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Exploring Architectural Design Creativity

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Abstract

This paper is an overview of different approaches related to the study of design and Creativity in Architecture. Being wicked and ill defined, design problems led to over simplified models that could not deal with their increasing complexity. Many design models have been elaborated in order to deal with this complexity and to offer more creative possibilities. This study defines Architectural design as a dynamic and situated cognitive process of exploration and coherent treatment of information in order to generate a response to a problem. Architectural creativity is considered as a multidimensional process of reorganizing information and putting together models, following some specific rules that may have implicit the type of geometric patterns that emerges, in order to built solutions to a situation or a problem. This study is a theoretical background for future researches on the development of creative architectural design processes.

Keywords: Architectural design, Design process, Creativity

1. INTODUCTION

The literature related to the study of Creativity began with the theories of Greek philosophers, centered round Aristotle's concept of nature reinterpretation and Plato's mythological theory of divine illumination. In the middle of the 20th century, the study of Creativity became one of the main scientific themes for scientists and engineers with the aim of increasing human productivity. Their efforts lead to the emergence of two main tendencies in the study of human creativity. The first approached Creativity through the lens of efficiency, focusing on cognition and perceptual processes, the second tendency was more emotional and spiritual. This suggests a divergence between scientists in regard to the definition of Creativity. For some researchers, Creativity is considered as a science that could improve human performance. For others, Creativity is something holly and metaphysical.

This duality between objectivity and subjectivity is seen as the soul of creative works in Architecture and design (Mackinnon, 1962). Therefore, history shows that Architects neglected the different researches concerning creativity in Architecture that have been mainly a key concern for Psychologists (Allport (1954), Mackinnon (1962), Smith (1964), Hudson (1966)). The problem with the psychological strategies in the study of creativity is their focus on the Architect as a person rather than a creator (figure 1). This approach does not seem to offer a whole understanding of the role and meaning of creativity in architecture.

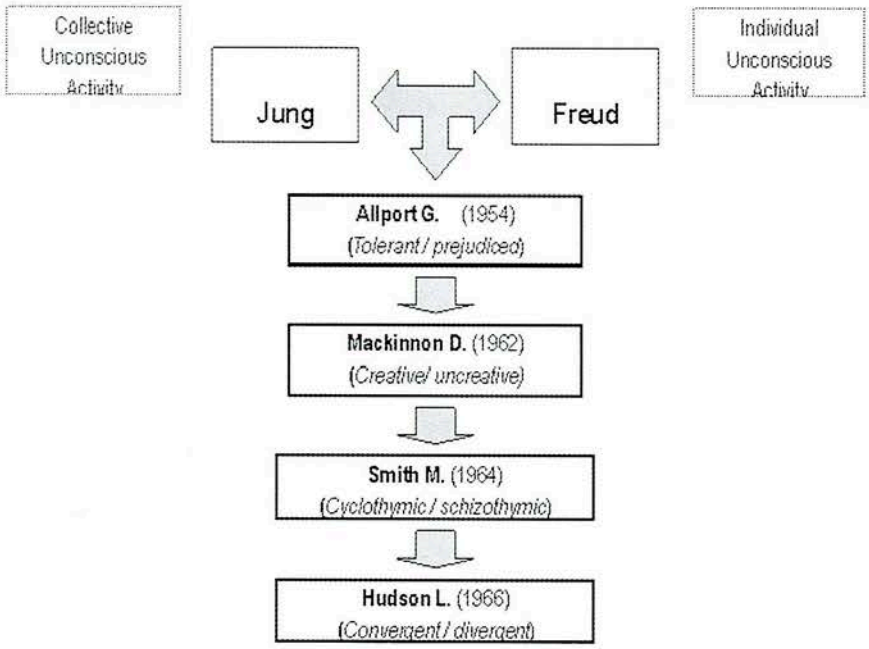

Figure 1. Modern psychology concepts of Creativity

2. ARCHITECTURAL CONTRIBUTIONS IN THE STUDY OF ARCHITECTURAL CREATIVITY

Since the 1950s, studies about Creativity did not deal with Architecture because Architects ignored the conferences on Creativity organized mainly by psychologists. According to Antoniades (1990), the reasons behind this ignorance were the language barrier between Architects and social scientists, the Architects preference for the ambiguity hiding their creativity and the split that exists between professionals and academicians in Architecture. Therefore, there exists an increasing interest in discovering the ways by which Architects design and generate creativity. Among the reasons behind this interest is the need to develop appropriate models and computational tools that may help in broadening the creative dimension and possibilities for Architectural designers. The history of studies on Architectural creativity shows that the exploration of the Creative dimension in Architectural Design has followed three main approaches (figure 2):

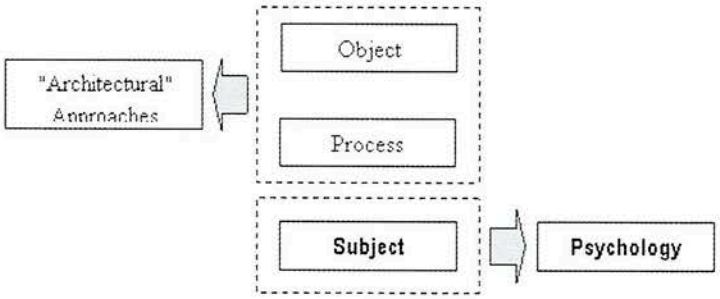

Figure 2. The different approaches related to the study of Architectural Creativity

2.1. Object-oriented approaches

Object-oriented approaches focus on the study of the design works as a product of a creative process. The idea behind these approaches is that the study of the design products may lead to the understanding of the processes that produced them.

2.2. Process-oriented approaches (Protocol Analysis)

In process-oriented approaches or protocol analysis (Akin (1993), Chan (1990), Eastman (1970), Purcell et al. (1994), Gero & Tang (2000), Goldschmidt (1991), Suwa & Tversky (1997)), the creative dimension is investigated by studying the architects in action as a more direct way to discover the nature of the processes they use. According to Dorst & Dijkhuis (1995), protocol analysis methods are divided into two categories; the process-oriented category that focuses on describing design processes in terms of a general taxonomy of problem solving (i. e. problem-states, operators, plans, goals, strategies), and the content-oriented category that aims to reveal the contents of what designers see, think of and retrieve from memory while designing.

2.3. Subject-oriented approaches

This category (Allport (1954), Mackinnon (1962), Smith (1964), Hudson (1966)) represents mainly psychological approaches based on the study of the personalities of the Architects in order to see what kind of people they are, which may help in exploring their ways of designing.

3. CRITICISM ATTRIBUTED TO THE DIFFERENT METHODOLOGIES RELATED TO ARCHITECTURAL CREATIVITY STUDIES

Object-oriented approaches:

- Designs that look similar might have been designed in quite different ways.
- Researchers might be misled while trying to deduce the process from the product (Broadbent, 1988).

Process-oriented approaches:

- The researchers presence might disturb the Architect while watching him in action.
- Some aspects of the design process might not be revealed.
- The human memory characteristics might influence the results (Gero, 2000).
- Some details might be missed.

Subject-oriented approaches:

- Study of the Architect as a person rather than as a creator (Freud).
- These approaches are subject to the conflicts between different factions in psychology.

4. STUDIES ON ACHITECTURAL DESIGN

The obsession of modern architecture by the "machine aesthetics" substituted the traditional "object aesthetics" values by a new "industrial aesthetics" system based on purity and simplicity. This emphatic change lead to an ignorance of history by architects and generated many ideological dead-ends. Since the

1960s, several theoretical and professional contributions have enriched Architectural theory as a response to these emerging problems.

4.1 The historic-critical approach (France, Italy)

In the historic-critical approach, history becomes an Architectural methodology by unifying historical and analytical approaches with design methods (Zevi (1964), Tafuri (1968)). In the same context, the approach of "Architecturology" (Boudon, 1971) tries to integrate history in an epistemological perspective, in which Architectural theory builds its own concepts (ex: Scale) in their historical processes.

4.2 The methodological approach (USA, UK)

This approach is focused on the design process rather than a historic-critical culture. Based upon cognitive-mathematical-technical methodologies, its premises began in the 1960s with the researches of Asimov (1962), Alexander (1964), Booker (1964), Reswick (1965), Jones (1966), Broadbent (1973) and Cross (1977). By reducing theoretical thinking to a positivist one (Adorno, Th.), the traditional intuitive design process was replaced by a rational, systematic and logic one. This approach considers design as a problem-solving process, which leads to the loss of the artistic connotations (where goals and standards are self-attributed) as well as the scientific ones (validating a formalized hypothesis). Another methodological impediment popped up, design problems in Architecture and planning are inherently ill defined and ill structured. They are wicked problems with non-definitive formulation that the system analysis approaches were too limited to handle (Reittel, 1967). Accordingly, the idea of the rational systematic design process has been abandoned and bipolarized into 02 tendencies:

- Black box theory (figure 3): a traditional, irrational and intuitive tendency.
- Glass box theory (figure 4): a rational and systematic tendency.

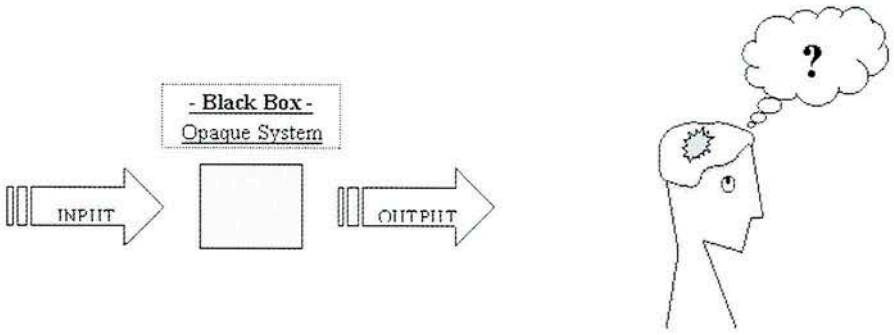

Figure 3. Opaque system of Black box theory (Jones)

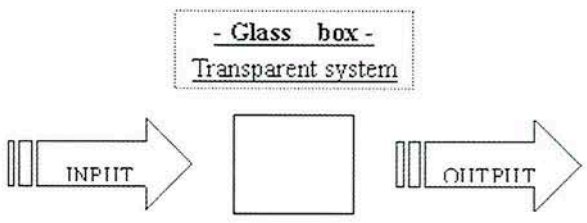

Figure 4. Transparent system of Glass box theory

Literature examination revealed a design taxonomy that seems to cover many important design models that evolved since the 1960s (Konda et al. (1991)). Konda's taxonomy covers different design models related to the methodological approach and proposes two main bodies of models. The first is the one of Design process models and the second is related to design models focusing on the artifact.

4.2.1 Design process models

Design process category includes engineering models, Architectural models, the hybrid model (Cross, 1989) and Warfield's generic design science.

The Engineering model

The Engineering prescriptive model considers design problems as similar to the ones in natural sciences. It describes the design process as a sequence of activities leading to intermediate results, proceeding from the abstract to the particular in order to keep the solution space as large as possible.

The Architectural model

In addition to the differences in knowledge domains, the differences between the engineering and the Architectural models dwell also in the nature of the respective problems, which are well defined in engineering and ill defined in Architecture. In the early 1970s, Hillier (1972) and Darke (1984) suggested that the prevailing Analysis-Synthesis model of Asimov (figure 5), in which problem analysis must precede solution synthesis, was based on a misunderstanding of the role of induction in science. Hillier proposed a conjecture-analysis model in which the designer develops a solution-conjecture that will be subjected to analysis and evaluation. According to Roozenburg & Cross (1989), the linear and sequential analysis-synthesis-evaluation model of Asimov, should be replaced by a model with a spiral structure that can emphasize a conjecture-analysis cycle, in which an understanding of both the design solution and problem are evolved in parallel.

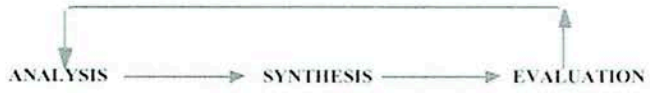

Figure 5. Asimov's (Analysis-Synthesis) linear model

The hybrid model (Cross, 1989)

This model seeks to be prescriptive as well as descriptive. It specifies a dependency at all levels of the design process, between problem definition and solution concepts as well as between identifying sub-problems and generating sub-solutions. The hybrid model postulates the necessity of building an overall solution by the generation, the combination, the evaluation and the choice of appropriate sub-solutions.

Warfield's generic design science

Warfield's approach to Design theory comes from a system theory perspective. It requires the existence of a general universal method for designing and argues for the necessity of a science of Design. Warfield's approach distinguishes between three kinds of design sciences. First, specific design sciences found in various disciplinary areas of study. Second, generic design science, which deals with matters common to all design activities but distinct from the specific design sciences, and finally general design science that integrates both.

4.2.2 Design Artifact models

Design Artifact theories are based on the premise that Design starts with a reasonably complete functional specification (General Design theory (Yoshikawa, 1987), Dasgupta's theory of plausible designs (1989)). Early Artificial Intelligence approaches attempted to reduce the Design methods into different kinds of search within problem-spaces. Later researches in this tradition allowed the infinity of the problem space by defining it according to a grammar rather than a fixed representation.

5. DEFINING ARCHITECTURAL DESIGN

Design can be defined as a highly organized mental process capable of manipulating many kinds of information, blending them all into a coherent set of ideas and finally generating some realization of those ideas (Lawson, 1980). For Luckman (1984), design process is the transformation of information (experiences, data, constraints, etc.) into available solutions. The difficulty of design formalization is due to its abductive and situated nature. Situatedeness makes the prediction of designing impossible, since the decisions to be taken depend in where the designer is at any particular time and how the designer perceives the situation to be when he is where he is. Gero's definition conceives Design as a goal-oriented, purposeful, constrained, decision-making, exploration and learning activity, which operates within a context that depends on the designer's perception of purposes, constraints and related contexts. These perceptions change as the designer explores the emerging relationships between putative designs and the context. The concept of exploration is related to the process of shifting between problem spaces within which decision-making occurs. The restructuration of the knowledge related to the design problems, constraints and contexts is involved by learning. Gero's definition categorizes design into three types (figure 6).

5.2. Routine design

Within a well-defined space of potential designs, Routine design follows a defined scheme that expresses the expectations of what will follow.

5.3. Innovative design

Innovative design proceeds outside the routine space, producing designs that have familiar structure but with new and different appearance.

5.4. Creative design

Creative design has the capacity to produce paradigm shifts. It involves the introduction of new variables, which perturb an existing scheme to produce unexpected and incongruous results by extending or moving the space of potential designs.

6. THE CREATIVE DIMENSION IN ARCHITECTURE

The Architectural creative dimension is often credited with 02 concepts. In one hand, the concept of synthesis, related to the knowledge by which the Architect may acquire information sprung from different disciplines (mathematics, physics, philosophy, etc.). In the other, the concept of continuity related to

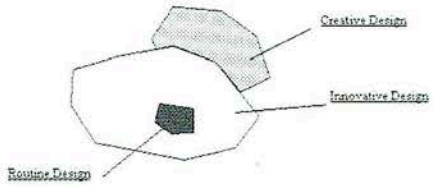

Figure 6. Routine, Innovative and Creative designs

the iteration and regeneration processes that take place during the design process. The examined literature revealed that the greater part of theoretical interpretations concerning Architectural Creativity tends to generalize, emphasizing on its extrinsic channels but informs us a little about its intrinsic nature (Füeg (1982), Broadbent (1988), Antoniades (1990)).

6.1. Füeg's pedagogical-professional model

Füeg's pedagogical-professional model defines Architectural Creativity as a behavioral, logical and gradual process through an active-minded way of thinking that depends on the Architect's checking, knowledge, experience and imagination

6.2. Broadbent's historical-Archaeological model

Broadbent's model, based on a historical-Archaeological study, proposes four channels of Creativity that were behind many creative Architectural works throughout history. These channels are the pragmatic, the typological (Iconic), the syntactic (canonical) and finally the analogical design, which seems to be the most creative way.

6.3. Antoniades's aesthetic-emotional model

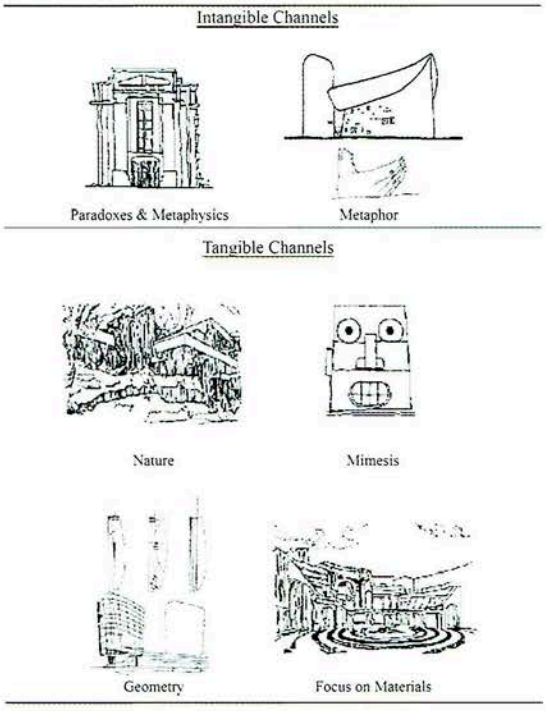

Figure 7. Antoniades's tangible and intangible channels of creativity in Architecture

Antoniades's aesthetic-emotional model describes Creativity as a state of total emergence of the cognitive mechanisms through which the designer should go during the design process. This model explored some tangible and intangible channels that were behind many creative works in Architecture, that's is to say: metaphor, focus on materials, nature, transformation, history, mimesis, metaphysics, etc. (figure 7).

In the 1990s, other models tried intrinsic explorations of the creative dimension in Architecture (Chan (1995), Gero (1996), Gero & Shi (1999)).

6.4. Chan's cognitive theory of style

Chan (1995) makes an operational definition of individual style in architectural design as being any distinctive mode of design that is repeatedly manipulated in the design process and thence generates certain common features across design works. The manifestation of a style results from the constant application of certain factors, which lead to the appearance of constant cognitive phenomena that, consequently, produce constant forms. Those factors include design constraints, search methods, goals and the sequential order of applying them.

6.5. Gero's model

Focused on Artificial Intelligence concepts, Gero's model of creativity (1996) is based upon an analogy with models of humor. Humor arises from the view of 02 or more inconsistent, unsuitable or incongruous parts or circumstances, considered as united in complex object or assemblage (Beattie, 1776). Gero suggests that Creativity is not simply concerned with the introduction of new features into a design, but this introduction should lead to an unexpected result in which schemas are perturbed by the introduction of new variables.

6.6. GERO-SHI model

According to Cross (1994), Diversity of design variation contributes to the Creativity of design. Based on this idea, Gero-Shi model introduces an analogy between diversity in biology and diversity in design by developing a model based on the principles behind the production of diversity in the biological world. In the sense of producing variation, design development becomes a process to explore the potential diversity under a defined theme. A design is considered as being composed of a number of components. If all these components are connected one by one according to mathematical expressions, the overall relations of the components in geometry, logic and attributes are expressed through iteration equations, which describe the development process of a complex system (Simon, 1996).

$$O_i = L_i^{Path} \times (P_{i,o}, A_i) = L_i^{Path} \times \left(P_{i,O}, \sum \alpha i\right)$$

Ai : Attribute of component " i ".

L_i^{Path} : Pathway is a logical (or geometric) connection from the top upstream component to the current component.

O_i : Component " i " of a design.

$P_{i,o}$: Base point of a component " i ".

$\sum \alpha_i$: Attribute of component " i " contributed by a large number of cells.

7. CONCLUSION

From nature reinterpretation (Aristotle) and divine illumination (Plato) to tangible and intangible channels (Antoniades, 1990), studies on creativity went through different definitions and interpretations and followed many strategies from object-oriented to subject-oriented. The Architects preference for their ambiguous Creativity, their indifference towards the study of their creative dimension and the split that existed between professionals and academicians in Architecture engendered researches that bypassed Architecture and offered incomplete input on the subject.

The linearity of some models (Helmholtz, Wallas (1921), Van Oech), the ideological divergence between many schools in psychology and the generalizing character of certain Architectural Creativity models (Füeg (1982), Broadbent (1988), Antoniades (1990)) do not reveal the complexity of creativity in architecture. Holland's theory suggests that the creative selection process that takes place in the Architect' mind, making him able to choose from a plethora of possible combinations, the one that beautifully gives a response to a problem, could be similar to the ones that take place in evolutionary biology, but in much accelerated time scale. Among the examined design approaches, GERO-SHI model introduces an analogy between diversity in biological systems and diversity in design, which contributes in improving the creative

possibilities, related to the design works (Cross, 1994).

Architectural design can be defined as a dynamic, complex, constrained, organized, contextual and situated cognitive process of exploration (exploring different dimensions) and coherent treatment and manipulation of information and models (building blocks) in order to generate a response to a situation or a problem. Creative insights in Architectural design might be revealed through the introduction of new variables that reconfigure or change some existent design schemes (or structures). This will lead to the emergence of new or unexpected design configurations. Architectural creativity can then be seen as a process of broadening design dimensions, reorganizing information and putting together models, following some specific rules that may have implicit the type of geometric patterns that emerges, in order to create solutions to a problem.

Exploring Architectural Creativity is an interesting experience related to the sphere of creation. Any approach related to this dimension might be problematic because of the delicateness of this concept. In this study, the concept of Emergence seems to have implicit many ingredients behind the creative insights in design. As a concept, Analogy is an important concept in architectural design, which have been studied since the earlier works of Architecture. Therefore, Mutation represents an unexplored dimension that hides many secrets of Creativity in Architectural design. This would be an interesting theme for future researches on Architectural Design Creativity.

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