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The Design – Construction Continuum for a non-linear, not-fragmented and not limited in time Design and Construction Continuum

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The intervention is within the "content axis". Reference will be made to the new subject areas which will have to be included in the new construction teaching. How can the teaching of construction incorporates the continuous developments in innovation? Three directions are proposed, following:

- An effort to map the new subject areas.
- A proposition to relate them to the history of technology.
- An invitation to locate some concepts of philosophy of technology in action.

The above directions designate three major educational axis we are dealing with in a 9th semester course of the School of Architecture of the National Technical University of Athens, called "Information Technology management and architecture". This course is not about economic management but is related to the fact that architectural/construction design is evolving through the integration of IT. We are embracing the position that IT, after dealing firstly with virtual space and then with digitally connected space, is increasingly implicated to physical space and its materiality.

As it is pointed out[1], a "structural turn" is witnessed, that prompts for a new relation of design and construction. "Smooth architectures" that existed only in paper are now constructed and offered to critical analysis. For a third time, after the modern movement and the open industrialization experiment of the seventies, Architecture meets Industry in a new registry managed this time by IT. Many researchers even think that this *structural turn* opens the possibility for architecture to completely redefine its theoretical and professional position and this precisely because of the changing design / construction relation paradigm[2].

In order to deal with those changes a conceptual diagram is elaborated called the Design – Construction Continuum (DCC)[3]. It is not about building a theory, but a field of thinking, permitting to cease the evolving integration of design and construction, as it is catalyzed by the IT applications. The DCC positions flows of information on the design construction process. It is a flexible educational tool in order to incorporate the continuous developments and innovations referring to IT in building design and construction.

In the design field, new concepts and tools are established giving emphasis to change, variability, generative logic, parametric design. They all try to deal with the *design of the transformable* and *interaction design*:

1. They propose to integrate the future building transformations into the initial design phase.
2. They also propose to extend design during the building's lifetime.

The questioning about the transformable is not new. In practice we rarely deal with a one shot elaboration and then construction of a Form that remains stable without any changes. Programmatic changes occur even during the initial design phase, changes may take place during the construction phase and also important modifications may occur during the building's lifetime. An individual or collective user does not want to take a definitive decision for all of its future activities and their spatial

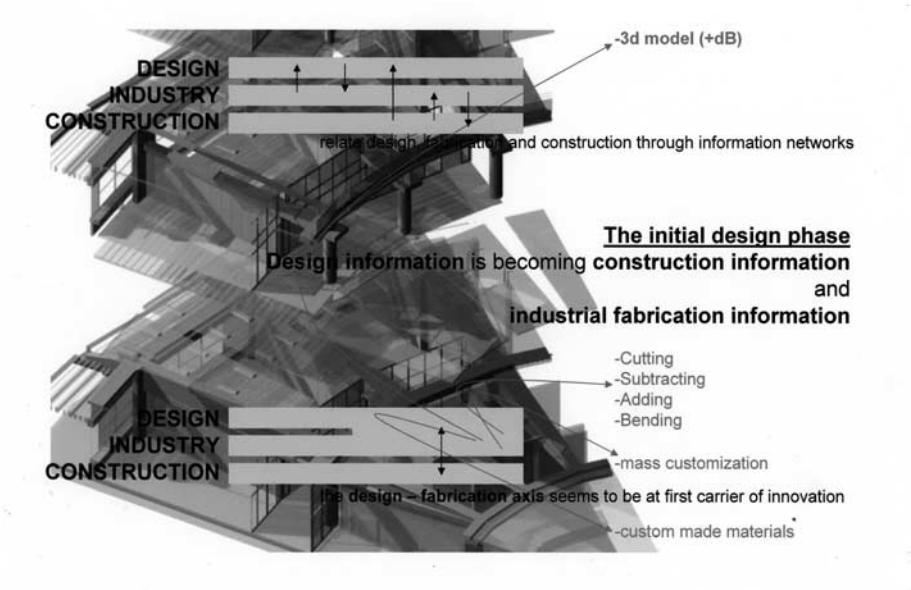
support. As George Kondylis had pointed out, we move from mass democracy to a *society of evolving expectations*. And as Antonino Saggio noted[4], defined spaces related to needs are replaced by *evolving supports of desire*. The definition of an ultimate Form is no longer the architect's goal and the IT is helping thinking towards that direction.

Mapping the new subject areas - Current trends that must be integrated in the construction educational curriculum

An effort to map the new subject areas shows that one of the dominant consequences of the IT implications in design and construction concerns the importance given to the *relations* between participants in the design / construction process rather than the production of the "final object" per se. As Branko Kolarevic had shown[5], the main trend is to relate design, fabrication and construction through information networks. Through that, *design information is becoming construction information and industrial fabrication information*.

Design information is becoming industrial fabrication information when *C.N.C.* is applied. Cutting, bending, subtracting, adding are industrial technologies operating through an immediate link to the design process. Fabrication information is produced and evaluated during the design phase.

Design information is also becoming industrial fabrication information when *mass customization* technologies are in action. Mass customization is proposed to an architecture that deals with *locality* restrictions and the *unique*. User defined variations are permitted. The digitally variable takes the place of the standard. The debate for



the definition of the identity (of a product) shifts to a debate that is related to the definition of what is stable through time and what must be parametrically defined.

At a different level from that of custom made products, *custom made materials* obey to the designer's prescriptions embracing the particularity of each project. The *virtualization of materials* integrates digitally intelligent parameters.

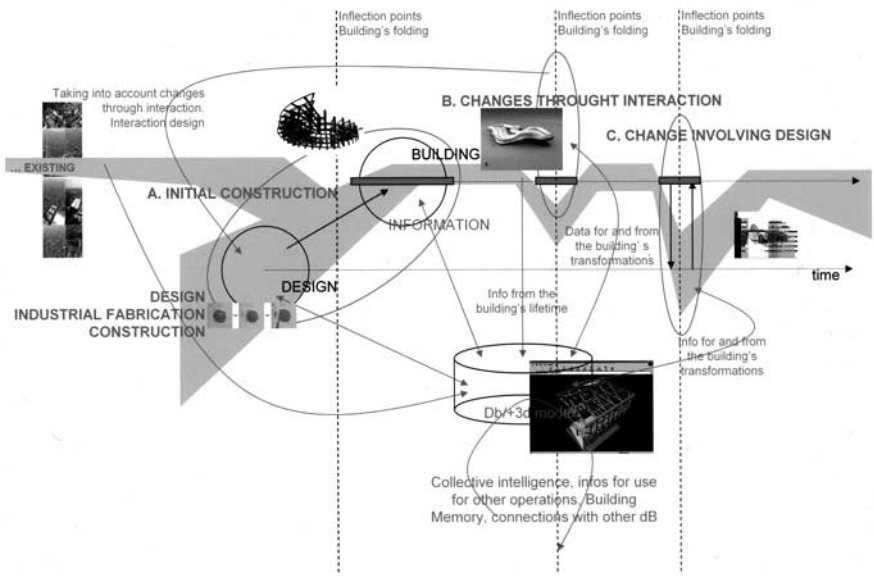
Conventional materials are redesigned in order to meet specific requirements. (carbon fibers in concrete). *Composite materials* are engineered in order meet specifications that alter from building to building. *Smart materials* integrate sensoring functions to transform environmental stimuli into information, alter their properties and become actuators or have both functions (smart concrete detects stresses and prevents damages). *Interactive materials* prompt for user's actions not included in a priori schemes. Swarm intelligence technologies are applied. High end technology embraces the very small scale. Well known classifications of materials cannot be operative and the whole scientific classification schema must be redesigned[6].

In the design construction continuum the *3d-model* is less considered as a representation tool and more as a vehicle of information trying to hold together a centrifugal gathering of actors. It is considered as s field where the management of the relations of all participants in the design – construction process takes place. The 3d model of Boeing 737 is proposed to take the place of Ford's T model. *Shop drawings* are seen as an obstacle not permitting to the architect to take the position of a digital "master builder". Construction "drawings" have to change their status. The 3d model can play its role of coordinator only if it is equipped with the capability of absorbing the pressures and demands of changes, due to the local strategies of the participants to design – construction process. That is if it is equipped with a parametric – generative logic. It is where this DCC coordination model meets the idea of architecture as field of forces, architecture not without identity, but with one continuously redefined, negotiating its *omoiopoiopoetic* and *eteropoietic* status.

The extended Design Construction Continuum

Extending the Design Construction Continuum towards the building's lifetime, propose us a larger conceptual field, adding to the DCC, issues of space transformation in time and interaction design. This research field is relatively new. Interaction is linked to the design of *dispositifs* prompting the user, but not defining in detail the space that will receive its action. We note more questions than answers:

- In what particular way future transformation and interaction with space are taken into consideration in the initial design phase?
- How do we deal with instable space identities?
- How do we represent and construct the "not yet defined in its details"?
- How do we define the constructability of intelligent evolving environments?
- What is the materiality of evolving supports of desire instead of predefined frames of needs (Antonino Saggio).



Technologies of interaction started to make their way into the field of architectural theory and practice[7]:

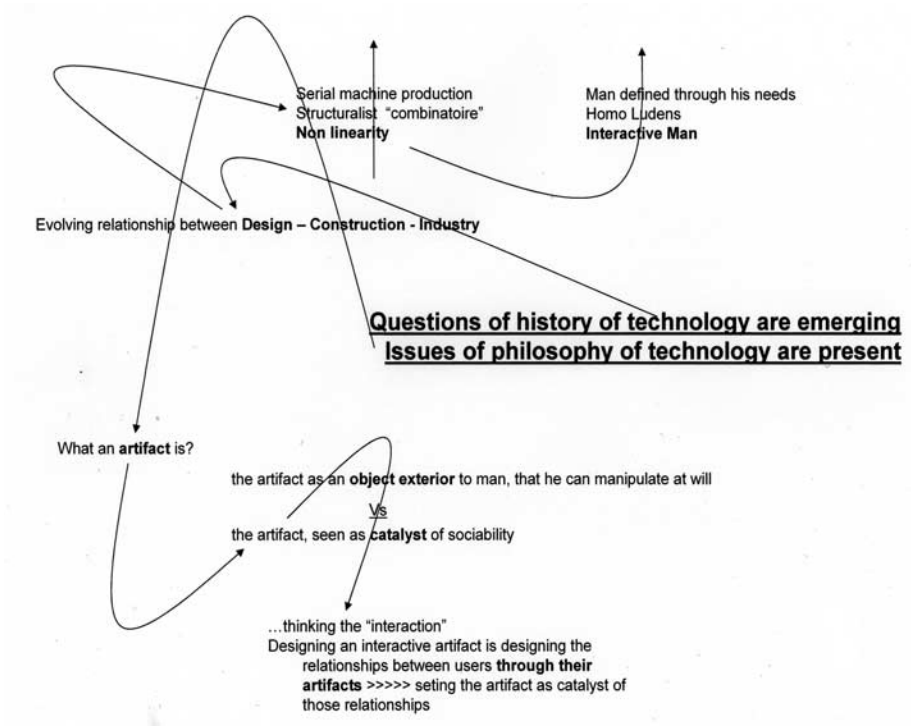
- Sensors detect action
- Tags identify actors
- Actuators close the loop
- Controls, displays, User Interfaces make it participatory
- Software models situations.
- Adaptive reassignment, growth and change are possible.

A need to elaborate location models or diagrams for their space distribution and integration is outlined. Interaction *dispositifs* are integrated into the physical – build space, forming *bridges between the physical and the digital*, giving birth to *Digital Territories*[8].

Questions on the history of technology are emerging

Thinking the DCC cannot escape a twofold reference to issues of history and philosophy of technology. First of all the DCC must think itself in terms of its past.

We need to count steps back from the present non-linearity of the digital DCC to the open industrialization's linguistic / structuralist *combinatoire* of the seventies and from that to the serial machine production dogma of the beginning of the last century. In parallel, we have to think, respectively, the correspondence of those steps with mental constructions as the *Interactive Man*, the *Homo Ludens* and the *Man defined through its Needs*.



Another step back is to the 19th century. In the Introduction of *Digital Tectonics*, Neil Leich, David Turnbull and Chris Williams are proposing the conceptual operationality of an old distinction between the Gothic and the Classical: "The Gothic is based primarily on understanding architecture in terms of materiality and structure, while the Classical is based primarily on understanding architecture in terms of visual composition. The Gothic is concerned more with process, the Classical more with representation"[9].

Furthermore, questions about a new relation to the "master builders" arouse: "The tradition of master builders did not survive the ...shifts of Renaissance... the theory was to provide the essence of architecture and not the practical knowledge of construction"[10]. "As architects shift their attention from drawing production to digital information authoring"[11] and as digital info authoring is directly related to the construction site, architects could regain a central position in this new close relation between architecture and construction, as "digital master builders". We must pay attention to the fact that the history of construction technology is closely related to the history of the profession of architects and in extension to the history of architectural theories. A French theoretical tradition dating from the '70s had already given strong conceptual basis to this matter. Reference must be made to the works of Jean Pierre Epron, especially because his thinking embraced open *industrialization*, a technological breakthrough of the '70 promising a *marriage* de raison between architecture and industry in a very closely way IT is promising now.

Issues of philosophy of technology are present

DCC cannot escape the questioning on its concepts, the evolving answers to the question "what an *artifact* is". The thinking of the artifact as an object exterior to man, that he can manipulate at will, as on object exterior to him, is a strong current in the philosophy of technology. But this conception of technology is a clear obstacle in the thinking of the transformable. On the contrary, the artifact, seen as catalyst of sociability, (in the direction of Latour, Serres, Levy) permits us to think the technology (and the materiality) of interactivity. as they prompt for interactions and frame virtualities for their evolution / transformation.

We need to let the artifacts "speak"[12], to be *quasi-objects* or *almost -subjects*[13], and possibly refer to the objectile - subjectile dichotomy in the works Bernard Cache. We must also let the artifacts tell us complex stories about the *real* (i.e. digital / smooth architecture based on concrete IT procedures, methods of fabrication, material production), the *discursive* (when artifacts take place in a discourse on fluidity and interaction) and the *social* (because changing relations between all participants in design – construction are at stake).

An artifact is then seen as a catalyst of relations that at the same time and with the same movement give it birth and transform it through time, a *catalyst of continuous interactions forming collectivities*. Those interactions could not be understood outside the materiality of the artifacts involved. That is, interaction design (in architecture) can not be seized outside the materiality of constructions involved.

As a conclusion, there is a triple path to follow for the incorporation of the new subject areas in the educational corpus of architecture:

a Mapping them with the help of a conceptual tool (may be DCC), including the initial design phase and extending it to the transformable and interaction design
b Make parallel and constant reference to the history of technology in general and the history construction in particular.
c Continuously elaborate an open constellation of concepts in action, related to philosophy of technology .

References

1 Neil Leach, David Turnbull, Chris Williams, *Digital Tectonics*, Willwy – Academy, 2004.
2 Branko Kolarevic ed., *Architecture in the Digital Age – Design and manufacturing*, Spon Press, 2003.
3 Various schematizations of the Design Construction Continuum operated since 2003 in the 9th semester course of the School of Architecture – NTUA "Information Management and Architecture" (http://www.ntua.gr/archtech/inman01/index.htm). They served to construct a common field of reference in order to position IT in relation to design and construction, seen as a whole.
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