# The Need for a Comprehensive Design Methodology: Epistemological Perspective

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**Abstract:**
This paper argues the expediency and need for a comprehensive design methodology to be introduced not only to the context of knowledge- based CAAD, but also to the contexts of design philosophy and theory of architectural Design. The ultimate purpose of the comprehensive design methodology is to produce design descriptions as large systems rather than to increase our understanding about how the design reasoning could be accomplished in a harmonic and orchestralizational whole through different levels of abstraction. Then , this study discusses such philosophic and theoretical foundations about the ambiguity of absolute design truth and relativity of design knowledge in order to recognize and extract the main features of the design knowledge . Furthermore, this study controverts the design theorization versus the design modelling aiming at looking for the most convenient intellectual human activity by which the comprehensive design methodology could be configured. Finally, An epistemological design approach is proposed and discussed through a proposed group of theoretical and philosophic hypotheses. Virtually, all the proposed philosophic and theoretical hypotheses, this study introduces and considers, could be become a subject of some contention. This is because, it is not possible to prove that they are correct. Consequently, they are assumed to be correct or at least " appropriate " enough for design context until they will be refuted by new future empirical evidences, or superseded by more consistent profound ones. They are just an admissible contribution to the design context.

## Introduction

Recently, several efforts and research work are introduced as new directions to both the context of knowledge- Based CAAD and the context of design theory and philosophy . The ultimate purpose is not only to increase the efficiency of the applicable design models and computer applications, but also to increase our understanding about how the design reasoning could be accomplished in a harmonic whole to generate a successful design product.

Virtually, most of this research work, if not all are configured and introduced as a collection of separated and independent attempts; A comprehensive framework is still an absent theory. Undoubtedly, we need – as architects and researchers – for a coherent conceptual framework to constitute, organize. And enhance this promised research work and put them in a comprehensive whole. Whereas the need for this conceptual body is not a subject of any contention, the mannar by which it is configured and based on is still a subject of some contention. Conceptually, this conceptual whole, we need, could be formulated

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in the form of " Design theorization " or " the methodological " design modelling " as different intellectual human activities. Then, the problem is what the most convenient intellectual human activity by which the design reasoning could be sufficiently manipulated to introduce the required conceptual framework?

For the last twenty years or so, there was a continuous effort from some researchers to answer this above question whereas most of their research works one still under consideration and investigation. The differences between the scientific methodology in the form of " theory " and the design methodology in the form of " Design model " had been argued by Gasparski, (W. Gosparski, 1981) . Jon Lang, call for design modelling through the role of the behavior sciences in Designing, ( Jon Lang , 1987) . The expediency and needing for design modelling had been also discussed by several researches, (Geoffrey Broadbent, 2000; George Rzevsk, 2000). Clive Dilont discusses both the design theorization and design modelling in view of the distinguishment between science and design, (Clive Dilont, 2000 ; Nigel cross , et al , 2000 ) . Garry Stevens calls for a design modelling to manipulate the design reasoning and process based upon the different aspects of the activity of designing which had been introduced by Bruce Allsopp, (Bruce Allsopp, 1984) .

This study argues the expediency and needing for a comprehensive design methodology, not only for the context of knowledge-Based CAAD but also for the contexts of design philosophy and theory of architecture. Ambiguity of absolute truth and relativity of knowledge is discussed so as to recognize and extract the nature and characteristics of design knowledge. Then, this paper controverts the design theorization versus the methodological design modelling aimed at looking for the most convenient intellectual human activity by which the design reasoning could be manipulated. Eventually, a proposed epistemological design approach is introduced in a form of a group of theoretical and philosophic foundations and hypotheses. Hence, the structure of this study is formulated in the following titles :

1- Ambiguity of absolute truth and Relativity of knowledge
   - 1-1 On the knowledge Acquisition Approaches: Historical Evidences.
   - 1-2 On the Position of Mind: Philosophic Evidences.

2-Design theorization versus Methodological Design Modelling.

3- A proposed Epistemological Design Approach.

**1- Ambiguity of Absolute Truth and Relativity of knowledge**

This section argues the ambiguity of design identification in view of the relativity of knowledge through two different approaches. The first approach is about the problem of knowledge acquisition in view of such historical evidences. The second approach is about the conceptual relationships between our minds and the cosmos we live in, through the sounded philosophic arguments.

History of human thought refers to the relativity of knowledge. A curiosity of the Italian Renaissance is the undistinguished contribution, it makes, to the history of thought. Platonism is reinvigorated, and scholarship breaks away from the petrified university environment, but there are no new philosophies, no intellectual waves, and no great leaps of the mind to stimulate and set human being looking at the world afresh. For a full century after the High Renaissance, Europeans still structure the world in an essentially medieval way, the worldview bequeathed by Aristotle. The individuals of the Renaissance have their hands more than full with the classical past. Therefore, much to recover and to think about. Antiquity fascinates them.

Only one thing foreshadows the future: the new criticality that the Renaissance brings to its encounter with a civilization dead a millennium. The Renaissance architects approach the ruins of antiquity with a critical eye, recording their observations with new and more effective methods, the better to emulate the greatness of the ancients (Ackerman, 1985) . A new attitude also is evident in learning: There is a widespread concern for self-education, for self-betterment. This, in fact, distinguishes the way people thought in the Renaissance from the Middle Ages.

This critical spirit is, however, restricted to the humanities and the arts. It is not until the last years of the sixteenth century that a few individuals bring their critical powers to bear on the venture started by the Ionians, the investigation of the physical world. The grand inquiry is resumed, and a whole way of looking at things is utterly overthrown and replaced by something completely different. The role of knowledge is changed. The scientific revolution changed the questions we asked, the way we explored them, the nature of the answers we gave , and the first principles which fascinated us for several hundreds of years . It redefined the connections of philosophy to other kinds of knowledge, the way in which authority could control knowledge, the sorts of knowledge regarded as socially desirable, the conceptual relationship of knowledge to human individuality and the relativity of knowledge . Three ideas are the foundation for this new outlook: that phenomena should be mathematically described, that nature can and should be manipulated, and that phenomena can be divided into whether they are knowledge objectivity or subjectivity.

The first of these ideas regarded by Galileo Gallilei (1564-1642). He reorients natural philosophy, as science is called in his time, and redefines its goals. Galileo rejects the prevailing Aristotelian conception of nature and natural inquiry. He is concerned to refute the Aristotelianism that had been petrified by the medieval universities, which did not start from sense experience but from Aristotle's own first principles. So weighty was Aristotle's authority that no one thought it possible that he might be incorrect or the viewpoints of the world could be interpreted through more than one face of truth. This attitude was further encouraged by Aristotle's belief that the basic or first or principles of any science were self- evident truths, or analytic statements. The classic edifice of absolute knowledge is demolished.

Euclid's geometry was complying with Aristotelian science, proceeding from self-evident axioms by logical means to complex theorems. Galileo does not entirely reject the need for absolute true first principles, but he takes issues with Aristotle's conception of the nature of scientific inquiry. Aristotle seems to have thought that it was natural inquirer's task to search for the correct definitions, the defining essences, of things. Motion was regarded as an accidental quality of objects. It is not possible to handle such a quality numerically, and so examine motion in more than a general mannar. Galileo abandons the study of qualities for the description of quantities. His moving bodies are mathematical bodies moving in a mathematical space. An important consequence of this is that science must work with simplifications of reality. Galileo sees that abstraction and generalization are important constructing scientific descriptions. If we always try to investigate the totality of a phenomenon, Galileo believes, we will never get anywhere. We must try to isolate the important parts and study them. Phenomena must be simplified or reduced to smaller, more comprehensible constituents.

Sir Francis (1561-1626) provides the second idea. His major charge against the Aristotelian is that Aristotelian methodology cannot, by itself, extract new information. He calls for a systematic program of experimentation to gain new knowledge of the world. He believes that knowledge acquisition is based mainly upon the experimentation approach. Bacon still has a problem with his own ascent up the arch of knowledge. He thinks that by accumulating masses of knowledge, one could climb a small part of the way up and set down a few general principles on which the theories are based. These could be used, together with more basic observations, to climb a little farther up, until one eventually reached the top of arch and a general theory of the world . It seems that Becon believes that general theories will simply emerge from the accumulated data. As it has turned out, no such program has ever been successful in the science. The science which most closely approximates Bacon's ideal , meteorology , has in spite of more than a century of data accumulation, failed to generate a grand theory, and still relies on brute simulations run on very large computers to produce more than very short-term predictions .

Bacon's importance lies in his call for an organized program of inquiry and the experintational approach to knowledge acquisition; It is the first attempt to observe the relationship between the experimentational experiences and knowledge. The most important thing he does is to change the attitude of people to the natural world. Logic and mathematics is not the only way to acquire knowledge.

Rene Descartes (1596-1650) calls for another different intellectual approach for knowledge acquisition. His preoccupation is with nothing less than the complete restructuring of all human knowledge. He is also contemptuous of medieval philosophy and Aristotelians. Bacon wants to start afresh by organizing a vast empirical program of research into the natural world. Descartes has a quite different idea. His aim is instead to construct a complete

deductive system that will explain all known facts and lead to new facts and knowledge, but not by starting with inquiry. Descartes dismisses Bacon's method because he says our senses are deceptive. No we must start right from the beginning, by doubting all received opinion, wisdom, first principles, and knowledge. Absolutely everything must be thrown out. He is saved from complete skepticism by the notion that we have some innate clear and distinct ideas, ideas that would not simply be silly to doubt, but the doubting of which would be logically self-contradictory. He believes, for example, that whatever else may be the case, there is something that can be known with absolute certainty: that he exists. He accepts the statement that " I think therefore I am " as one of rock –solid indubitability, an a priori statement. Descartes does not so much ascend the arch of knowledge as assume that he is already at the top. From his small beginning, he goes on through various means to erect a vast intellectual structure culminating with a proof of the existence of God. His method may claim to establish reliable knowledge about minds, and only likely knowledge about the material world. Descartes introduces an efficient intellectual approach on which knowledge acquisition is based.

Copernicus (1403-1543) believes that the plants revolved around the sun (the heliocentric hypothesis) – not the sun. Copernican theory was a direct attack on the earth centered (geocentric) basis of astrology and all the whole system of correspondences. The medieval worldview placed human beings and the universe existed for the world, and all the wonderful correspondences were for our benefit. If we were not especially privileged, then the foundation of the entire edifice was threatened. Virtually, the new astronomy and physics were not just theories of the world, they were profound threats to the entire social order and the illusion of the absolute truths of knowledge. The universe and knowledge are being changed at a time. Between Galileo and Bacon, around 1620, to the death of Newton in 1727, the new philosophy, as they called it, established itself as an enormously successful way of investigating the natural world, producing notable achievements in astronomy, mechanics, optics, natural history and chemistry. Many of its ideas established themselves in other areas , in law and religion, and spread throughout society .

A crucial difference between the classic system of thought and the new philosophy was not only that astrology and witchcraft linked natural phenomena to the moral concerns of humanity but also that the first principles of knowledge were utterly transcendent rather than static and absolute truths. Science denied any such connection. It destroyed the medieval intimacy between a person and the world. By defining science's domain as that area in which phenomena into the domain of unknowable. All the processes of the human mind were set aside as unfathomable, incapable of mathematization. Descarts' method of thought implied the same severe distinction between mind and the world. Thus science, and the world it described, had nothing at all to do with a person's moral nature – the world was morally neutral, value- free. The knowledge about the world is naturally relative according to the relativity of our cosmos not to the relativity of our thought . The relativity of cosmos is arisen from the natural continuous motion of any entity – physical or nonphysical – within the space.

**1.2. On the Position of Mind: Philosophic Evidences**

Kant (1724 – 1804), over throw the classic metaphysical edifice about what is the absolute truth, in view of the relationship between the mind with its abilities and the reality with its physical components. The classic philosophic approaches believe that our knowledge about the universe is naturally arranged and organized according to the reality with its conditions and components. By contrast, Kant believed that , the reality with its physical components and conditions are arranged and organized according to our mental reasoning and its abilities . This is because the perception of reality cannot be constituted without human mind as a substantial instrument. Virtually, the human mind sees the reality not as it exists but as a result of mapping between the essence of that reality as it exists, and the laws of mental reasoning. He did not deny the existence of the essence of reality without our mental perceptions but he confirmed that knowledge about the reality as it exists, is unfathomable, non-understandable and inconceivable one. Kant believed in the existence the absolute truth of essence of reality, but we cannot conceive it as it exists; we only conceive the reality as we see we do not recognize the essences or the absolute truth but we only recognize the aspects of reality. The laws of our mental reasoning, by which the reality could be perceived, are instinctive and idiosyncratic first principles. Then, the mental reasoning with its idiosyncratic first principles vouchsafes the reality –or aspect of reality – its meaning. He distinguished between the aspects of reality, as we see it, and the essence of reality as it exists. Then, absolute truth could be conceived in different interpretations. Each of which is just a different face for the absolute truth. This is because we are naturally different. Our different minds perceive different faces of the same truth. Hence, all the knowledge is relative rather than all the different faces could be complementary. Relativity of knowledge, especially in designing, should be admissible because all the different faces of a particular thing should be handled in complementary whole not in conflict one another. Kant believed in the relativity of knowledge as a result of relativity and differences of our minds.

John Dewy (1859 –1952) believes that there is no separation between the mind and relativity, they are manipulated on one operation. The human experience is a vital and developed human system to observe and manipulate the changing and developing of reality from situation to another. This is because the reality is naturally changing and developing. While Kant referred the relativity of knowledge to the differences of our minds, John Dewy believed that the relativity of knowledge is a result of the relativity and natural changing of the reality . Furthermore, human experience is a powerful tool to discover and observe the reality while the mind is a consistent tool to understand and explain the relationships within the reality . Thus, if we accept-with Kant-that there are some first principles by which our minds can conceive the reality, these principles are not idiosyncratic ones, but they are naturally constituted as results of human experiences. According to John Dewy, these first principles as a set of Meta-knowledge grows during the natural grow of any individual with his or her experiences. Achieving knowledge about the reality should be satisfied through a conscious system of human experiences, not only to observe

the changing of reality with its characteristics but also to build up our meta-knowledge about how we can conceive and understand the aspects of reality. Herbert spencier (1820 – 1903) had manipulated the relativity of knowledge through his prominent book " the First Principles ". He believed that the relativity of knowledge is just the essential resultants arising from that the knowledge is a relationship generated within the consciousness or feeling as a response to existing relationship within the physical context of our world. Then, the knowledge is about the relationships between the aspects or our mental symbols. Consequently the knowledge should be relative because of the relativity and continuous changing of the aspects.

Two conceptual problems could be arisen. **The first problem** is about the way by which the first principles are generated to be the foundations on which the generation of theories should be based. Euclid stars from a set of statements so obvious that no one could possibly dispute their truth, according his assumptions. He uses rules of inference to arrive at conclusions, which are then used to arrive at other conclusions. The " elements " consists of hundreds of these, which we call " theorems ". Since he was dealing with a technical subject, all Euclid's arguments use technical terms about his first principles. The presents 23 definitions of such things as point, line, circle and angle. After these, Euclid lays down the initial statements. These statements are defined and named as " axioms ": he called them " postulates " and " common notions ". The first group are meant to be purely geometrical axioms; the second group are supposed to have more general applications, Euclid chose the axioms as the first principles he did for two reasons. First he believed them to be self-evidently true. Anyone would assent to them. It was felt that the first principles were obvious properties of space that just had to be true. The second reason was quintessentially mathematical, and quintessentially Greek. A system with many axioms is not an aesthetically pleasing system.

The first principles, on which the theories are based, in order to be verified, are assumed as a group of absolute truths about the world without any verification. This is because they seem to be unverifiable; it is based greatly upon our simple experiences and intuitions. The first principles on which the theories are based are just a group of unverifiable assumptions based on our experiences. Euclid's geometric theories were based on his first principles that are accepted as scientific truths about the world. In fact, all the traditional first principles, Euclid proposed, on which the Euclid's geometry was based are completely not true when applying to the spherical surfaces or cylindrical surfaces. Them, the first principles are not absolute truths about the world,. The first principles describe such entities of knowledge about the world. The relativity of the first principles refers to the relativity of knowledge. The truth has several faces; each of which could be accepted within a particular context.

**The second problem** is in fact one of the most important result from the relativity of knowledge and truth. This problem is characterized in terms of falsifications, (Stevens, G., 1990) especially in science. The key to this description of science is the realization that theories can never be conclusively verified, but they can be conclusively falsified. Science does not prove

anything (Stevens, G., 1990). It cannot prove the earth is round, or prove that we orbit the son, or prove that the heat flows through a building in just such a way. It can marshal evidence; it can persuade, but it cannot prove. There is always the possibility we are wrong. Because it is always possible for our knowledge to turn some astonishing disconfirming instance to a theory, no theory can be taken as absolutely. On the other hand, but a single disconfirming instance will falsify a theory. The real way to test a theory is to go out and falsify it, to look for disconfirming instances. Form this follows an important consequence: Every theory must be falsifiable. A theory is falsified by discovering something that the theory says explicitly will not happen. A good theory must therefore make a prediction that we can test. If the prediction is successful, the theory lives until a disconfirming instance is discovered. If the prediction fails, the theory must be modified or abandoned. Falsificationism and changing of theories refers not only to the nature of science but also to the relativity of knowledge and truth. Any theory must be generated based on such first principles. These principles are supposed according to our experiences or our thought. Because of the limitation of both our experiences and our thought, our generalizations ( i.e. the first principles ) about the world are in fact incomplete; and should be related and restricted to a certain context . The relativity is not only a character of our senses, experiences and / or our thought themselves but also a character of the knowledge by which they are manipulated. Eventually, whether there is an absolute truth or not , our knowledge about the world seems relative in nature .

Virtually, Any fruitful human contribution should be introduced to deal sufficiently with the natural relativity of knowledge and to handle and manipulate the facts of knowledge through their complementary not for their contradiction. These facts therefore can conceptually constitute and make up a coherent system for the phenomenon under consideration- conforming to the reality. Theories are in fact one of the most useful human contributions to explain and control such phenomena whereas they are restricted themselves with their static and callous assumptions and principia. Theories are to totalitarian conceptual instruments; they accept only one face of truth. Hence, theories seem irrelevant to set up any comprehensive conception and the collision is always anticipated.

**2-Design Theorization versus Methodological Design Modelling:**

Theorization and methodological modelling are quite different intellectual human activities the design reasoning could be based and manipulated by one of them. Theorization is so restricted and callous not only in its intellectual structural methodologies (such as , rationalism, experimentalism , logic patterns , ... etc ) but also in its acceptable resources of knowledge and classification of facts about the world . Logic patterns of reasoning is the conceptual framework on which the theorization is based. Theories as results of the theorization activity describe and manipulate only one face of the relative truth . Consequently, they cannot agree with different facts about the same subject. On the other hand methodological modelling is so flexible that it can use all the sources of knowledge – whether rational or irrational. Models based on self- generation and experiences could play an essential role in design a

methodology, combination between subjectivity and objectivity seems more consistent and efficient in dealing with reality. This section discusses and proposes two different hypotheses aimed at looking for the more efficient intellectual human activity by which the design reasoning could be manipulated and understood.

The first hypothesis believes that theorization, as an intellectual human activity is irrelevant to manipulate architectural design activity. This is because there are five drawbacks when applying theorization to design activity: (1) concerning values; (2) methodological narrowness; (3) Quantification; (4) Abstraction; and (5) Completeness methodology. **First**, theory is in fact held to neglect the primacy of human issues and operates in a callous inhuman way avoiding any subjectivity and invoking such severe objectivity. Theory should be general and objective. By excluding values from the world, it ignores the most important qualities of that world; aiming at generalizing such conclusions from its observations. Further, theory is preoccupied with manipulation and control, of both nature and of humanity. Architectural design is in fact a Socio-cultural activity based greatly upon such values and traditions, nonphysical factors rather than unqalifiable issues that manipulate not only each other but also the final design product. The lack of theory to manipulate the humanity of design is obvious and critical. **Second**, theory limits itself to a narrow and stereotyped methodology, depriving itself of the creative powers that belong to a truly imaginative thought. This is because the theorization is based mainly on so rational methodology whereas the great leaps of the mind to generate the radial and bedazzle theories proved that they are not completely rational; how several great theories were introduced is based on such irrational ways of thought. Theorization cannot deal with the irrationalism even though its conceptual foundation is however irrational in character. Furthermore, The reductionism methodology of theorization is inadequate to the unified quality of nature, which is more than simply the sum of its parts.

**Third**, theorization is concerned only with generalities, and with the quantifiable issues . It is indifferent to the qualitative nuances that separate each individual from other . The narrow instrumental focus of theorization ignores many important aspects of reality that cannot be quantified. Since architectural design as a creative activity is based greatly on lot of imaginative thinking while theorization cannot quantify such creativity or imagination, the classic theorization, as a methodological human thought, is irrelevant to deal with the nature of architectural design. **Fourth**, theorization is not prepared to take reality as it finds it. It imposes certain arbitrary theoretical demands and standers on the infinite variety of the world, while a true humanism would accept each concrete situation in its entire individual variety and complexity. Hence, because theorization is very strict, ruling, callous, and severe, theories – as resultants – face always such disconfirming instances and Falsificationism is a natural character of the theorization activity. Any theory has a life and must be falsifible. A theory must therefore make a prediction that we can test, If the prediction is successful, the theory lives to fight another day. If the prediction fails, the theory must be changed or abandoned. Abstraction itself not irrelevant to deal with architectural design but the strict methodology of

abstractive reasoning is of course inappropriate to manipulate the unique design situation. **Fifth**, theorization as a human activity is a complete methodology in spite of the relativity of knowledge and human thought. The knowledge is alive. Theories are configured as a complete package; on changes; on modification, and no contentions. They deal with the knowledge as static entities. The world is alive and the knowledge is changed and grows. Theories are not dynamic enough to manipulate the natural growth of design knowledge- that is the experience as a powerful tool.

The second proposed hypothesis believe that the methodological modeling and paradigmatism, as dynamic intellectual human activities, are appropriate to deal with architectural design. Despite the lack of theorization to manipulate sufficiently the architectural design activity, methodological modelling can play an important part in design context. This is because methodological modelling is flexible reasoning and based on several resources of knowledge – not only on logic and mathematics as in the theorization activity. Design methodology as a result of the activity of methodological modelling should be formulated not only to increase our practical abilities in producing design descriptions but also to increase our understanding about how the design reasoning, as a mental phenomenon, could be accomplished in harmonic whole. Paradigm or methodology incorporates such assemblage of ideas, techniques, procedures and process... Etc. All the knowledge available constitutes an accepted conceptual framework for working in. It provides a set of guidelines, as to which techniques are considered to be, where the next advances might be made.
Also, it provides the architects how the design situation is manipulated and how he thinks about design reasoning. Some of this knowledge is picked up from textbooks that encapsulate the paradigm or methodology. Textbooks are of necessity conservative. The time lag in publication alone ensures that they cannot be aware of the cutting edge of research. More knowledge is acquired through contact with young architects (such as tutors and demonstrators) and old ones ( professors ) . Quite a lot of the knowledge that constitutes the design paradigm or methodology does not exist in written form and is passed down verbally from professor to tutors to student. In addition, design experiences are a very important resource of knowledge about not only design information and data but also (and mainly ) design process and techniques .

Virtually, design methodology or paradigm is naturally configured in an incomplete manner because of the growth of knowledge. It is very flexible to model the nonphysical design issues rather than the physical ones. Design methodologies should be based on such philosophic principles at the high levels of abstraction and such logic ones at the implementation levels of abstraction. The twofold character is so profound and powerful enough to accept all the faces of such a truth – whether they are seemed in conflict or not- on the philosophic levels, and to provide the designers with all the rediable resources of design knowledge -whether they are rational, such as logic patterns of reasoning or irrational, such as intuition and experience- on the implementation level. Consequently, as well as the rational basis and principles, methodologies could be based also upon irrational patterns to

acquire the knowledge required for problem – solving behavior. Then, methodologies could be based upon the case-based reasoning (as in Al techniques) in spite of the importance of generalizations.

Eventually, we need strongly for a comprehensive design methodology instead of theorizing the design reasoning in order to increase our abilities in generating design descriptions and to increase our understanding about the design activity. But on what ground this design methodology should be based?

**3- A proposed Epistemological Design Approach**

This section discusses a proposed epistemological design approach through three hypotheses. The aim is to identify the architectural design as a conceptual unique human activity. These conceptual hypotheses introduce such conceptual outlines and strategic framework for five essential topics: (1) The most relevant intellectual human activity by which the design could be handled, through the role of design experiences in design reasoning, (2) The ultimate purposes of architectural design activity, (3) The most convenient design knowledge tools in design reasoning, (4) The conceptual way by which the design knowledge tools could be implemented to generate an artifact, (5) The concept of creativity in architectural design.

Design methodology and philosophy of design methods are entangled in the two paradigms, which currently dominate design understanding – i. e. design as " Art "; design as " Science ". The failure to develop an internal theory of design understanding forced would be theorists to operate with these theoretical systems is inimical to design the philosophy of design method cannot develop on an adequate basis. Therefore design theorists must develop a new understanding of design not based on either paradigm.

Epistemologically, human activities such as science, art, technology, humanities, Architecture... etc, are identified and characterized through four conceptual attributes. The conceptual attributes that are adhered to any human activity could be characterized as:

1- A certain **" ultimate purpose "**
2- **" Final product "** which satisfies the ultimate purpose of the human activity.
3- Particular appropriate **" knowledge tools "** which are requires and used to generate the final product.
4- The **" way "** by which the knowledge tools are used.

For example, the ultimate purpose of the Art, as a human activity, could be characterized in terms of self-expression and / or social –expression. The final product is different from type of Art to another; it could be a piece of music in Music, an artistic statue in Sculpture, a wonderful picture in Photography, ... etc. The knowledge tools, the artists use, are the Aesthetics and Meta-logic. The ways, which map the knowledge tools of Art, are the intuition and inspiration. Knowledge tools and ways in Art are, in fact, subjective and individual.

Virtually, any human activity itself is not identified according to the type of its knowledge tools. The identification of any human activity is mainly defined and characterized through two issues:
1- The ultimate purpose of the human activity.
2- The way (s) by which the knowledge tools could be implemented.

For example, although technology and science have the same knowledge tools ( i.s. methodologies and formal logic patterns ) , they are naturally different in definition . The difference between technology and science arises mainly from the difference between not only the ultimate purpose of science and that of technology but also the difference between their conceptual ways by which the knowledge tools are used. While the purpose of science is to discover things within a particular context, the ultimate purpose of technology is to solve the real physical human problems in certain context, using basis of science. Therefore, product of science may be introduced as a " theory " hypothesis ".. etc , while product of technology should not be theoretical artifact but it must be " physical models " . Falsificationism is the main way of reasoning by which the knowledge tools are manipulated in science, to generate and enhance a new theory. On the other hand, paradigmatism is the way by which the knowledge tools of technology could be manipulated to generate the physical models.

By analogy, through a linguistic model, we can observe that some languages have the same linguistic vocabularies even though their grammatical structure is different. " Linguistic vocabularies " which constitute the " semantics in language " could be considered as a " tools of language " while the " grammatical structural rules " which constitute the " syntax in language " could be considered as " the way " by which the " tools of language " are implemented and manipulated aiming at producing such " meaningful sentences " . Then, it is obvious that the identification of any language is not determined and characterized according to its tools (i. e. the linguistic vocabularies or semantics) . In fact, the identification of any language is designated according to the way by which the tools of that language are implemented. In other words, identification of language is based greatly upon the grammatical structure and rules. For example, natural languages such as English, French, and Germany are partially similar in their linguistic vocabularies whereas they are different in definition. This is because they are different in their grammatical structure (the way) .

The above argument about how to identify and characterize a specific human activity through epistemological perspective could lead to three philosophic hypotheses about Architecture as a human activity.

The first hypothesis believes that even though the Architecture uses mainly the knowledge tools of Art ( i. e. Aesthetics and Meta- logic ) and the knowledge tools of science ( i. e. Methodologies and Formal logic patterns ) , the identification of Architecture and its features are not the sum of both Art's and science's features. Identification of Architecture cannot characterize as a combination between those of Art and Science. Architecture is a unique human

activity. Then features of Architecture are greatly different from any features of other human activities.

The second hypothesis believes that in architecture " the way " by which the knowledge tools are implemented should be in fact, different from the ways of science and those of Art. This is because of the natural difference between Architecture and any human activity. Consequently, the scientific techniques and artful techniques cannot constitute a comprehensive design methodology. Historical and epistemological evidences can be considered and discussed here.

Mathematics as a powerful knowledge tool was used in Architecture by three different ways of reasoning through the history of architecture, Table (1). The ancient architects, Greek and Roman architects, believed that every thing is arranged according to numbers and mathematics is the tool by which the cosmos is organized and arranged. Pythagorean, who flourished about 530 B.C, just before the classical Greek priod, is struck by the fact that phenomena that are at first glance quite diverse, exhibit deep similarities and analogies that can be expressed mathematically. He notices this metaphysical conception in the study of music. Pythagoras consequence of this mathematical beauty. He believes that mathematics somehow is the cause of beauty. Pythagoras is enraptured by this discovery, for he believes that he has discovered the key to understanding the universe, and about him develops a school that is as religious and mystical as it is mathematical. It is secret school, an exclusive brotherhood, for these are great mysteries. Pythagoreanism creates a spatial relationship between the real. World and the abstract world of mathematics. It opens the door not only to a mystical conception of the universe but also to such Analogic reasoning on which the theory of architecture was based by Alberti (1415-1490 ) , Palladio ( 1508-1580 ), ....etc. Hence, mathematics becomes an essential part of the Renaissance aesthetics and architecture.

Analogic Reasoning had been the " way " by which the mathematics was handled to generate and introduce the theory of proportioning systems and theory of harmony. Alberti makes his important statement that beauty in building is the integration of the proportion of its parts into a harmonious whole. And this harmony can be obtained in precisely the Sam way as musical harmony, through whole – number ration. Analogic reasoning as a way of thinking is in fact irrational one. It was based mainly upon not only the metaphoric thinking but also the accumulation of knowledge about what is architecture, what is aesthetics, and how to generate a beautiful artifact. This accumulation of design knowledge, apart from its assessment constitutes the first principles on which the architecture of certain age could be based. This assemblage of ideas and methodologies constitutes a " paradigm " as an accepted framework for working in. It provides a set of guidelines as to which technique work and which do not, what the great problems are considered to be, where the next advances might be made. Some of this " design knowledge " is picked up from textbooks that encapsulate the paradigm. More knowledge is acquired through contact with young and master. Quite a lot of design knowledge that constitutes the paradigms does not exist in written form and is passed down verbally from the old craftsman, through pupilage systems.

| | Greek, Roman, Renaissance Architecture | Egyptian Architecture | Scientific Approach 20 Th. Architecture |
|---|---|---|---|
| **Conceptual Purposes** | Esthetical purposes | Noncorporeal and metaphysical purposes | Scientific purposes |
| | Symbolic / Analogic Expressionism | | Logical Analysis |
| **The Aim** | To generate a beautiful artifact | To express the secrets and noncorporeal knowledge. | To generate an efficient design descriptions. |
| **The Way** | Musical Analogy | Personal Analogy | Analytic Reasoning |
| **Instrument** | Theory of Proportioning systems & Theory of Harmony. | Personal, noncorporeal Proportioning systems. | Optimization & Simulation Computer- aided design models. |
| **Rationality** | Non rational | Non rational | Rational |

*Table (1): Even though the mathematics, as a powerful knowledge tool, was used in architecture, the ways by which the mathematics was implemented were different from time to another. Each way of reasoning had produced a particular design paradigm with concrete ultimate purposes in a conceptual accepted framework for working in, as first design principles, reflecting the relativity of design truth.*

Design knowledge is accumulated, learned, enhanced and generated through the human experiences. Obviously, theories of Renaissance Architecture had been developed and enhanced from Vitruvius to the other pioneers step by step at a time.

Also, Egyptian architecture used the mathematics not only for esthetical purposes but also for noncorporeal and metaphysical purposes. While the Renaissance architecture uses the " musical analogic reasoning " as a way by which the mathematics is handled, Egyptian architecture uses the " personal analogic reasoning " as a different way by which the mathematics is handled too. Renaissance Architecture and Egyptian Architecture could be considered as the great golden ages of architecture. Their building are still alive through thousands of years to tell us more and more about these ancient societies and their cultures and sciences.

On the other hand, at 1960s, the architects of the traditional scientific approach believed that architecture is scientific activity and it is substantial that scientific knowledge tools such as mathematics should not only be applied to designing but also the scientific ways of reasoning should dominate all the design process. The aim was to generate an efficient design product. The architects had use the mathematics by ways of reasoning based on methodologies and patterns of logic. Evan though this ways of scientific reasoning is more rational than those the ancient architects were used, this approach-i.e. The traditional scientific approach- could not generate any applicable design description,

(Zaki, M., 1992 a 1992b) . In fact both the ancient architects and recent ones use the same knowledge tool – i. e. the mathematics – to mack up a comprehensive theory in architecture, the ancient architects succeed in configuring a comprehensive theory while the failure of the architects of traditional scientific approach in contriving a coherent design theory or in producing any applicable design description becomes not the subject of any contention. This is because architecture is different from science. Scientific methodologies and logic patterns of reasoning as a way of thinking with such knowledge tools proved that they are irrelevant in design reasoning as an only way ; whereas scientific knowledge tools could be considered as a powerful efficient tools by which the design reasoning is manipulated .

Design knowledge incorporates all the experiential rules (whether subjective or objective) required not only for building comprehensive design methodology but also for accomplishing all the design activities in harmonic whole. Experiential rules of design knowledge should characterize, organize and identify the design reasoning at different levels of abstraction, and finally the appropriate organization of design knowledge in logic structure.

**Creativity** in the context of design knowledge could be easy characterized. Creativity, as an activity of reorganizing the first principles and vocabularies to generate a unique complete whole, could refer to not only the originality of the final design product but also may be satisfied by :

1- Applying and using a unique design strategy or design process during design implementation ;
2- Accomplishing and performing the design tasks and design systems through a new original conceptual method of thinking and controlling.
3- Generating a Rechness of design interpretations by appropriate design systems.
4- Avoiding the strict design strategies and repetition of particular design processes for different design problems; each design problem should be handled by particular unique design strategy.
5- Using such design knowledge defined at different levels of abstraction with high degree of flexibility.

A proposed conceptual model for the activity of architectural design could be now extracted from the previous analytic argument and hypotheses, table (2). The ultimate purpose is not only to generate a successful design product, but also to increase our understanding about the design reasoning as a complex human activity. The final product is a design description in physical form with non-physical interpretations. The proposed model opens the door to use any knowledge tools, whether subjective or objective, rational or non rational so as to represent, model, and manipulate the design experiences in the form of experimental rules and design facts. The way by which the design knowledge tools could be implemented should be based on the modelling of the design experiences. Knowledge – based design methodology could be the consistent intellectual instrument in dealing with the design activity as a unique activity.

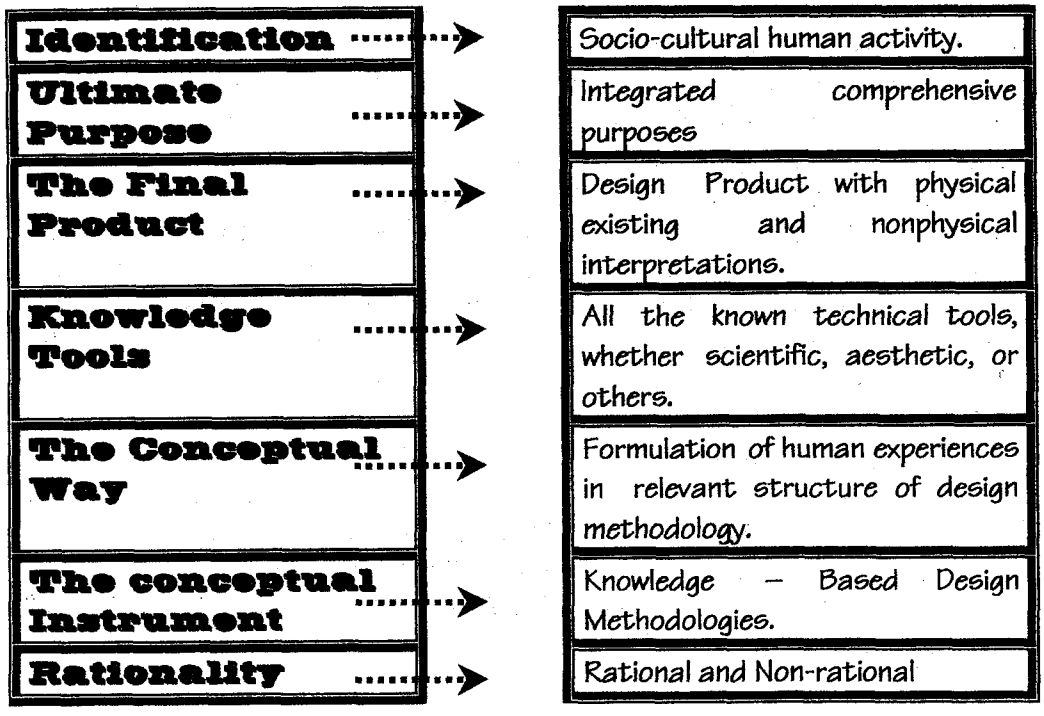


***Table (2): A proposed Conceptual Model for the Activity of Architectural Design.***

Third philosophic hypothesis could be now titled in the following statements:

1- One of the most efficient approaches to architectural design can be introduced through the theory of knowledge. (Gero, 1990). Architectural design, as a conscious accumulation of knowledge from Vitruvius uptil now, is a cognitive purposeful activity heavily reliant on the growth of human experiences rather than the organization and manipulation of knowledge.

2- " **Experience** " incorporates the patterns of design knowledge required for design reasoning. Design knowledge should be, therefore, configured as an experiential Rules, Laws and formulas, pertaining to the behavior f people , materials , objects and spaces . Knowledge can be axiomatic in character, such that it can be stated in unequivocal terms . It may be causal in character. Design knowledge could begin with naïve statements as hypotheses and they are enhanced through several operational design experiences. The knowledge could be improved from specific to more general formulation and to degree of certainty could also be increased at a time. This opens the door for learning procedures. The knowledge with which we are concerned in design may also apply to different abstractions of the design process and to different abstractions of design description. There are different control levels in design. There is also knowledge about appropriate actions to perform in producing configurations, and knowledge about tasks, activities and strategies. Knowledge about how to control, manipulate and organize the design knowledge is substantial for design reasoning.

3- In architecture, as a unique human activity, " the way " by which the knowledge tools are manipulated can be based on the " Experiential Reasoning, " ( the formulation of human experiences in consistent structure of design methodology ) . Experiential Reasoning is rational in term of knowledge organization through logical patterns and irrational –i.e. intuitive – in term of knowledge manipulation through creative and causal patterns of design strategies and processes.

4- " **The knowledge – based design methodology** " is still an absent issue in architectural design researchwork whereas it seems very efficient not only to increase our understanding about design reasoning but also to increase the efficiency of our abilities in dealing with the different design situations and problems. Knowledge – based design methodology is increasingly needed in architectural design context. Knowledge – based design methodology is not to mimic human beings to use it in ways that are intuitively appealing. This study attempts to demonstrate that knowledge – based view of design is more appealing to human designers than was evident with the design methods and traditional scientific view of design. Hence, certain tasks that are difficult to model mathematically can be accomplished more feasible through the knowledge – based design systems. It opens the door to use efficiently the fruitful applications of expert design systems and artificial intelligent models in architectural design reasoning.

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# الحاجة إلى منهجية تصميمية شاملة: منظور معرفي


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**ملخص**: تبحث هذه الدراسة و تناقش مدى الحاجة إلى وضع منهجيات تصميمية شاملة و تقديمها للعديد من مجالات البحث و التنظير في العمارة و بخاصة في مجال استخدام الحاسب الآلي و أنظمة الذكاء الاصطناعي في التصميم المعماري فضلاً عن نظريات التصميم المعماري. يتمثل الهدف الجوهري في كون هذه المنهجيات لا تتعامل فقط مع العملية التصميمية من وجهة نظر متكاملة و شاملة و لكن أيضاً يمكن لها أن تلعب دوراً بارزاً في زيادة قدرتنا كباحثين و منظرين على فهم آلية العملية التصميمية كما تتم بالفعل و ليس كما يجب أن تتم من وجهة نظر العديد من المتحذلقين. إن المزيد من تفهم آلية العملية التصميمية التي تتم على مستويات متعددة من التجريد العقلي و في إطار من الترابط و التكامل و التوافق الرائع يلعب ذلك دوراً حيوياً و مباشراً في قدرتنا على تطوير أدائنا -كممارسين و مصممين - فضلاً عن قدرتنا - كباحثين - على صياغة نظم منطورة و ذكية يمكن لها أن تلعب دوراً واقعياً و مؤثراً في عملية التصميم المعماري ذاتها لتحقيق أعلى مستوى من الكفاءة التصميمية المتاحة.


تناقش هذه الدراسة بعضاً من الأسس النظرية و الفلسفية التي تتناول مفهوم غموض فكرة الحقيقة المطلقة فضلاً عن الرؤية الواقعية لنسبية الحقائق بهدف استنباط أهم سمات المعرفة التصميمية بمكوناتها المتعددة. ثم تقدم هذه الدراسة رؤية تحليلية و نقدية لإشكالية البحث عن منهج شامل للفكر التصميمي في مقارنة بين التنظير في العمارة كمنهج متماسك و مقبول و موضوعي و بين النمذجة المنهجية كمنهج بديل أكثر مرونة و واقعية و يتم ذلك من خلال طرح العديد من الفرضيات و مناقشتها و تحليلها. و في النهاية تقدم هذه الدراسة مجموعة من الخطوط العريضة و الفرضيات النظرية التي يمكن أن تساهم في صياغة ما يمكن أن نطلق عليه مدخل تصميمي معرفي يرتكز على مفاهيم النمذجة المنهجية في إطار فكري ملائم.

و الواقع أن مجموعة الأطروحات و الرؤى التي تقدمها و تقترحها هذه الدراسة لا يمكن البرهنة على مدى صحتها بصورة مطلقة نظراً لطبيعة الإشكالية المطروحة إلا أنها تظل مجرد رؤى لها قدراً من القبول و لو على المستوى النظري و الفلسفي إلى أن يتم تطويرها أو إثبات عدم جدواها في المستقبل.