

Changing Design Cognition

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ABSTRACT

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Building Information Modeling methodology is the current interest for many didactic programs around the world. May be the Master program can be an opportunity to understand the whole BIM concept in the AEC industry. In the Master BIM in Pisa, Italy we are teaching an approach that is not only “tech”. In the Building Information Modeling methodology, the digital representation receives a new strategic task in the world of construction: reducing the gap between the “*res aedificanda*” and its simulation via object-oriented graphics. Developing research on this way means to offer new powerful opportunities to re-think the link between “the fact” and “its representation”. There is a strong link between graphics approach and cognitive paradigms in design architecture. If the Building Information Modeling could be an answer for the actual needs of the world of AEC, digital design in BIM becomes the way to think the whole project “as one”. In the BIM graphics environment, the digital drawing changes the sign in ontology. To sum up, we are moving beyond vision to “experience” the design before it is built: we design the constructive ontology according to our experience of the “*fabbrica*”. Modeling the interaction means represent the process through the time.

Keywords : Design, Cognition, Architecture, Change, System

I. INTRODUCTION

Nowadays BIM is become, also in Europe, a “huge buzzword in AEC”; the digital representation receives a new strategic task in the world of construction: reducing the gap between the “*res aedificanda*” and its simulation. Developing research on this way means to offer new powerful opportunities to re-think the link between “the fact” and “its representation”. The

digital drawing, in the Building Information Modeling methodology, becomes a challenge to regain the meaning of design on architecture, in addition to evaluating its possible extension and transformations. To sum up, we could say that the value of the graphics in BIM design, is relevant to the procedural *iter* (methodological aspect), to the dynamic of knowledge (cognitive aspect) and to the concept (ontological aspect). Some pre-concepts could

block the education to this value in architecture: one is understanding the digital dimension just as a “tool” (therefore excluding it from direct relevance, prevent it to having real effects in architectural theory and practice). One other pre-concept 1making the contribution of digital design in the project to coincide with only the esthetic component of a specific type of building (these shapes are currently undergoing a lot of criticism). But, from always, the digital “resources” for design have always affected our ways of thinking and designers, studying design techniques, have also disclosed a unique view of reality and - at the same time - a "way of being" towards the meaning of design itself (Heinsen, 1995). From many years by now, the digital models evolve from being simple tools for the implementation of working methods to affecting the genesis of a potential transformation of the designing conception and practice. Nowadays there is a continuous transaction on digital graphics (ACM Siggraph, 2006).

II. METHODOLOGICAL VALUE

In our times, architectural design has become so complex that traditional ways of managing the process design are no longer sufficient. Design should be not merely a process, but a co-evolution of efforts and events in various places and times, both synchronous and asynchronous (Anders, Jabi, 2003). We know, instead, as the process design is fragmentary owing to the numerous “actors”, phases, environmental contexts, and cultural backgrounds. This leads to considering the Design as a set of isolated and sequential compartment. All this introduces an inefficiency of costs and/or timing, or leads to buildings that do not attain the required performances, and, locally, produces buildings that after some times are unliveable (Carrara G., Carrara, Fioravanti, 2001). If the BIM methodology could be an answer for the actual needs of the architectural design, the first step to overcome the complexity

becomes the way to think the opera “as one”: the whole opera and the whole environment where it is located (fig. 1).



Figure 1: The opera in the real environment simulation

The nature of the BIM concept could reshape the cognition of the constructed environment, overcoming the assumption that Architecture was always compared to the study of the inert, of everything “static”. On the one hand, digital devices allow us to expand our approach to a new dimension, on the other hand, we can affirm that the digital device in design goes in line and not against tradition.

III. THE ARCHITECTURAL DESIGN AS "VERIFIED CONCEPT"

Design has always played a key role: that of being a “verified conception”. In the past, a conception was implicitly verified as one designed and built to the professional standards that had been developed by tradition over the centuries (Gucci, 1998). Nowadays, the designing conception is verified (in “a priori” manner), before the building is erected through the modelling of its structural features, through an interactive process running across different disciplines and iterative between the time of the ideational expression and the time of its verification, based on a wide-ranging concept of digital modelling, (not just as pure geometrical modelling). How digital

cognition in BIM could assert and promote this way? The value of digital BIM is to be a logical-functional model of the future construction, that permits to obtain in an “unicum”, not only the possibility to study the different phases of construction, to simulate the thermo-physical properties, the cost, etc... but allows to generate everything in a combined manner. It is not just a procedural method change (to build directly a constructive object-oriented model from which documents: views, sections... are derived afterwards instead of the opposite), but a cognitive change: the design concept needs to be integrated since an early stage (Eastman, Teicholz, Sacks, Liston, 2011). In the fig. 2 a sample of a parametric dynamic micro-simulation used to verify the idea of an integrated design, before the beginning of the construction: architecture design, traffic flows and safety condition for people, in case of accident, are parts of an only one concept. (Materials, executive details, speeds, vehicles, visibility conditions, spaces and times are connected according to the constructive reality).



Figure 2: A parametric dynamic micro-simulation

IV. COGNITIVE AND ONTOLOGICAL VALUE IN BIM DESIGN

The digital design generates new cognitive spaces for the designer and “in” the designer (Saggio 2005; Mitchell, 1999). This change involves as much our conceptual and designing potentials as their implementation. The digital dimension affects the

way designers works through the generation of new mode to perceiving conceiving and imagining space and to relating to it - and “in it” - in a new way. The digital design turns a new “environment” accessible through a new graphic door, where it is born and grows a new concept of an unusual form of interaction between the designers (subject) and the design (object). In the BIM graphics environment, the digital drawing changes the sign in ontology. To sum up, we are moving beyond vision to “experience” the design before it is built. We design the constructive ontology according to our experience of the “fabrica”: a virtual aedificium. “BIM thinking” means to discover an interactive architecture (Fox, Kemp, 2009) and, also, to increase our designing abstraction skills about the whole process: understanding a kind of visualization of our mental space. The designer can improve, progressively, the nature of the designed object through an interaction on the parameters of the object. This dynamic was always believed in the arts and design history, i.e., regard the idea to overcome the concept of Renaissance Window towards a dynamic relationship between subject who observe and object that is observed (i.e., the design vision of the famous Brunelleschi, Alberti, Velázquez, Magritte, Picasso).

V. AN INTERACTION SYSTEM IN DESIGN

In the last two decades, a common conceptual base of Architectural vanguard experiences was the concept of environmental form: digital information (as a set of ever-moving, ever-changing data) becomes shape and vice-versa (thinking, i.e., about to the architecture “of immaterial”). The process-product in BIM often becomes the architecture “of relation”: it does not keep its distance from the onlooker (the actor of the process), it asks the onlooker to enter the design system. The BIM approach is a resource of the urban scale too, as in fig. 3:

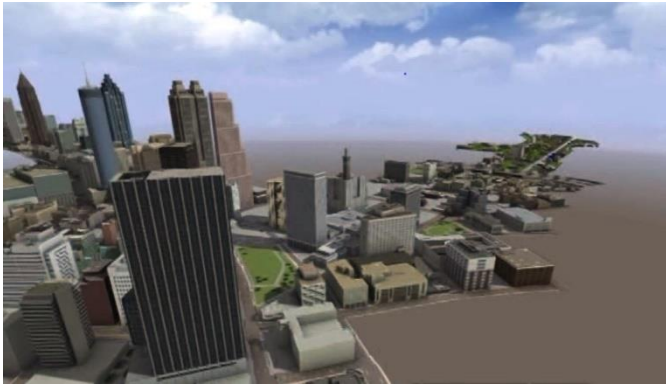


Figure 3: A urban scenario needs certain ontologies

it is necessary only change the “brick”, the object oriented, the ontological base we used to understand and to model the whole design scenario. The design becomes, before, a system of “artifacts” and, after an only one "artifact". This design cognition in BIM is no longer defined by the image it offers but also by the number and features of the services it supplies, its ability to change as quickly as possible, to be open to anything without contradictions. The design cognition in BIM becomes a whole system whose value is related to its ability to fulfil a given number of requirements. The scale of the representation can move in both directions: from the complex system, as the mega structure in fig. 4, where we can combine a GIS and BIM approach, to the single object, and vice versa from the single detail, at the



Figure 4: The city scale as an integrating system

single construction components scale in fig. 5, to the whole town. The graphic interaction reveals the

ontological one: connected as our age, parametric as our constructions (Woodbury, 2010).



We can design the object as we will build it and, in addition, as we will manage it: this is a deep cognitive change. Please note, that the Building Information Modelling cognition doesn't mean a standardization or a new industrial look for the architecture: it is only the current way to upgrade our idea of the link between what we design and what we build: this is the BIM core.

VI. CONCLUSION

Today, the debate on the relationship between “representation” and “fact” in Architecture is actual and totally open. Design in BIM means to simulate the connections of the real building, during the whole process: it means drawing cognition models through the time. The change of the cognition models is strongly related to the change of the paradigms of the Architecture and vice-versa. It is knowledge itself that is “represented” in the architectural object. Thinking i.e., to the digital animation, we could understand “the movement” as dynamic force, a creativity resource, not just as pictures sequence (Saggio, 2005). The design cognition in Building Information Modeling approach becomes a constructive verification. Renaissance Architecture (influenced by the “new science” of Perspective) has been transformed to be “perspectivable” itself. The

Architecture of national “Funzionalismo” - the international Modern Movement - has been transformed to be “industriable”: objective, separated, mechanical, not just standard-built (the axonometric representation was its announcement). Today, we can affirm, that the current digital design approach is transforming part of the architecture to be “digitable”. It is necessary time to understand the whole BIM approach and to use it: at the University of Pisa, (fig 6), the one-year international Master in BIM (it is online too) is become a real important opportunity for professionals and graduated students, coming worldwide, to learn and make real work experiences, using the new knowledges and tools; www.unibim.it. Today, in Europe,



Figure 6: The international BIM Master at the University of Pisa

BIM is mandatory for the public works and in more Countries the process is at the begins. The construction sector needs to understand and metabolize the news. Can we affirm that the digital cognition affects, dramatically, the actual theoretical phase of the architecture and the procedural phase of the world of construction? From a theoretical point of view, the digital cognition in BIM evolves between two opposite risks. The digital control can become an obstacle to designer imagination; and the digital power as Land of Utopia, idealizing the possibility to optimize the process. In the last decade, i.e., we well know how the digital shape of the building has

prevailed over its function, on the consistency of the constructive decisions. If the digital cognition in architecture has not reduced its message to pure form, now is necessary to not reduce it to pure efficiency. For the future, it is hoped that the discussion about graphics devices and design cognition for Architecture shouldn't be about its orthodoxies, what matters instead is its effectiveness. The challenge for the designed Architecture is to try to take hold of the new digital paradigm, BIM included, but without taking them - *tout court* - as "objective" parameter to assess the achievement of a new quality of built Architecture.

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