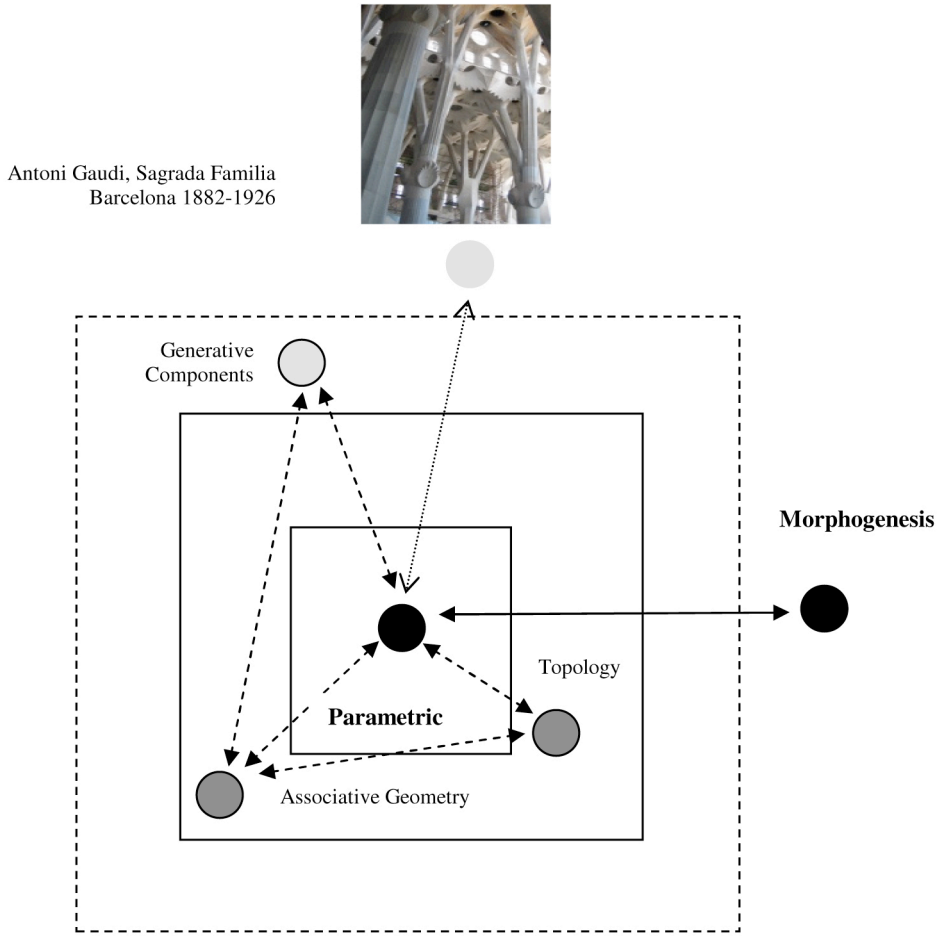


*FIG 4: Parametrics*

On the other hand, parametrics also underlies advanced engineering design practices and methods e.g. flux structures, (Sasaki, 2007). Thus the conceptual constellations of this term are both complex to represent and rich in interpretative potential.

Figure 4 illustrates a well-know precedent, the Segrada Familia by Antoni Gaudi. The remodeling of the Segrada Familia is associated with parametric systems (Burry and Murray, 1997). The next related concept is deriving from conceptual associations with terms such as *Morphogenesis.*

### 6.5 Morphogenesis

We have seen that the terms *free form* and *parametrics* are characterized by diverse meanings and connotations that have developed and evolved historically. The presence of theoretical, design models and methodological/technical content makes the visual characterization of conceptual relationships difficult. Certainly, in additional to scientific and computational content, these concepts also contain ideological content.

The fourth term which we present is *morphogenesis*. This term further illustrates the rich body of discourse (or in other words, the complexity of the conceptual network) that canonic terms can generate. Morphogenesis essentially relates to processes of *form evolution* and particularly to modeling of *"natural"* processes of form generation (Hensel, Menges, and Weinstock, 2004). In design, the term is strongly related to the historical tradition of *form-finding* and *self organization* in the work of designers such as Frei Otto. Furthermore, it is associated with the terminology of *performance-based design*, the methods of *performative analysis* and the potential of *performance driven generation* (Oxman, 2008; 2009). The discourse of morphogenesis has become associated with studies of the principles of form generation in nature and their exploitation in design (*biomimicry*) and with the associated contemporary discourse on material in design (Oxman Neri, 2008; 2010).

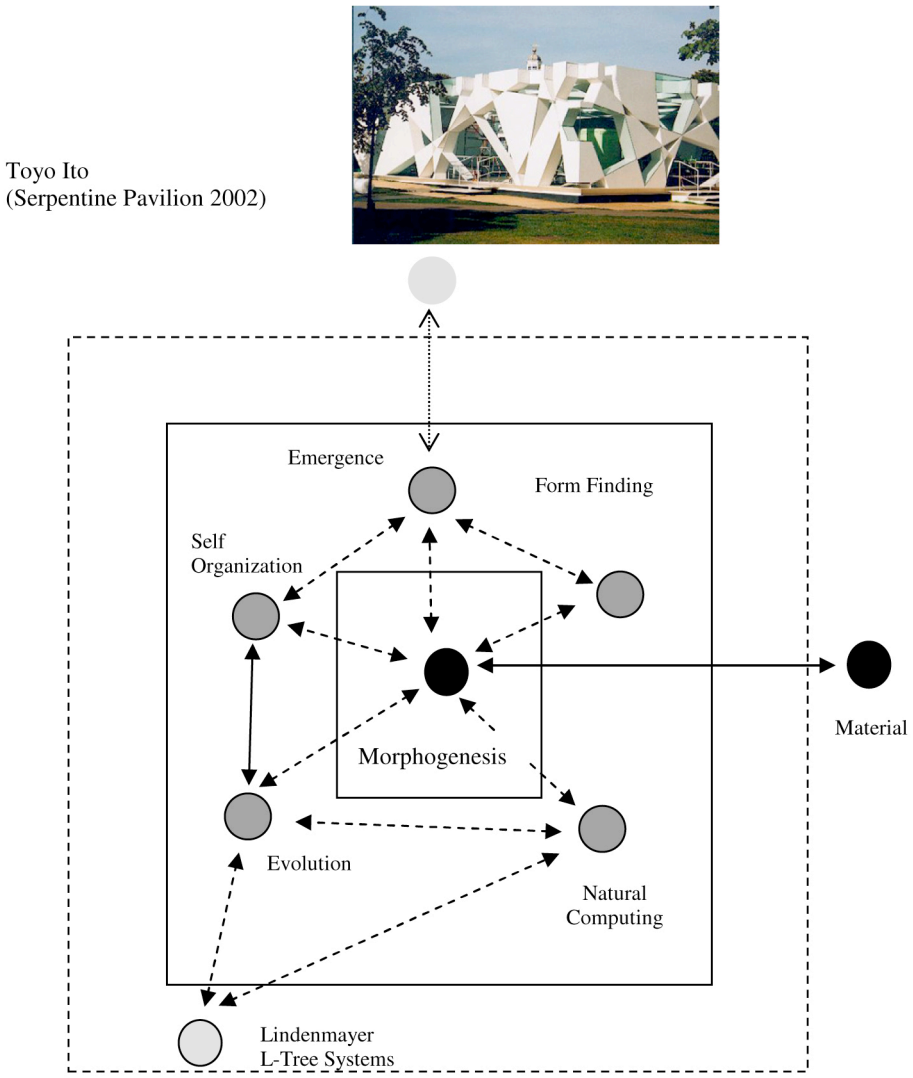


*FIG 5: Morphogenesis*

This term is proposed as a key term in an emerging body of key concepts that contribute to generative models, methods and techniques related to emergence in design (see Fig. 5). The term thus exemplifies a highly complex level of discourse in which multiple key terms are interrelated in new processes of conceptual development.

**6.6 Summary**

Perhaps the most problematic of the obfuscations of the terminology of digital design is the term Digital Architecture. Whether distinct architectural phenomena actually exist and justify such a term is a question of some import. Given that such phenomena do exist and that they are simply stylistic indicators, it seems doubtful that they justify the claim of a "new architecture". Certainly the meaning of the new digital presence in design is that we are able to at last, abandon the dinosaur sanctuary of form.

We hope that in the future this knowledge may become accessible by using a computational tool that will enable the construction and usage of DDNET. Furthermore, some of these topics will be a subject of future work publication which will contain a selection of readings from canonical texts, a comprehensive bibliography of the field as well as a final version of DDNET.

## 7. FROM NETWORK STRUCTURE OF KEY CONCEPTS TO DITACTIC PRINCIPLES

We have attempted to build educational content by explicating the new conceptual structure of digital design. In reality, the integration and interaction of technological content with that of conceptual content is obviously part of the formative process of learning to design with media.

### 7.1 Beyond Formal Representational Design

The first stage of such a conceptual mapping is predicated upon the prevailing models of design at the level of their own conceptual structures. The prevailing model of modernist design is a formalist model in the profound sense of what we might term design ontology. Modernist design is formulated about the sequential development of symbolic representations of the design. It traditionally begins with considerations of space, with the major emphasis being upon the manipulation of visualizations of the design object - the design of form - through the stages of conceptual design, schematics, design development and materialization. The formal foundations of modern art and design have been theoretically defined and the evolutionary process of formal-graphical evolution in design representation has been well-formulated by various theoreticians.

We are now moving beyond this formal syndrome. The parametric, topological, geometric and generative characteristics of current digital design are in profound theoretical contradiction to shape production in the formalist models. Irrespective of how unique that shape may be, it is still the process of shape production as the production of a static form. Digital design characterized by generative processes related to movement and time is neither formalistic nor static. Form generation, beyond formalism, produces conditions of pliancy and continuity in both the conception and geometry of form.

### 7.2 Formation, Generation and Performance – Implications of the Models

Formation, generation and performance are the motivating forces in the new design. They, as concepts and processes, begin to condition new design procedures that are uniquely conceptual. To some extent, these conceptual stages - in the establishment of an appropriate morphology for the design- are also non-contextual. Shreds, Strands, Bleps, Flowers and Folds are among Lynn's (1999) interpretations of the morphologies of digital form.

First material, then generative procedure, and then performance appear to be the methodological sequence of digital design. It is this methodological sequence of procedures that supports the preference for time-related transformational states in place of the representation of static design representations.

This characterization of the digital design model is completely contradictory to models of design such as Schön's "reflective practitioner" in which the visual representation of the design is manipulated by visual reasoning through a succession of stages generally in the medium of sketching. This interpretation of sketching as design thinking through iterative stages of visual discovery is the antithesis of the digital model. Digital design brings new design ontology beyond the visual interpretation of form.

### 7.3 Digital Design Systems as a Medium for Design Process and Modeling

The term digital design system, according to our definition implies the digital integration of attributes related to the morphology + structure + behavior of certain morphological - geometric classes of material form. Furthermore, in the studio the need for the integration of both the digital model and the physical model were found to be extremely meaningful for the conceptualization of digital material. Since current descriptive geometrical modeling lacks material and structural logic, the physical model provide a complementary medium. The physical model – Fast Prototyping and Fabrication processes (Sass and Oxman, 2006) is still very useful for feel and touch in exploring principles of form, morphology and structure. Physical studies can then be translated into digital *fabrication models* for transformation and versioning.

## 8. RE-THINKING DIGITAL DIDACTICS – EXPERIMENTAL PROJECTS

### 8.1 Introduction

In the following section a didactic approach in guiding three different paradigmatic projects is presented and illustrated. Each project was developed by exploiting digital concepts and techniques that suited the theoretical and conceptual content of the project. Each conceptual basis presented the designer with a medium for the development of the material concept through its parametric and morphological evolution. In each of the following selected projects a conceptualization of digital material and a unique digital process appropriate to the material concept and to the type of media is presented.

Our didactic process consists of the following four basic tasks: the first task is to conceptualize and test a generic type of digital material. The second task is to define a unique responsive strategy for modification. The third task is to select a generative model. The fourth task is to select a context that can best demonstrate the behavior and applicability of the design material in relation to task specifications. In the following sections we demonstrate and illustrate these didactic steps in a series of selected projects.

### 8.2 'Topological Boundary Wall'

The first project is termed "topological boundary wall". The following DDNET network components were defined:

- KEY CONCEPTS: Topology
- MODELS: Formation
- MODELLING SYSTEM: Free form surfaces, mesh system
- PRECEDENT: Möbius house - UN Studio

The specific context is related to a design program dealing with site conditions, programmatic aspects and constraints which vary along the length of a boundary line. The design material in this project attempts to apply topological conditions that maintain the same relations along the boarder line. It accommodates the new complexity of a certain topology, departing from the more static and typologically deterministic logic and design methodologies of the previous generation (see figure 6). The changing requirements found along the boundary create a constantly changing condition of context and program along the otherwise continuous design of the boundary. Together, the performance-based technique and the definition of parameters produce differentiation and heterogeneity in the design rather than the instantiation of a particular style, or standardized, modular structure as is currently routinely applied irrespective of complex changes of program and conditions.

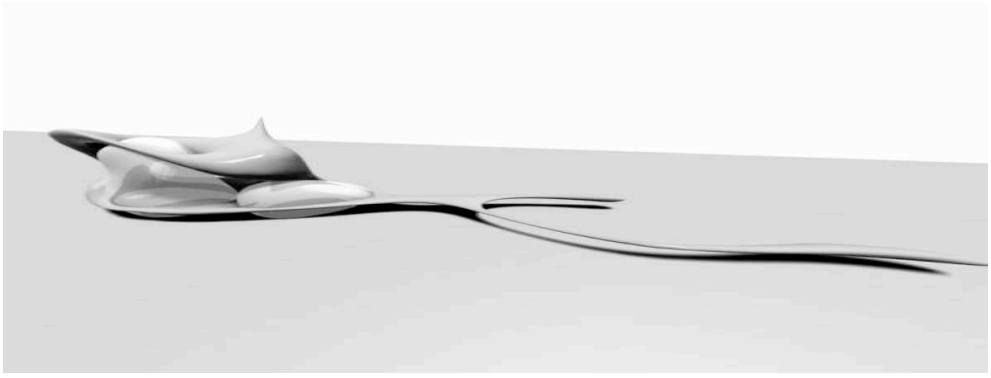

*FIG 6: Topological design of The Dynamic Boundary (designed by Farah Farah)*

### 8.3 'Parametric Inner Space'

The next project is termed a "parametric Inner Space". The following DDNET network components were defined:

- KEY CONCEPTS: Prametrism
- MODELS: Formation
- MODELLING SYSTEM: Parametric System
- PRECEDENT:  Swiss RE building - Foster & Partners

The digital material is defined as a structural and morphological system of parametric and responsive modules (see figure 7). The design process resulted in the production of parametric differentiation of the continuous material morphology responsive to light. Light conditions were selected as a context to test the applicability of this system. Different interpretations of small and large scale applications of the material systems were integrated as local and global scale of particularization. The context of the lighting demonstrated the applicability of this parametric approach to specific light conditions.

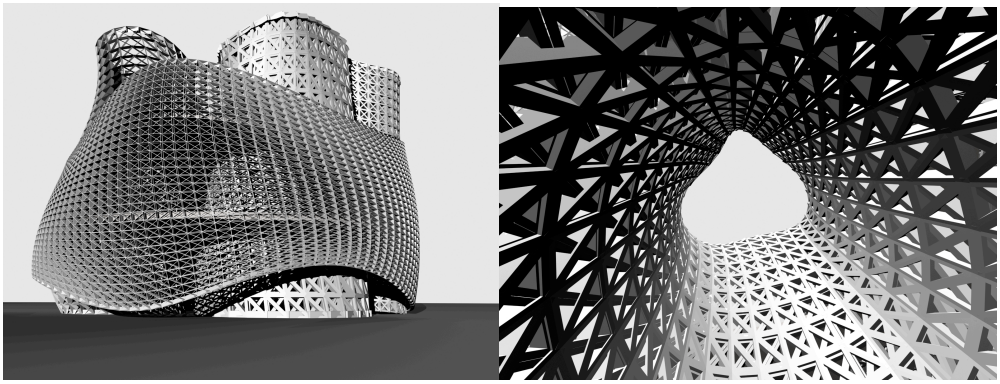

*FIG 7:  Parametric design (designed by Shoham Ben-Ari- Technion*

**8.4 'Texlight Mechanism'**

The next project is termed "texlight mechanism". The following DDNET network components were defined:

- KEY CONCEPTS: Prametrism
- MODELS: Formation
- MODELLING SYSTEM: Interlacing System
- PRECEDENT: GenFab - MyLight.MGX - Lars_Spuybroek

The third project was termed "texlight mechanism". The conceptualization of the digital material is based on morphological principles of woven textiles. This woven material created an indeterminate range of heterogeneous folded profiles that were versions of folding and weaving principles. These profiles evolved to enable spatial, structural and environmental envelope functions within the woven matrix (see figure 3). The design transformations are defined by a set of syntactic rules (see figure 8). A Marina along the sea shore was selected as a context to inform the development of a continuously evolving structure.

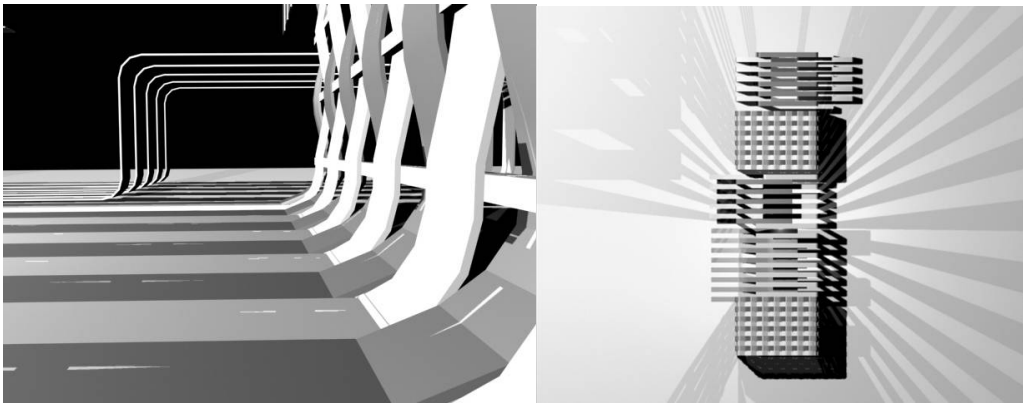

*FIG 8: Textlight Mechanism (Designed by Alex Eitan and Tal Kasten - Technion)*

## 8. SUMMARY AND COCLUSIONS

Our research has demonstrated that a new world view develops conceptual structures for design that may contradict the prevailing logic of design thinking. Rather than the employment of digital technologies, it is these emerging conceptual structures that strongly influence the logic of architecture and its design methods. These conceptual changes become the content of new pedagogical methods of design education. The awareness of change and conflicts can stimulate the necessary theorization and conceptualization for new approaches to design didactics. Our qualitative observations have demonstrated the following:

- The "shock of the new" is not simply in the discovery of new formal vocabularies, but in the establishment of new approaches to design media. Among these, the election of the digital material as a suitable material morphology for a particular class of form generation has proved to be a productive and generative medium.
- Design thinking precedes design learning. The evolution of design thinking in the last decade now appears to have generated a new paradigm for design. As this paradigm crystallizes we first encounter it as a filed of conceptual conflicts between the prevailing and the new values of two design ontologies. New pedagogies can operate within this condition of the evolution and instability of ontologies. However, it can do so only by directly articulating and working with conceptual structures as pedagogical material. It is in this endeavor that we have established our studio for experimental didactics.
- The exploitation and experimentation with new concepts has proved to be an articulate environment for design learning in which learning by making is transfigured by its conceptual, rather than computational, content. Given that a rigorous formulation of such emerging concepts does not yet exist, any work based upon an as yet unformulated body of theory must by necessity be in itself experimental.
- Perhaps the most problematic of the obfuscations of the terminology of digital design is the term Digital Architecture. Whether distinct architectural phenomena actually exist and justify such a term is a question of some import. Given that such phenomena do exist and that they are simply stylistic indicators, it seems doubtful that they justify the claim of a "new architecture". Certainly the meaning of the new digital presence in design is that we are able to at last, abandon the dinosaur sanctuary of form.

We hope that in the future this knowledge may become accessible by using a computational tool that will enable the construction and usage of DDNET. Furthermore, some of these topics will be a subject of future work publication which will contain a selection of readings from canonical texts, a comprehensive bibliography of the field as well as a final version of DDNET.

## Acknowledgements

Parts of this paper were published and presented in VOLOS Greece 2005 (European Computer Aided Design in Architecture) and in Canada in CAAD Future 2008. The following students are deeply acknowledged for their

deep involvement and their creative work: Alex Eitan and Tal Kasten, Shoham Ben-Ari and Roey Hammer and Farah Farah.

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