RECONSIDERING ARCHITECTURAL PROGRAM WITHIN THE FRAMEWORK OF CONJECTURES AND REFUTATIONS: THE DESIGN STUDIES JOURNAL

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ABSTRACT

RECONSIDERING ARCHITECTURAL PROGRAM WITHIN THE FRAMEWORK OF CONJECTURES AND REFUTATIONS: THE DESIGN STUDIES JOURNAL

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The discussion of *program* in the field of history and theory of the *Modern Movement* in architecture enters a new period in the 1960s and 70s under the influence of the strong embodiment of science and technology in the field of *design research*. Beginning with this period, the idea of program arises both in a series of generations parallel to a specialized, sophisticated understanding of design and as an autonomous professional area of study. While the concept was being largely developed under the influence of a *scientistic*, *positivist* epistemological framework called *analysis-synthesis*, since the mid-1960s, it had also become the focus of a parallel research campaign for a Popperian counter-framework: *conjectures-refutations*. As an alternative to analysis-synthesis, the conjectures-refutations framework addresses a series of issues and yields to new principles results in a reconceptualization of program. The primary aim of the thesis is to define a historical and theoretical background to this framework by tracing the program focused line of thoughts in the design research field particularly through the journal *Design Studies* (*DS*). Secondly, the thesis aims to set out a structured critical look and identify the weaknesses created by the scientistic, *program-based* approaches sourced from analysis-synthesis. Finally, it seeks to provide foundations of a novel, *conjectural* understanding of *program* at the more open, flexible, falsifiable, and creative level.

Keywords: architectural program, design research, conjectural program, *Design Studies*

ÖZ

MİMARİ PROGRAMI VARSAYIMLAR VE YANLIŞLAMALAR ÇERÇEVESİNDE YENİDEN ELE ALMAK: DESIGN STUDIES DERGİSİ

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Mimarlık alanındaki *Modern Hareket*'in tarih ve teorisinde önemli yeri olan *program* tartışması, 1960 ve 70'li yıllardan itibaren bilim ve teknolojinin *tasarım araştırmaları* alanında güçlü bir şekilde yer almasının etkisiyle yeni bir aşamaya girer. Bu aşamayla birlikte program düşüncesi, hem tasarımın sofistike bir çerçevede, bir jenerasyonlar serisi olarak gelişimi algısına parallel hem de, otonom ve profesyonel bir uygulama alanı olarak karşımıza çıkar. İki durumda da *analiz-sentez* diye adlandırabileceğimiz *bilimci, pozitivist* bir epistemolojik çerçevenin etkisinde olduğunu gördüğümüz kavram, 1960'ların ortalarından itibaren bu anlayışın paralelinde tartışmaya açılan *varsayımlar-yanlışlamalar* olarak nitelendirilebilecek Popperyen *post-positivist* bir karşı-çerçevenin odağı olur. Analiz-sentezin alternatifi olarak varsayımlar-yanlışlamalar çerçevesi, bir seri problem alanı tarif eder ve programın yeniden kavramsallaştırılması sonucunu içeren yeni prensipler ortaya koyar. Bu tezin öncelikli amacı çeşitli katmanlarda, farklı çalışmaların bir araya gelmesiyle oluşan bu söylemi görünür hale getirebilmek için *Design Studies* (*DS*) dergisi üzerinden tasarım araştırmaları alanında program odaklı tasarım geleneğinin izini sürmemize olanak verecek bir kuramsal çerçeve tanımlama çabasıdır. Tez ikinci olarak, yapısal bir eleştirel bakış ortaya koyarak, analiz-sentezi model alan, bilimci, *program-temelli* tasarım yaklaşımların zayıflıklarını tespit etmeyi amaçlar. Son olarak da, *varsayımlı programlama* olarak nitelendirilebilecek

daha açık, esnek, yanlışlanabilir, ve yaratıcı bir düzeyde kurgulanan yeni bir program anlayışının altyapısını kurmayı amaçlar.

Anahtar Kelimeler: mimari program, tasarım araştırmaları, varsayımlı program, *Design Studies*.

To Metin Özten

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I dedicate this work to the memory of my father, Metin Özten.

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INTRODUCTION

First, the taking in of scattered particulars under one Idea, so that everyone understands what is being talked about…Second, the separation of the Idea into parts, by dividing it at the joints, as the nature directs, not breaking any limb in half as a bad carver might.
—Plato, 265D

It is not hard to see why the analysis-synthesis, or inductive, notion of design was popular with theorisers and even with designers as a rationalisation of their own activities. The architectural version of the liberal-rational tradition was that designs should be derived from an analysis of the requirements of the users, rather than from the designer's preconceptions. It is directly analogous to the popularity of induction with scientists who were anxious to distinguish their theories as being derived facts in the real world.
—Hillier, 1972

It is not an accident that Christopher Alexander begins his *Notes on the Synthesis of Form* (1964) with an epigraph taken from Plato’s *Phaedrus* in which it is assumed that speaking (and thinking) is possible through *systematization* of knowledge. Systematization there implies that the clarity and consistency in thought comes from the conception of a dialectical relation between division and collection of wholes and parts. As pointed out by Greg Bamford, under the title of *scientific method,* such an understanding has become the main paradigm for science since the scientific revolution of the 17th century (Bamford 2002). From the 1960s onwards as a result of the great disappointment of the *Modern Movement* in architecture and design problems’ “insoluble levels of complexity” which triggers the need for rationality, it has become the main paradigm for design too. In architecture (as in other fields), the method works on the assumptions that “an act of analysis will automatically result in an act of synthesis” (Rowe 1996, 8) and that “physical clarity cannot be achieved in a form until there is first some programmatic clarity in the designer's mind and actions" (Alexander 1967, 15). By drawing attention to "functional origins," Alexander's drew attention to "the idea that every design problem begins with an effort to achieve fitness between two entities: the form in question and its context." This implied that "the form is the solution to the problem; the context defines the problem" (Alexander 1967, 15). Similarly, the scientific method heads designers towards familiar shores this time more alluringly than before.[1]

There are numbers of reasons why –after the defeat of the functionalist project of the *Modern Movement*– the analysis-synthesis model once more started to dominate architectural discourses. Firstly, at the beginning of 1960s, computers had become more practical and personal as opposed to their earlier forms –i.e. desk calculators, punched-card equipments, and analog computers. Secondly, computers had reached enormous storage and computation capacity and started to implement processing of exceedingly complex data of design problems which are too complex for human designers to process.[2] The most dramatic results of the advancement of technologies of analysis-synthesis in the 1960s seem to result in architecture's profound alienation from its own past. Such analytical computational processes in design are based on a clear-cut rejection of the so-called "traditional"[3] design methods and of the architectural design culture.[4]

1 Although it is new for some younger design fields, analysis-synthesis is a familiar paradigm for architecture since the 17th century. Even if one does not take into consideration the earliest rationalist precedents, he/she can easily find them in the early modern architectural discourses (Modern Movement). As a result of this second wave of rationalist studies, analysis-synthesis has entered the modern architectural jargon under the influence of Louis Sullivan's motto "form (ever) follows function." His study is also one of the earliest references to an evolutionary model in the field of design. (L. Sullivan 1896)
2. (Aspray 1990)
3 Under the analysis-synthesis paradigm both the Design Methods and neo-functionalist British frameworks have called themselves revolutionary, but it seems that they are rather reactionary to the inconvenient results of some of the modern architecture's experimentalist attitudes towards large-scale urban proposals. In that context, being the opponent of the traditional design tools and methods was one of the main arguments in the pioneering sources

The alienation has two sources. After the failure of the functionalist project, aspirations to base architectural design on the paradigm of analysis-synthesis surfaced strongly in the *Design Methods* movement and the British neo-functionalist discourse.[5] Although both approaches aim to rationalize the design process and seek to externalize design knowledge, the first one's emphasis is on the necessity of a wider interdisciplinary framework including the translation of techniques from Operational Research (OR) into design (Broadbent 1969, 9); on the other hand, the second one's emphasis is on the clarification and reconsideration of the phenomena of "modern architecture" (Summerson 1957, 227). Therefore while the first one is mainly pioneered by interdisciplinary figures such as Horst Rittel (urban planner,) J. Christopher Jones (industrial designer and ergonomist,) Christopher Alexander (mathematician and architect,) Bruce Archer (engineering designer,) Geoffrey Broadbent (architect), the second one is initiated mostly by a narrower group of British architectural historians such as John Summerson and Reyner Banham[6].

The two approaches provide the main historical and conceptual framework for the paradigm *analysis-synthesis* and the subject *architectural program* just before the launch of the *Design Studies*[7] (*DS*) [8] journal in 1979 in Britain.

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of the Design Methods. See for example Chapter III in Chris Jones' Design Methods (1970,) or "Introduction" part of the Notes on the Synthesis of Form of Christopher Alexander (1964).

4 According to the main sources of the period, the phenomena that we called Modern Architecture is erroneous mainly due to lack of a rational, systematic approach; it is not aware of quantity, complexity and difficulty inherent in the contemporary design problems; it is grounded on the limited capacity of individual designer in calculation of design problems (Alexander1,11); it is "irresponsive" in handling of design problems (Broadbent, 1973, vii); it is isolated, and therefore suffers from the lack of some vital features such as interdisciplinarity and participation (Jones, 1964,xviii).

5 Here neo-functionalism is used to express a self-critical attitude that started around the late 1950s in modern architectural history and theory in Britain.

6 At some point, Banham's mechanical engineering education bring him closer to a more interdisciplinary approach by means of architects' use of alien methods and technology.

7 The term "design studies" refers to both an academic discipline addressing complexity of the design as an activity, and the title of the journal founded in the Britain in 1979.

8 From now on, the title of the *Design Studies* Journal will be abbreviated as *DS*.

As one of the first and prestigious periodicals of the design research field[9], *DS* provides an intriguing historical perspective on contemporary debates about the nature and role of architectural program. It is also a unique framework for studying the effects of the counter-paradigm: *conjecture-analysis*.

1.1 Scope , Objectives and The Research

The main theme of the present thesis is the *architectural program*. The thesis examines the process entailed in the *rational*, or *revolutionary* as deemed from within design literature that focuses on particular design *paradigms* that emerged in 1960s and have been evolving since. For doing this, the main departure point is the assumption that architectural program has an evolving conceptualization and an important place in the design models formulated in these paradigms. The thesis examines the consequent changes in their (re)conceptualization and (re)formulation of the program with reference to the evolution of the mentioned paradigms and accompanying changes in their conceptualization and formulation of the design process. It proposes that the evolution of program has three main stages:

The examined design model of the first stage is that of the *Design Methods Movement.* It dates back to early 1960s, and it is based on a model, which is taken from science, and called *inductivism* or *scientific method* as it was conceptualized at that time. Opposed to the *traditional conception of design*, design process is thought as a transparent, transferable, and a systematic process, and the program is conceived as a serving agent, which enables and even ensures these aspects of the design. In this conception, program is actually almost external to the process, which can be best described as a "brief" in accordance with the British tradition. Different from the historical and conceptual boundaries usually drawn for the *Design Methods* movement,

9 To avoid confusion with the journal Design Studies, the term "design studies" used for the academic discipline will be cited as "design research." The two terms are already being used as substitutes of one another in the design field.

this stage maintains the possibility of an epistemological parallelism and coherence between the movement and program as the supposed origin of the short-lived British neo-functionalist and revivalist approach to the *Modern Movement* in architecture.

The second stage can be dated to around late 1960s, 10 years after the declaration of the main thesis of the *Design Methods* movement. What comes out of this stage is a result of self-evaluation and self-criticism of what has followed the declaration. Basically, the main target of the criticisms is the scientistic conception of design that is essentially reductionist with its emphasis on the quantitative aspects of design as opposed to its qualitative aspects. This conception, qualifying design almost down to a mechanical process, in turn, was unable to cope with the complexity of the design process. What was discovered in this period is the fact that, unlike claims of the previous decade, design is not fully compatible with the *scientific method*. Unless design methods are radically reinterpreted in context of intuition and progressively expanded beyond the confines of relatively limited origins, there will be no advancement. However, this shift towards a more expanded understanding of design in turn demands a reconception of the program itself. Now, program is conceived as an active controlling agent of the design process. It defines and controls the stages of the process, the relations between the components and the stages. Compared with the previous conception of program, it is now an advanced constituent, and becomes not only an active part of the process, but also the principal one to control it. Despite the self-critical attitude, at this stage, one can easily identify the scientistic model of design still residing as a dominant reference point at the background. As a result of shared epistemological framework for this stage and the previous one, design is seen to essentially be about dividing one big problem into sub-problems. Each problem is to follow one another in an order of causality and solving these sub-problems presumably will, at the end provide a solution to the big problem.

The third stage involves a radical critical reexamination of the previous periods. It calls for a more comprehensive and essential reform upon what was already established. Where the existing tradition mainly establishes itself on symposia and manifestal proceedings, this stage, differently, marks the beginning of a maturing period in a new platform that is the periodicals. One of the first of these is *DS*,[10] which in time will be the most influential.[11] At the very beginning, what comes out from the discussions in *DS* is a demand for a shift in our understanding and conception of design, but at the same time, it marks a beginning of that shift from scientistic models to something else. That *something else* is most comprehensively expressed at the very beginning of the *DS*'s launch, where we only witness the evolution of the ongoing tradition; though indirectly, we also can identify a change in the conception of the program. This is what makes *DS* special for the present study: not only does its launch mark a critical turning point in the evolution of the *Design Methods* movement, but it also becomes the medium which we can witness and examine the forthcoming (r)evolution which transforms into *Design Research*. In search for new conceptions of design, and design as a discipline, *DS* paves the way for searching for building-up new paradigms, and consequently, transformations in the way we see program.

The changes we witness in *DS* are twofold: On the one hand being a descendant of the *Design Methods* movement, we still can observe in it a

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10 As indicated by its official website accessed via *Elsevier*, *Design Studies* is described as: "the only journal to approach the understanding of design processes from comparisons across all domains of application, including engineering and product design, architectural and urban design, computer artefacts and systems design." Its aim is to "providing a unique forum for the analysis, development and discussion of fundamental aspects of design activity, from cognition and methodology to values and philosophy." It is the journal launched by the Design Research Society (DRS), which was founded in 1966 in the UK in continuation of the conference on Design Methods held in London in 1962.

11 Although there is an older journal called *Design Methods and Theories* (1977) launched by the joint collaboration between the UK based Design Research Society (DRS) and the USA based Design Methods Group (DMG), Bruce Archer implicates that its limited contribution to the field was a handicap for it to deserve the title of the first all-embracing journal in the field of design research (Archer 1981, 33). After the birth of *DS* the two journals continued a separate publication life. In 1992 *Design Methods and Theories* journal turned to the *Design Methods*

resident scientism and positivistic conception of design in some approaches.[12] On the other hand, especially influenced by the significant interpretations of the philosophy of science of the period, by figures such as Kuhn, Popper, and Lakatos, a post-positivistic atmosphere emerges attached to the notion of a conjectural, evolutionary design paradigm at the background.[13] With such a conception in the *DS*, we see the beginning of a call for a new understanding of design, a shift from what already existed. This twofold structure seems to be contradictory, however as it was argued by Archer, what was proposed under the name *Design Research*, is somewhat a container that already incorporates what existed before. Yet from another point of view, a new paradigm incorporated into the tradition of the *Design Methods* movement, is not so benign: by nature, it demands a change in the core notions of design, and more importantly for the present study, the program. Inherently, post-positivism and the attached conjectural evolutionary paradigm reject determinism and the traditional control of program over design (or its process). New models of design in turn demand a reconception of program, and its relocation away from where it *traditionally* resides. While such a challenge has almost never directly accepted and not really been addressed yet in a systematic fashion in design research literature, historically and contextually *DS* represents a turning point in the shift of understanding of such issues. In the journal, critical attitudes that target inductivism and design notions that include logic of counter-inductive arguments, albeit indirectly, address program issue. Although studies may not always clear and precise for detecting program from their main arguments (as seen in titles, main topics, and keywords of various articles, opinions, and editorial parts), they have enough information in their epistemological

12 Cross exemplifies such attempts under the titles of "scientific design" and the "design science." While scientific design seems to refer directly to the Design Methods movement historically, design science is described as somewhat evolved version of that approach. For Cross, design science is first used by Buckminster Fuller but then adapted by Gregory into the context of the 1965 conference on "The Design Method." Some other proponents of the approach are: Hubka and Eder. Cross, "Designerly Ways of Knowing,"in Design Studies, vol.17, no.3, 2001,pp: 51-53.
13 Some of the early proponents of that approach in DS are: Bruce Archer, Jane Darke, and Nigel Cross.

structures and methodological references to build a comprehensive and convincing picture of the concept (either positivist or post-positivist). In that sense, *DS* serves as a valuable research ground for a study on program. The study of design has come a long way, with a tradition of more than fifty year (partially witnessed in the *DS*), but program as a major epistemological issue in design still prone to further investigation and speculation.

Therefore, the main motivation behind this study is an opposition settled in between the positivist and post-positivist worldviews of analysis-synthesis and conjecture-analysis. It is the maturation of the design research field and fruitfulness of today's position within which one can see architectural program under a different light, from a broader perspective, and with a chance to distinguish the conjectural from the analytical.

1.2 Methodology

In the present study, I utilize the conceptual framework from the early modern rationalist, futurist and functionalist discourses, 1960's design methods tradition, and primarily the *DS* journal for a critical reconsideration of means and uses of program in design. I propose an expanded programmatic conception of architectural design as a means of reconsidering, advancing, and expanding the valuable content of the mentioned line of inquiries. The proposal focuses on a conjectural model of program in design, in light of the emerging design models based on the ideas of the conjectural basis of scientific knowledge.

This study is also a historical investigation of the periodical *DS* with focus on program. It concentrates on the pioneering names, places, dates and events that signify conception, reconception, and use of program and seeks to understand transformations within *DS* from these perspectives.

The study makes a content analysis through a series of systematic reviews focusing on different levels and cases in the *DS*. It reports systematic and quantitative description of the content of the *DS* from 1979 to the present concluded with a theoretical reflection. The latter is an attempt to review and synthesize the *DS* and the work of other design researchers from a programmatic perspective. It concentrates on key reference points such as a call for a paradigm shift and also tries to detect peripheral discussions settled around the core issues. Finally, it also marks the opposing, conservative arguments in the *DS*.

Consequently, within the preliminary chapters, I analyze the existing interpretations of conjectural approaches within the studies that constitute my architectural context. I present a selection of conjectural ideas in the field of design research to show their potentialities, their relevancy and applicability to architectural program. To do this, I examine the *DS* journal by following the structure, and historical and conceptual framework of the conjectural models of architectural design.

The method of inquiry into the journal is simultaneously structural, historical and conceptual. By structure, I mean, totality of the relations between certain approaches of modern architectural theory, the ensuing discrete set of arguments in design research and the two rival paradigmatic approaches (analytical vs. conjectural). The relevance of the historical inquiry is high especially when it is considered that the majority of design studies have been triggered by periods of reconceptualization in programmatic understanding of the design process. Conceptual inquiry on the other hand provides a framework for restructuring historical and structural layers underlying the programmatic content of the thesis and especially identifies conjectural models.

CHAPTER 2

BACKGROUND: GENERATIONS OF DESIGN METHODS AND THE EMERGENCE OF *DESIGN STUDIES*

The exclusive history of the *DS* cannot be separated from the general course of the larger body of the design research. Its history is a part of a milieu resulting from several interrelated consecutive phases of how the concept of *design* has formed in the 60s and 70s largely in the UK and the USA. The *DS* is part of an age of manifestos through which the pioneers of *Design Methods* began to identify *systematic design* as the core subject of theoretical as well as experimental studies. Early steps leading to the development of the design research perspective can be primarily discussed in three associated phases: first-generation, second-generation, and third-generation design methods.

In light of these phases, this chapter discusses the emergence of two distinct epistemological frameworks (analysis-synthesis and conjectures-refutations) as generators for different conceptions of architectural program in the *DS*. The two frameworks each contribute to build an independent, autonomous design literature. The first originates in the generations model described by Rittel and Webber and the "first" and "second" generations of design methodologies whereas the second one arises from the idea of a “paradigm shift” proposed in the studies of Broadbent's "third" generation. Epistemologically the two consecutive frameworks span over both positivistic and post-positivistic viewpoints in both science and design research.

Rittel and Webber’s generations model was widely accepted and used for describing the evolution of methodologies in the design research field from the beginning to the early 70s. The model provided a progressive understanding of design methodologies and strengthened the weaknesses of the earlier methodological approach, which is widely known as the *Design Methods* movement. The model is created to propose a framework for understanding the growth of knowledge in design research between the early 1960s to the 1970s.[14]

According to the view asserted by the *Design Methods*, the conception of design should be reconstructed to fit the unquestionable success of traditional scientific tools and methods. Therefore, like any other science, design should primarily be taken as a "process," a sum total of a rational series of interrelated stages rather than an "end product" as in the stylistic approaches of traditional architecture.[15]

Such an understanding shaped the first-generation methods and mostly underlined the main motivation behind the whole design research area. It continued in the second generation and dominated the design field in the late 1970s. The difference between the two generations was not as much in the epistemology that they share, as it was in methodology. Second-generation methods stood critical to the first one's problematic points.

Broadbent’s third-generation on the other hand was not simply another ring in the generation chain. Rather than the partial critical revivalist second-generation methods, Broadbent’s third-generation carries out very strong critical evaluation by directly targeting the epistemological base of the first and

[14] The idea of generations was one of the first attempts of theorizing and historicizing the design research field. It is a foundation for the following approaches and revivalist views in design research and the *DS* and a potential for surveying current state of the art of the field. Although in some contexts, title of *Design Methods* represents a general atmosphere of design research, in this study, it denotes a degree of consciousness exist at the early stage of the design research tradition.

[15] The term *traditional design/architecture* mostly refers to the Beaux Arts school of design tradition. It is “considered the most important set of factors contributing to the nature of the design situation to be those associated with the final outcome or end product.” (B. Lawson 1980, 2)

the second generations. [16] Since it demands a radical holistic perspective change, the third-generation proposes a new, more appropriate paradigm than improving the existing one. Rittel and Weber's first and second generations operate on different ends of the spectrum of the *scientific method*, namely: analysis-synthesis. On the other hand, Broadbent's third-generation (G. Broadbent 1979) operates on the Popperian counter-paradigm known as conjecture-refutation.

Since the two paradigms behind the three generations operate on contradictory assumptions on the place and role of program in design, it is important to delineate and distill program through these bases.[17]

2.1 First-Generation

Rittel and Webber developed the generations model retrospectively in the second decade of the *Design Methods* movement. The first decade was then seen as the first stage of an understanding proposing "design methodology as a subject or field of inquiry" (Cross 2007) which was described as "a systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, purpose, value, and meaning in man-made things and systems" (Archer 1981). Its object was to "make public the hitherto private thinking of designers; to externalize the design process" (C. Jones 1970). As an alternative to the Modern Architecture project, alias traditional[18] design procedures, first-generation heavily concentrated to develop a new problem-solving approach to delineate, "how designers arrive at a configuration for the

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[16] Although they belong to different epistemological paradigms, both second and third generations emphasize a wider, inclusive design idea, and both generations were mostly proposed and advanced by architects and planners.

[17] In 1980s and 2000s, two more generational frameworks have emerged in design research. Together with the first wave, such approaches have provided the main direction of the field through the design media and proposed basis of the advanced design models.

18 Pioneering design research literature is used the term "traditional", especially in the first periods, as a substitute for modern architecture (as for the others), as synonymous with the design process, which prioritizes end-product. Such reductionist interpretation flattens significance of various historical categories.

thing or system" (Archer 1981, 31). It dealt with "hard methods" "emphasizing quantification and the expectation of an algorithmic benefit, or problem solution, from the use of methods" (D. P. Grant 1975, 96).

Ironically, what once roused the antagonism of *Design Methods* became the main source of complaint in *Design Methods*. In early 1970s, the movement was accused of being extremely insensitive to real issues and actual processes of design and of using incompatible methods. The term "first-generation" was first used to criticize what we know as the *Design Methods* movement, its way of dealing with the design problems, and the frame of reference through which *design* was described. Although the effects of the critiques were catastrophic for the pioneers[19] of the movement, they were rejuvenating for the foundational ideal. Following Nigel Cross's words, "the design methods movement refused to die. In fact, it was saved by another suggestion of Rittel" (Cross 1981, 4). As a result, during the 1970s, mathematical and mostly computational frameworks of "systems-approach" and "operations research"[20] were on the target. Both methods were accused of being inadequate for dealing with wicked-problems, and being limited, and un-argumentative.

> The methods of Operations Research play a prominent role in the systems-approach of the first generation; they become operational, however, only *after* the most important decisions

[19] See (Alexander 1971) (C. Jones 1977)

[20] The systems approach as we know today is first introduced under the name of the "general systems theory" by Ludwig von Bertalanffy in 1940's and developed by Ross Ashby in the 1950's. It is a form of rational inquiry and practice that concerns with "the study of whole systems as opposed to atomistic systems." It is "based on the assumption that there are universal principles of organization, which hold for all systems, be they physical, chemical, biological, mental or social" (Heylighen 1999).
Operations research is originated in the World War II. It "is essentially identical to systems analysis. Historically, it was a narrower area of activity that stressed quantitative methods and did not concern itself with tradeoffs between objectives and means or with problems of equity" (Heylighen 1999). According to the Operational Research Quarterly of Great Britain: "Operational research is the attack of modern science on complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government and defense. Its distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as change and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically." (1962, 282)

> have already been made, i.e. after the problem has already been tamed. (Rittel and Webber 1973, 162)

Rittel and Webber's idea of generations of design methodologies is based on the argument that "the search for scientific bases for confronting problems of social policy is bound to fail, because of the nature of these problems" (Rittel and Webber 1973, 155). They use the term "wicked" to refer how "malignant," "vicious," "tricky," or "aggressive" design problems are (Rittel and Webber 1973, 160). Design problems are so ill-defined that finding "the problem is thus the same thing as finding the solution" or in other words, "the problem can't be defined until the solution has been found" (Rittel and Webber 1973, 161). There are no criteria for the sufficient understanding required to solve a design problem and since these problems are often open systems, no ends can be defined either. Therefore, design problems are pursued until a satisfying, rather than an ultimate answer is reached.

For this reason, an ultimate testing of the consequences of design problems is also impossible. They cause irreversibilities. They are "one-shot" operations and there is no chance of learning through them by trial-and-error. The solutions in design problems therefore are infinite. They are unique; there are "several more ways of refuting a hypothesis than there are permissible in the sciences."

Finally, Rittel and Webber declare that because design problems do not aim to find the truth they are only dealing with the "would-be solutions" which do not have to be right or wrong. These solutions have "no proofs to hypothesis, only potential refutations (Rittel and Webber 1973, 161-167).[21] A demand for

[21] Characteristics of wicked problems as given by Rittel and Webber are: 1) There is no definite formulation of a wicked problem, 2) Wicked problems have no stopping rule, 3) Solutions to wicked problems are not true-or-false, but good-or-bad, 4) There is no immediate and no ultimate test of a solution to a wicked problem, 5) Every solution to a wicked problem is a 'one-shut operation'; because there is no opportunity to learn by trial-and-error, every attempt counts significantly, 6) Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-decribd set of permissible operations that may be incorporated into the plan, 7) Every wicked problem is

distinguishing a "second-generation," of methods coincides with the first self-critical attempt made by the design research society and arises from the problems mentioned here. Others join in Rittel and Webber. For example, Nigel Cross also points out that the ideal solid scientific basis sought for design shifts to an unstable vague condition:

> Nearly 20 years ago, the design methods movement seemed to offer a clear picture of the future for design: a logical, rational, coherent activity using systematic procedures. Now, the picture is much less clear, and the movement appears to be in crisis. (Cross 1981, 3)

With this critique, the first-generation methods are now described as parts of a "classical paradigm of science and engineering" which is "not applicable to the problems of open societal systems. The origins of the design methods movement can be found in applied science experience of the Second World War. The application of OR techniques in management decision-making was one of the originators of design methods. They are "tame" and "benign" (Rittel and Webber 1973, 160). They are merely the results of a "translation of techniques from Operations Research (OR)," systems analysis and statistics, set theory, information theory or importing psychological models of human existence into design (G. Broadbent 1969, 9, 11).

Among those reacting against the *Design Methods* project were also some of its pioneers. Christopher Alexander stated with an apologetic manner that the first-generation methods "destroy the frame of mind the designer needs to be in if he is to design good architecture" (Alexander 1971). He thus dissociates himself from the field and resigns from the editorial board of the DMG newsletter (Alexander 1971). Similarly, in 1977, Chris Jones reacts against the

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essentially unique, 8) Every wicked problem can be considered to be a symptom of another problem, 9) The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanations determines the nature of problem's resolution, 10) The planner has no right to be wrong (Rittel and Webber 1973).

first-generation and its tools such as machine language, behaviorism and the over-encompassing logicism (C. Jones 1977).

2.1.1The Impact of the First-Generation on the Programmatic Content

The first-generation design model described design as a linear causal process, a simple path, a direction represented by an arrow from the point A to the point B. It was based on the idea that the design process (like any other industrial production process) should be entirely explicable like machines (see figure 1). In this model, information was processed by optimization while “the designer moved linearly through discrete stages toward a final product” (Kostelnick 1989, 269).

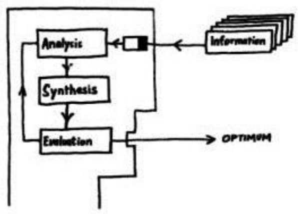

Figure 1 The glass box approach, or designer as a computer (G. Broadbent 1969, 195)

The main motivation of the model was the idea of externalizing the design process. Such a glass box approach places analysis in the prime role for the *Design Methods* (Kostelnick 1989, 272). This model guides the early years of the *Design Methods* movement with the aim to resolve "a conflict that exists between logical analysis and creative thought" (C. Jones 1963), and to keep "design requirements and solutions completely separate from each other" (C. Jones 1963). In this model, the logical and the creative parts were assumed to be reunited by the idea of "finding" the solution within the synthesis part. However, contrary to the hopes of many, due to the poor representation of actual design activity, the model was later declared to have failed by those who came to be the second-generation. For the second-generation methodologists at the crossroad in the late 60s, refinement meant to upgrade this three-stage linear model: “analysis, synthesis and evaluation”[22] (C. Jones 1963), or shortly analysis/synthesis.[23]

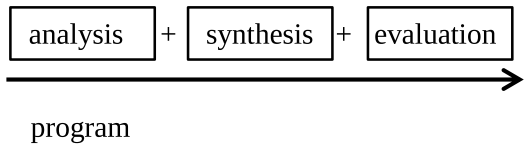

Figure 2 the place of program in the typical first-generation analysis/synthesis model

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generation see program as the analytical first phase of the design process (see figure 2). Christopher Alexander explains and visualizes the approach while reconceptualising the concept “program”. In his *Notes on the Synthesis of Form* (Alexander 1967) he systematically identifies a series of stages focusing on a programmatic understanding of architectural design according to set theory. Here, program comes to the core of design activity. Alexander’s studies have great effects in design research and in many schools of architecture. To him, program is in a sense “a reorganization of the way the designer thinks about the problem” thus “finding the right design program for a given problem is the first phase of the design process” (Alexander 1967, 83-84). In this interpretation, though it is placed before the synthesis stage as in Jones’s

[22] The model was described by Christopher Jones as a three-staged process. 1. *Analysis:* listing of all design requirements and the reduction of these to a complete set of logically related performance specifications; 2. *Synthesis:* finding possible solutions for each individual performance specification and building up complete designs from these with least possible compromise; 3. *Evaluation:* evaluating the accuracy with which alternative designs fulfill performance requirements for operation, manufacture and sales before the final design is selected (C. Jones 1963).

[23] The main idea behind the second-generation was to strengthen the weaknesses of the first-generation methods by focusing attention on refining of analytical procedures controlled by program and programming in design.

diagram, *program* (or *analysis*), is both the starter and the carrier of all the burden of the design process.

2.2 Second-Generation

As a result of their comparative binary relationship, discourses on first and second generations are naturally so combined into one. In late 1960s, the dissatisfaction from the first-generation methods in architecture and planning resulted in a pursuit for “softer”[24] methods. For the rising second-generation this meant to “emphasize communication and ‘objectification’ or making understandable of decision bases instead of quantification, and the benefits of problem familiarity and deepened awareness of the problem as the outcomes of using systematic methods, rather than the generation of specific problem solutions” (D. P. Grant 1975, 105).

Second-generation shed light on the most problematic parts of the first-generation. It gave various design fields a chance to observe the proposed design methodologies at a critical distance and encouraged researchers to emphasize differences rather than the similarities that were avoided by the extremely cautious leading community of the first generation. As a consequence, a transition was observed in the way of approaching design research. Its effects were primarily observed in main body of the pioneering studies. The emerging sensitivity provided a means for changing visions away from those of the previous studies. For the first time since the beginning, studies moved away from the experimental applied approaches towards more theoretical ones. The second-generation thus seems to be a turning point for a reconsideration for all the diverse design fields who shared, contributed to and applied such methodologies. As such, it was not just the *Design Methods*, but

[24]Christopher Jones emphasizes that soft methods “provide tentative outputs in every category prior to the fixing of problem structure”, on the other hand hard methods are “capable of providing a firm basis for the exploration of new problem structures or of removing logical obstacles cannot be used until provisional outputs have been obtained.” (C. Jones 1970, 81)

also the blanket idea of "Design as a discipline,"[25] that went under a major revision.

> Where the first generation of design methods was based on the application of systematic, rational, 'scientific' methods, the second generation moved away from attempts to optimize and from the omnipotence of the designer (especially for 'wicked problems'), towards recognition of satisfactory or appropriate solutions (Herbert Simon had even introduced the notion of 'satisficing') and an 'argumentative', participatory process in which designers are partners with the problem 'owners' (clients, customers, users, the community). However, this approach seemed to be more relevant to architecture and planning than engineering and industrial design, and meanwhile these fields were still developing their methodologies in somewhat different directions. (Cross 2007, 2)

The manifestation of the revision had two concequences: studies that exemplify a modest application of the second-generation and studies that exemplify dissociation and opposition.

Sanoff as one of the most eager participants of the modest application of the second-generation in architecture published an edited book called *Designing with Community Participation* (1978). In the book, he shared his ten years worth of experiments with eighty community design centers in the USA. The book had three parts: models for design assistance, environmental awareness techniques, and field approaches to community participation. This structure of the book can be taken as a typical understanding of second-generation methods in architecture. The book also explored some ideas on communication and emerging radical positions.

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[25] For the design research, Design refers a wider, expanded field. On the new understanding of design, see Christopher Jones's explanation: "Literature on design methods began to appear in most industrialized countries in the nineteen fifties and sixties. Before that time it was sufficient to know that designing was what architects, engineers, industrial designers and others did in order to produce the drawings needed by their clients and by manufacturers. Now things are different. There are plenty of professional designers who doubt the procedures that they have been taught to use and plenty of new methods that have been invented to replace the traditional ones." (C. Jones 1970, 3)

In “Participation in Resident Design: A Method for Generating Choice and Its ideological Consequences,” Pyatok and Weber argue the need to develop an “appropriate shared language” for an alternative design process. Similar to Sanoff, their emphasis was on communication by means of providing a “congruence of language with users and clients” (Salama 1995, 129).

At the cutting edge of the second-generation, these positions represent a more complex understanding of, and an evolution in, systematic design. The emphasis on the systematic approach is consistent with its extensive interaction with systems theory and computers. All this accounts for the emerging computational approach. Sanoff explains the computational roots of participatory design as in below:

> In northern Europe, participatory design grew out of work beginning in the early 1970s in Norway when computer professionals, union leaders and members of the Iron and Metalworkers Union strove to enable workers to have more influence on the introduction of computer systems in the workplace (Winograd, 1996; Spinuzzi, 2005). Several projects in Scandinavia set out to find the most effective ways for computer-system designers to collaborate with worker organizations to develop systems that most effectively promoted the quality of work life (Sanoff 2008, 58).

Unlike the first-generation, which lost the glory early on, second-generation is still a major framework dominating design research and a significant factor continuing to shape a large percentage of the research pool. Hence, although it is older than the *DS*, second-generation methods have received much attention from researchers from the first issue of the journal to the last.

As a sequel to the first-generation, the second-generation eagerly pursued to advance methodologies for a computer friendly understanding of design. This attitude had reflections in the *DS*. For example, Raymond McCall, introduced to the design research society *PHI* (Procedural Hierarchy of Issues) the aim of which is to extend Rittel’s *IBIS* (Issue-Based Information System) (McCall

1991). Both systems were actually *nonlinear* information based software for "organizing and documenting design discussion."[26] *PHI* was thought to be "a basis for" design theories, methods and other software. McCall's study indicates that in the areas such as computer aided design, software development and expert systems, the second generation implies "a need for qualitative information gathering, so as to develop expert systems with increased effectiveness and acceptability" (Tunnicliffe and Scrivener 1991). The second-generation, which was developed after the initial wave of the 1970s, then brings new challenges and pursues methodological advancement in design and architecture (especially by dynamically adopting richer and more complex models developed in software engineering) (Budgen 1995, 316).

In 1990s, as part of the second-generation methods, instrumental theories, software development and programming enter into the school curricula. Different from the first generation "problem-solving" approach, they define design as the process of "open-ended problem solving." From this perspective, design education is studied not only as the provision of technical skills, but primarily as a complex system structured on "thought development, subjective developments, or the resolution of wicked problems" (Verma 1997, 90).

The novel effects of the second-generation are easily followed in participatory and collaborative revisions of the design process, integration of user issues, and providing an advanced computer support for complex design activity. Additionally there were a handful of studies that rather retroversionary in character in the *DS*. Although they are not many, they indicate an interest in architectural history and theory specifically just after this second turn of

[26] Articles focusing on experts systems and software development in design are more and more become reports of applied processes based on the particular issues such as: documentation, management, and decision-making. As such, they increasingly resemble articles in the computer sciences and programming journals.

generations.[27] In Alan Lipman and Peter Parkes' "The Engineering of Meaning: Lessons from Las Vegas Recalled…and Declined" (Lipman and Parkes 1986), researchers argue the role of meaning in architecture and examine Venturi, Scott Brown and Izenour's book *Learning from Las Vegas* (1972) with a focus on its relation to modern architecture.[28] Compared to the tendencies dominating design research at the time, Lipman and Parkes's article might have a minor effect on the ongoing *Design Methods* literature, but it indicates an emerging trend, a positive orientation toward earlier architectural paradigms especially toward the modern tradition.

2.2.1The Impact of the Second-Generation on the Programmatic Content

The aim of the second-generation design methods were boldly described as to integrate "social aspects" to the previous design model to enlarge the reality, and in that sense to make a revision of what the previous model fails to represent (Rittel and Webber 1973) (Simon 1973) (Rittel 1972). Such "undoing of the mistakes" caused a renovation in the analysis/synthesis model (C. Jones 1970). The novel approach can be followed from a number of sources. Jones, gives the crux of the approach which is to move from fixed to variable goals:

> To organize life by fixing the goal, and then planning a series of steps by which it can be reached, with certainty, is the essential method of technology as we know it so far. It is the method of the production-line, the main source of industrial wealth. But it is the opposite of the way of living that is recommended by the wisest thinkers … It is time that we begin to de-mechanize our lives, that we dismantle the monstrous extension of production methods to life itself, as if we, and everything else, existed only as a means and never as an end, never as something good in itself. In design, this undoing of the mistakes of our industrial

[27] Because of the existential opposition declared by the first generation (*Design Methods* movement) to the previous traditions, conventional architectural history and theory had simply ignored by the early design research studies.
[28] In the article, "rigid, fixed, mechanistic, positivist" Modern architecture is called the first generation and Venturi, Scott Brown and Izanour is called the second. The article provides an opportunity to compare how modern ideals, paradigms, methods and operative strategies similar with ideals, paradigms, methods and operative strategies of the design research.

> past can begin, not by abandoning goals all together, but by switching from fixed goals to variable ones. The essential pre-requisite for this is to negotiate, with those who are paying for the designing to be done, an agreement to reconsider the objectives, and the whole brief, whenever it becomes clear that the design process is teaching us that our initial thoughts were mistaken. (C. Jones 1970, xxii-xxiii)

As a result of the critiques, the second-generation made an addition to what we know as the first-generation design model. The addition aimed to capture variables that represent the complexity of the "problem space." It thus provided researchers a fruitful framework to develop strategies and tools in dealing with continuous modification required for the solution generation (Simon 1973, 192). In Rittel's words, in the second-generation:

> The design process is not considered to be a sequence of activities that are pretty well defined and that are carried through one after another, like 'understand the problem, collect information, analyze information, synthesize, decide;' and so on; and another being the insight that you cannot understand the problem without having a concept of the solution in mind; and that you cannot gather information meaningfully unless you have understood the problem but that you cannot understand the problem without information about it - in other words that all the categories of the typical design model of the first generation do not exist any more… (Rittel 1972)

In a parallel line of critique, Sanoff provides answers to questions such as: how the basic linear scheme of the first generation has changed, and how it enables *argumentation* and *variation* in architecture. According to Sanoff, the "multiplicity of processes necessary to work through a problem," (Sanoff 1977, 5) needs "more order and more organization in the process" (Sanoff 1977, 3). Therefore, the first phase of the design process should be "program development." Other consecutive phases are: the preliminary design phase, the production phase, the construction phase, and the evaluation phase (Sanoff 1977, 3). Here, the difference between first and second generations should be considered. While the first-generation understands the first phase, or program, as a rigid and stabilized body with no flexibility, the second-generation interprets it as more flexible, open and porously dynamic structure (see figure 3). While the first one can be called program, the second one can be called programming.

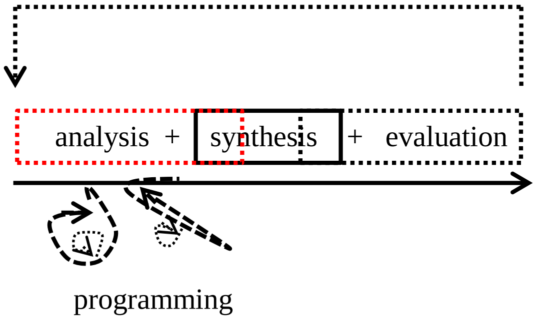

Figure 3 The place of programming in the typical second-generation analysis-synthesis model

As seen from in (figure 4), Sanoff simply extends the "analysis" phase of the first-generation to cyclic bipolar operation zones at the entrance and exit of the remaining phases. As such, he describes the design process as a loop that proceeds from analysis (program development, preliminary design phase) to synthesis (preliminary design phase, production phase, construction phase) and terminating back at the analysis (evaluation phase). In this model, programming as the core element of the revisionist second-generation agenda, operates nearly the whole design process. This framework permits multiple agents to participate the process (via smaller feedback loops) and involves finding *satisficing* ways to organize their demands in order to build a new integrated understanding of Architecture.

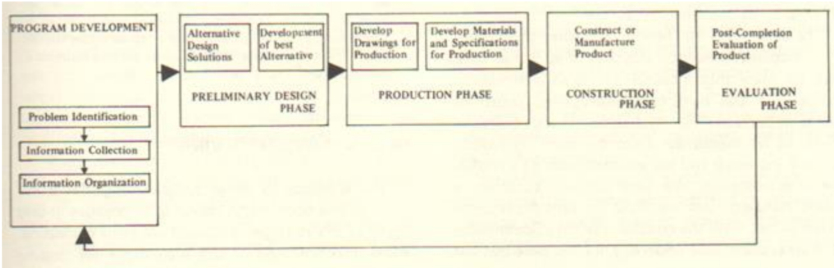

Figure 4 Phases of a design (Sanoff 1977, 3)

The aim of advancing the programming knowledge and skills is placed at the heart of the second-generation design agenda. As being both starter and coordinator, programming is described as an active agent of more integrated second-generation design processes. Thus, essential features of the second-generation such as flexibility, openness and multiplicity (those that represented with cyclic processes resulting in alternative design solutions) depend on the merits of programming.

The second-generation demands a shift from understanding design as rough optimization processes to a more refined design decision procedures, improving the degree of adaptability to "open systems" (Rittel and Webber 1973, 156). As such, the epistemological framework of design as analysis-synthesis has been upgraded to a degree that offers highly complexified and inclusive programmatic operations both in architecture and in its software counterpart. Within this framework, a close interconnection between computation and architectural programming has been refined and become habituated. Progress in handling complexified documents, data processing and developments of related software have increased the confidence to analysis-synthesis as well as programming in architectural design and uptrended issues such as "user," "collaboration," and "participation." Hence, in such a condition, it is not a surprise that the idea of architecture as analysis-synthesis and therefore programming was first initiated and propagated under such topics.

For Architecture, the second-generation agendas (participation, communication, computation etc.) opened up an untouched research area, created a possibility to change the rigidity in design towards building up a more argumentative, participatory design processes. On the other hand, they did not question the design model constructed by the first generation. For all its criticality towards the process, second-generation design was still described as a phenomenon operating in the accustomed pattern of analysis-synthesis and still operates inductively. The approach overstated and extended the role of analysis, and evaluation. It was seen that the stages that were assumed to operate on the factual level (analysis and/or evaluation) enlarged and covered the whole design process and this were caused exaggeration of design requirements as the prime motivators of the design process. Contrary to the binary logical system (analysis-synthesis) upon which they were born, this caused a dramatic shift between two contradictory categories of decision-making these are rationality and irrationality.[29]

Similar to the first-generation, the second-generation also interprets design as intangible by the "traditional"[30] tools (C. Jones 1970, xxi). They primarily focused on developing tools and methods to carry out more elaborate model for a "complex," "argumentative," orientation of data (G. Broadbent 1969, 198) (C. Jones 1970) (Rittel and Webber 1973) (B. Lawson 1980). This choice leads them to make revisions on the existing raw *Design Methods* framework rather than questioning the overall model.

The second-generation caused an expansion (industry, research, education …etc.) and sophistication (history, theory, politics…etc.) of design research

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[29] How prioritization of design requirements and use of analysis in the entire stages of design increase problems of irrationality were discussed by Colquhoun in detailed. (Colquhoun 1969)
[30] The term explained by Jones as the opposite of the "era of craft evolution," and "design by drawing" (C. Jones 1970, xxi).

methods. Although, it is a remedy for the dissatisfaction in the late 1960s design research, it is also a passageway for delivering other critiques and generations into the field. The idea led the design literature just before the launch of *DS*. As such, it absorbed the post *Design Methods* trauma, changed the state of the literature from disarray to a direction by launching a new method, and by giving hope led to the birth of the *DS* journal.

2.3 Third-Generation

> It seems to me therefore, that Rittel's Second generation of Design methods is now giving way to a third which takes a Popperian view of designing whilst recognizing that within it there are people, experts, whose job it is to make the design conjectures (G. Broadbent 1979, 44)

Broadbent's lines were the precursor of a "third" generation in design research. While the objective of the second-generation was to propose a "more empiricist, experiential position" (Coyne 2005, 7), the third-generation was to adopt the Popperian conjectures and refutations approach for design. However, for a better understanding of the third-generation, second-generation should be clarified. In the second-generation methods:

> The objective was to make explicit the hidden processes of professional judgement and to expose them to scrutiny, through methods and diagrams. If professional methods defy some core in an idealisation of rationality then at least we can all play the role of empirical scientist in analysing the processes by which any judgement is made, and in an objective way. But this move from a rationality based on abstract logic to a more empiricist or experiential position merely shifted the problem of defining rationality and rational criteria to the broader arena of community consensus. (Coyne 2005, 7)

As stated by Coyne, both first and second generations are rational. Their differences come from what they emphasize. While the first-generation uses analysis-synthesis for emphasizing a more abstract logic in decision procedures of design, the second-generation uses analysis-synthesis for emphasizing "the broader arena of community consensus" (Coyne 2005, 7). Broadbent describes the two generations from a different, a more critical perspective. For him, the first generation of design methods "was wrong," and the second generation design methods "was seen to be right…but also had its limitations" (G. Broadbent 1979, 44).

As different from the first and the second generations, third-generation methods focus on some key architectural problems[31] based on the application of a conjectural understanding of design accompanied by the hope for producing "a real design solution" (G. Broadbent 1979, 44). As expressed by Popper, the conjectures-refutations approach is actually a counter-hypothesis in which the logical problem of induction (the belief that science – or the growth of knowledge – proceeds from observation to theory) is critically reconsidered. One of the main consequences of such reconsideration in design is that it has challenged the question of "what is the structure of a design process?" and "how does a design process begin?"[32] and therefore challenged the role of program and programming in design. For conjecture-refutation,[33] the success of design is not based upon rules of induction, but depended upon "luck, ingenuity, and the purely deductive rules of critical argument" (K. Popper 1957, VIII).

2.3.1The Impact of the Third-Generation on the Programmatic Content

Third-generation or perhaps more appropriately named as the conjectures-refutations generation invites the traditional approach of architecture to design

[31] As explained by Broadbent, because of the the limited perspective of the *Design Methods* tradition, such problems couldn't be seen by the previous studies.
[32] A clear inductivist answer to these questions came from Christopher Alexander in his *Notes on the Synthesis of Form*. In the very first centence of the chapter "The Realization of Program", he states that: "Finding the right design program for a given problem is the first phase of the design process. If is, if we like, the analytical phase of the process. This first phase of the process must of course be followed by the synthetic phase, in which a form is derived from the program. We shall call this synthetic phase *the realization of program*." (Alexander 1967, 84)
[33] or the idea that "theories can never be inferred from observation statements, or rationally justified by them" (K. Popper 1957, IV)

research in the sense that it emphasizes significance of concepts over requirements in the beginning part of design and puts analytical thinking to the next phase (testing) (see figure 5). The role of analytical thinking in this process is to refute. According to this view, the quest for refutation cannot be a motivation for design and because analytic thinking is to divide, it does not lead the designer to see the whole picture.[34] After all, analysis-synthesis is a study of the elements "with reference to their elementary properties and the laws of their synthesis" (Petermann 1932, 4).

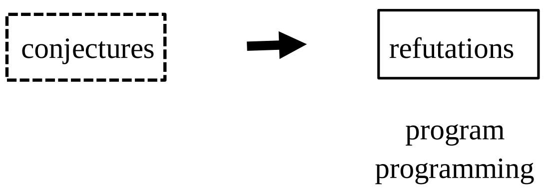

Figure 5 The place of programming in the typical third-generation conjectures-refutations model

The conjectures-refutations model offers a simple scheme regarding the reversion of the design process illustrated and developed by the previous

[34] This read as a typical non-atomist worldview as opposed to a typical atomist inductivist claim. For the word "atomism," Merriam-Webster entry is: "a doctrine that the physical and mental universe is composed of simple indivisible minute particles."
In the early twentieth century, Wertheimer, Koffka, and Köhler put forward gestalt theory as a "fundamentally new psychology in radical opposition to all other work which has been done in psychology" (Petermann 1932, 2). They studied on the "wholeness" characteristic of physical phenomena. The atomistic approach on the other hand, depend "upon the natural sciences for its method of thinking, tried to conceive the reality of psychic life as built up of Sensations and Feelings, of conscious elements, and set itself the task of carrying through a construction of this sort on *the basis of a study of these very elements with reference to their elementary properties and the laws of their synthesis*" (Petermann 1932, 3-4). Gestalt psychology claims that traditional "atomistic" method of science is unsatisfactory. Atomistic problem as to "how it is possible for a whole to arise out of elements" is itself problematic.
For Merriam-Webster entry for the word "gestalt:": "a structure, configuration, or pattern of physical, biological, or psychological phenomena so integrated as to constitute a functional unit with properties not derivable by summation of its parts."

design research models. In the following chapter, we will see the emergence of the model and its relation to architectural program and the *DS* in detail.

The conjectures-refutations model contradicts established dogmas of design research, such as relation to previous paradigms, upleveling designers, allowing "preconceptions, hunches, and arbitrary solution ideas," and putting tradition at the service of design (Cross 1981, 4). The conjectures-refutations model was not totally excluded by the design community, but there were some reservations about its applicability to disciplines other than architecture. Despite the understanding that "it fits well what the designers already do in practice," it had only been studied within the boundaries of a group of researchers (Cross 1981, 4).

Out of the leading first three generations, new arguments have emerged. These can be taken as individually tailored proposals, or rather personal research subjects two of which are vital for the *DS*: Nigel Cross's "post-industrial" fourth generation, and Rivka Oxman's "digital design" generation.

2.4 Nigel Cross: "Post-Industrial" Fourth-Generation

In an article entitled "The Coming of the Post-Industrial Design" in the *DS* (1981) Nigel Cross brought some key issues into the core of the design research literature. The study can be considered as the first step to understand the future editor of the *DS* journal as well as the programme that he will orchestrate in the future.

Cross's study is not just one of the pioneering articles of the early years of the *DS*. It is also representative of a perspective on the necessity of technology in design. Before he arrived at a conclusion on the current state of the field in 1981, he opens up some significant points throughout a series of studies. In the first article in 1979, he calls our attention to the "designer's dilemma" as the symptom of the present tension existing between the different viewpoints that describe the relation the between "technology" and "social forces." He points out a clear opposition between approaches of the "utopian" and the "anti-utopian" or in other words the "want" and the "need" (Cross 1979, 127-128). In the second article in 1980, he emphasizes the progressive loss of the "utopian spirit" in design research. After commenting on the "pervasive" and "powerful" designers and "disillusioned" artists of the era, he questions why utopianism has turned into dystopianism and asks, "Where are the positive visions that will help us re-orientate our plans?" (Cross 1980, 316). Finally, in 1981, he more articulately dwells on the issues by reviewing a major research agenda in reference to Rittel and Webber's "generations of design methodology." The question "Is the current generation game in the design methodology a parallel of the paradigm shift in science?" (Cross 1981, 4) leads Cross to open up one of the pioneering frameworks of the *DS* at its dawn. The generations phenomenon, which has also been the topic of this chapter up until now, indicates a new level of maturity in an advanced understanding of design, on the other hand, it disassociates a previously solid perspective.

Cross draws attention to a significant point on the continuous emanation of new generations in the late 1970s. He explains that the generational view "permits Young Turks within the movement their radical ideas which, from time to time, can be sifted by the Old Guard into a sanctioned next generation" (Cross 1981, 4). However, third-generation influences part of the society unfavorably and triggers the emergence of a conservative counter-attack regarding the future state of the design research. Within this period, *Design Methods* ideals have reemerged in some areas including the *DS*. As emphasized by Alan Bridges, some researchers were simply disappointed in the new comers such as conjectures- refutations, and some others ignored that there might be a third-generation that would actually be an "attempt to reestablish a designers' role in design method" (Bridges 1986, 52).

For Cross, the second generation can be described as “escapist” since it ignores the “reformist zeal” of the *Modern Movement* and the *Design Methods* movement (Cross 1981, 4). His disappointment in the degree of *reform* implied for the second generation is valid for the third-generation also. Being clearly motivated by the inductivist understanding of science, Cross puts a reservation on the emerging “rival” (third) generation and asks, “but what happened to the desire to *reform* designers' practices, that was so much a part of the original motivation of the movement?” (Cross 1981, 4) In continuation of such dissatisfaction, he predicts the coming of a reformist “fourth-generation,” which “will see a return to this reforming zeal, particularly using automatic procedures that generate designs without the meddling inference of human designer, and a return to the premises of the Modern Movement.” (Cross 1981, 4) [35] After reminding the society that what we need is a “method,” that is an “objective system,” he emphasizes that such a revolutionary scenario should be named as “paradigm” instead of “generation.” By referring to Thomas Kuhn’s theory, he explains that:

> An alternative to the generational view has similarities with the view of developmental change in science proposed by Kuhn. [12] His view is that science progresses by a series of major changes in the paradigms held by scientists. Thus, for example, the paradigm based on Newtonian physics has been superseded by one based on Einsteinian physics. (Cross 1981, 4)

Cross’s purpose is to test whether or not there is a paradigm shift in parallel to the ongoing “crisis” of design research. He searches for the anomalies and, in order to explain the situation well, recalls the nearest paradigm shift in the history of architecture that is the *Modern Movement*.

> … if we are to pursue Kuhn's view, it seems more likely that what we have been witnessing is the emergence of a crisis

[35] As opposed to the foundational objectives and declarations of the *Design Methods*, Cross announces the premises of the Modern Movement as identical with the ideals of the *Design Methods*. Not calling it *Design Methods*, such a progressive link first proposed by Summerson, Banham and Fuller just before the movement.

> within the design paradigm which has been held this century… The Modern Movement itself is in crisis, as witnessed by the search for post-Modern styles in architecture, and the shifting sands of design methodology are a further indication of the need for a revolutionary new paradigm… It is, indeed, particularly unfortunate for them, since it is only recently that they have begun to gather the flowers of the seeds planted by the pioneers. (Cross 1981, 4)

It seems that, for Cross, the reformist spirit and commitment of the high-end industry made the *Modern Movement* a belated model for the recent design research (Cross 1981, 4). The article can be taken as both an obituary for the loss of the objective systematic *Design Methods'* ideals,[36]and a self-critique with a hope for its advancement with regards to technology.

As the "late flowering of the Modern Movement", design research tradition needs "committed design scientists" who use and conduct technology that will advance the model by designing-out the adverse side-effects of previous models. The Modern Movement has simply failed because it has assumed that the "ethos of functionalism" is fully consistent with the ethos of men. In other words, it has assumed that defining, modeling and translation of person's needs into objective artifacts satisfy person's needs. What we need now is a technology "conductive to more satisfactory model including "essence of being human," "mysteries of life" which was missing in the previous one (Cross 1972, 11).

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[36] The reformist spirit, starting from anew, and praise for a clean slate approach are not new. For the *Design Methods* movement, designers must be "objective" and "must learn to distinguish what they *believe* to be true from what can be *proved* to be true" (C. Jones 1970, xix). Similar attitude, the call for giving up what architects traditionally do was also main part of the underlining framework of 1960s' neo-functionalist late modernist discourse. Summerson in his *The Case for a Theory of Modern Architecture* describes program as the source of unity for architecture and clarifies its method as the analysis-synthesis. He then warns us that if we do not stick to this method and make design decisions by typified traditional conventions rather than by analysis-synthesis, there will be no difference between architecture of 1920, or 1800, 1750. (Summerson 1957, 227,235). Finally, in the closing remarks of the famous book *Theory and Design in the First Machine Age* (1960), Reyner Banham demands from architect to "discard his whole cultural load" to "keep up" with technology (Banham 1989, 330). Again, we find similar concerns in Buckminster Fuller's book *Utopia and Oblivion* (1969).

As part of such an approach, the main objective of the "post-industrial design methods" is declared as the will for turning back to the foundational ideas of the *Modern Movement* and *Design Methods* as well as revitalization of the design process armed with proper technology:

> Design, the conception and creation of new artefacts, is the central function in a technology which has been facing the crises of energy and resources, and the criticisms of the antitechnocrats and alternative technologists.…If, from these unprecedented crises and criticisms, a new technology emerges, it will need new, post-industrial design methods. Just as the pioneers of the Modern Movement recognized the need for new design concepts to match the new technology of the 20th century, so the pioneers of the post-Modern movement recognize the need for new design concepts to match the emergent technology of the 21st century. (Cross 1981, 5)

It seems that Cross's urge for the re-creation of foundations of *Design Methods* has shifted to another phase. One year later, in 1982, he proposed a rather modest way of approaching design under the name of "designerly ways of knowing" which directly refers some of the second and third-generation sensitivities.[37]

Although the post-industrial fourth-generation foresaw a "new awareness" and emphasized some important issues, it was quite far from describing an entire model. From a programmatic point of view, its structure was similar to the analysis-synthesis structure of the first and second generations. It was rather a justification of a future model through which technology was able to take a great leap forward.

2.5 Rivka Oxman: "Digital Design" Generation

The generational idea in design research and the *DS* has continuously evolved. Apart from the earlier first wave and the post-industrial generation, the last significant attempt to describe a new generation came from Rivka Oxman in

[37] A detailed explanation of the "designerly ways of knowing" is in chapter IV.

late 2000s when she heralded a “digital” generation of design and design education.

> The evolution of digital design as a unique field of design endeavor, motivated by its own body of theoretical sources, promulgated by a culture of discourse, supported by new technologies, and producing unique classes of designs is a phenomenon that has been rapidly crystallizing in the past decade (R. Oxman 2006, 229).

The declaration of digital design follows a wide range of issues covered under several headings. These are: new forms of knowledge, new scientific foundations, and new models of design, but overall, a new terrain containing all.

> Are we encountering the same cognitive phenomena of known processes of design in the new digital media? Or are we encountering new forms of knowledge, new scientific foundations, and new models of design? A basic assumption presented here is that we are, in fact, facing new terrain in design thinking and that there is a need to formulate a rationale for digital design didactics (R. Oxman 2008, 102).

Oxman’s conception of generation resembles Cross’s conception of a “post-industrial design method” in the sense that they both have revolutionary and radical technological tones in their discourse. They both analyze the state of design in a shifting position and prefer to use the word “paradigm” rather than generation. As a result of the assumed paradigmatic change, digital design is described as an extremely autonomous phenomenon. Although it needs “a re-examination of theories and methodologies in order to explain and guide future research development” (R. Oxman 2006, 230), it evolves “unique design methodologies, unique form of design interaction and unique formal content” (R. Oxman 2006, 229). As such, digital design is carefully disengaged from the former generations (R. Oxman 2006, 234). It is even distinctly separated from known design discourses and described as a unique new field: digital design.

> The academic/scientific perspective tends to be unique in its emphasis on formulating the theoretical and methodological aspects of digital design. Much less occupied with the formal innovations that have been such a strong motivating device of the first generation of digital designs, the academic/scientific emphasis presents a much clearer focus upon digital design as a new set of technologies and unique media of design that are transforming our traditional definitions and concepts of design. It is this emphasis the influence of new media upon design processes and design thinking (Oxman and Liu, 2004) that characterizes much of the research involvement with digital design and promises to be one of the research contributions to this rapidly evolving field. (R. Oxman 2006, 238)

To give emphasis on guiding technology and to give priority to technological advances are the distinguishing characteristics of revolutionary approaches in design generations. Cross's deep sympathy to the *Modern Movement* and the *Design Methods* and being distant to the second and third generations was sourced from the same revolutionary spirit. It is this spirit that makes the first, fourth and the digital design generations similar, and it is this spirit that explains why Oxman fits to the category of the utopian designer/researcher (Cross 1979, 127). The concept utopian is an attribute, an indication of a type of researcher who is assumed that "technology (and therefore design) changes society" but not vice versa (Cross 1979, 127).

In digital design, the issue of program is shaped by the techno-utopian revolutionary essence of the evolving digital design theory. This is a demand for a "cultural transformation of root design concepts" such as normative, static, and typological aspects by offering alternative proposals (R. Oxman 2006, 232-233).

2.5.1 The Impact of the Digital Design on the Programmatic Content

Digital design is represented as a compound unit in which designer and the four basic components of design (performance, evaluation, representation, and generation) are integrated parts of a single dynamic system (R. Oxman 2006) (Figure 6).

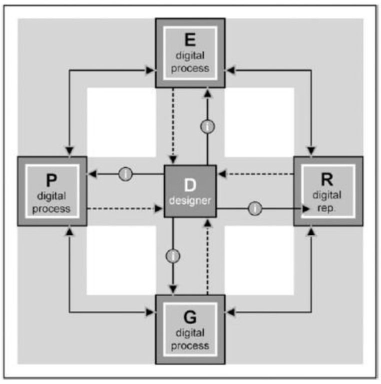

Figure 6 Digital design as the combination of designer, performance, evaluation, representation, and generation (R. Oxman 2006, 261).

Parts of the whole are interrelated with each other through complex, dynamic and non-linear digital operations (R. Oxman 2006, 263). As such, digital design is described as a complex organizational system at the high end of digitally networked environment. The question of what the relation between digital design and program is largely related to the role of designer in such an environment.

> As digital design media become more complex and more demanding with respect to knowledge of multiple types of software, knowledge of scripting languages, and the manipulation and maintenance of complex data models, a new generation of digital design specialists is emerging... The thought of the designer as digital toolmaker reflects both the potential for customizing digital design media as it does the necessity for specialist knowledge needed to operate such media. So presently, the idea of a class of ‘digerati’, or digital literati as advanced digital systems designers appears to be an accurate description of the contemporary situation. (R. Oxman 2006, 262)

In a system such as this, the role of the designer is described as "digital design specialist," and "digital toolmaker." These roles necessitate specialist knowledge to operate digital media (R. Oxman 2006, 262). At the center of everything, and managing, controlling, and manipulating the whole processes, the digital systems designer, or as coined by Oxman "digerati," reminds of a sophisticated version of the programmer in the 1970s. As explicated by Mark Burry in detail (Burry 2011), it is conceivable that having the knowledge and power of scripting languages, the digital designer is an upgraded version of a programmer.

> Scripting is a rather loose term by any definition and in this primer can be taken to mean computer programming at several levels. For the novice dabbling at the more accessible end of the user spectrum, scripting is the capability offered by almost all design software packages that allows the user to adapt, customize or completely reconfigure software around their own predilections and modes of working. At its most demanding for the emerging connoisseur, scripting can refer to higher-level computer programming where, in the 'open-source' environment, 'libraries' of functions can be combined with preconfigured routines (algorithms) as a means to produce manufacturer-independent digital design capability. (Burry 2011, 8)

Yet on the other hand, another duty attached to digerati changes this position a bit. For Oxman, digerati has two duties: "scripting" and "manipulation and maintenance of complex data models" (R. Oxman 2006, 262). While scripting is a technical skill, a specialty, as in fine use of a tool, manipulation and maintenance of complex data models is where the creativity and design comes. On the other hand, for Burry, the term "scripting" seems to involve both:

> 'scripting language' is often synonymous with 'programming language': it is the means by which the user gives highly specific instructions to the computer with which they are interacting. At a semantic level, it is possible that the designer is less likely to flinch at the term scripting than they might at the

> term programming, for it is quite clear that most of the designers who use computers as a core part of their digital practice do not automatically turn to programming to form part of their repertoire. By not doing so users at once place their entire trust in the software engineers in the expectation that those anonymous collaborators have thought through all that might be wanted by the designers, just as they are conceding that what seems on occasion endless manual repetition is an acceptable use of their time when they could otherwise have been seeking some degree of automation. Software modified by the designer through scripting, however, provides a range of possibilities for creative speculation that is simply not possible using the software only as the manufacturers intended it to be used. Because scripting is effectively a computing program overlay, the tool user (designer) becomes the new toolmaker (software engineer). (Burry 2011, 9)

Assuming that a "systematic" and "scientific" utilization of advanced technology provides a revolutionary framework for design may very well fit to a typical analysis-synthesis model. In that sense, digital design is evolving as an experimental research project.

As a loyal member of the design research tradition, whose roots still strictly anchored to the inductivist principles, digital design describes and despises traditional design methods as "stylistic" and prioritizes "process" over "product" (form). It argues that in the digital age, "change in the professional culture of architecture" gives rise designers to "transcend stylistic agenda" (R. Oxman 2008, 100). On the other hand, digital design distinguishes itself from the typical form of analysis-synthesis. It "modifies" conventional "analysis-synthesis-evaluation" scheme toward a "performative organizational systematic process" (R. Oxman 2008, 107-108). The change redefines program as a continuous performative programming activity all through the design process and modify synthesis with generation. On the other hand, hidden behind this framework still lies a positivism and a danger of determinism. As in the classic inductivist phrase "form follows function," "the actual form emerges from a process seeking for optimal performance" (R. Oxman 2008,

107) is no different. As such, digital design defines a more program-bound scheme for evolving inductivist design (see figure 7).

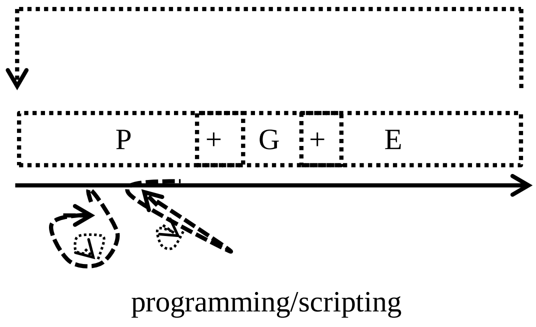

Figure 7 the place of programming/scripting in the typical digital design model (P: performance simulation; G: generation; E: evaluation)

Design Methods have changed the perception of design. In the 1970s, design researchers reached an agreement on the ill-structured character of design and its unclassifiable nature under Science. Same period was also characterized by the emerging post-positivist perspectives questioning the foundations of traditional approach to science. This has shifted what the design research knows about design all over. Within the new framework, "the designer has to take the initiative in finding a starting point and suggesting tentative solution areas. Solution and problem are then both developed in parallel sometimes leading to a creative redefinition of the problem, or to a solution that lies outside the boundaries of what we assumed to be possible" (Cross 1994, 18). As part of this shift, in this chapter, the question was how architectural program might have been affected from such progress.

From the late 1970s to the present day, design research discourse and therefore the concept "program" seem to be oscillating between two paradigmatic bases.

The two paradigms can be traced in four distinctive historical stages.[38] First stage corresponds to the early 1960s, or namely the *Design Methods* movement; second stage corresponds to the late 1960s, first self-critical period of the *Design Methods* movement; third stage corresponds to the launch of the *DS* and a more pluralistic environment, and fourth stage correspond to the digitally motivated era of design which we are experiencing now. The two paradigmatic bases give way to two rival understanding of design process. While the first of which operates through revolution and on the side of objective, scientific method, an inductivist approach on design; second of which operates through evolution and claims a hypothetico-deductive scheme for understanding of design.

[38] Although Cross mentions a fourth-generation, he leaves it without a plausible account of the term. That's why his fourth-generation cannot pass beyond the realms of symbolic and ideological and become a real proposal.

CHAPTER 3

PROGRAMMING IN ARCHITECTURAL DESIGN

In the previous chapter, two epistemological foundations to the concept of program are explored as they evolve over a series of generational cycles of design research. In this chapter, programming is analyzed as the primary concept for the emergence and evolution of a specialized, more sophisticated understanding of the design process.

Starting from the early 1970s, architectural program[39] has changed over from the traditional form-function discourses to a programming-oriented rhetoric. Basic references of today's architectural programming discourse were established along a line of thought initiated by a group of American researchers including Pena & Parshall (1969,) Sanoff (1970,) Duerk (1993,) Kumlin (1995,) Cherry (1999) and Hershberger (1999.) Following extracts are illustrative of how programming was described as being determined by a novel understanding of design process:

> Programming is problem-seeking (Pena, 1977, 15)
>
> The structure of program is similar to an industrial process that converts raw material into useful energy. The program converts raw information into useful design information with the aides of a vast array of catalysts. (Sanoff, 1977, 21)
>
> A design contract may specify that the client or the client together with the designer is responsible for starting clearly what the building (or other setting) is expected to do. This document is called the "program" and the process of preparing it "programming". (Zeisel, 1984, 36)

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[39] In the literature of design, addition of the suffix "–ing" at the back of the word program refers two types of usage: adjective and verb. The first contributes to the advancement of the architectural brief toward a more complex specialized activity, a discipline; while the second, as transferred from the computer programming, contributes to a way of exploration and mapping by creating a sequence of instructions throughout the design process.

> The first part of the design process is called programming (Duerk, 1993, 8)

> Programming, like design, is an iterative and heuristic process. Both of these activities have an identical identified beginning – *the mission statement*. The program describes in detail *what* needs to be done to fulfill the mission statement; the design describes, in phases of ever more explicit detail, *how* to do it. (Kumlin, 1995)

> Programming is the definitional stage of design – the time to discover the nature of the design problem, rather than the nature of the design solution (Hershberger, 1999, 1)

> Architectural programming is the first stage of the architectural design process in which the relevant values of the client, user, architect, and society are identified; important project goals are articulated; facts about the project are uncovered; and facility needs are made explicit... architectural program is the document in which the identified values, goals, facts, and needs are presented. (Hershberger, 1999, 5)

> Architectural programming is the research and decision-making process that defines the problem to be solved by design. (Cherry, 1999, 3)

The discourse is grounding on the argument that some of the worst examples of architecture and planning had happened in the period between 1945-1975 (Kumlin 1995, 1). The primary outcome of the programming efforts is mostly called “facility programming”. In the broadest sense, the term has evolved on a methodological critique of the existing situation that there is a strong need to be systematic to overcome the faults of the earlier design. With its emphasis on the idea of economy as well as simplification of design, transparent and causal description of design process, programming was highly preferred by commercial enterprises and speculators. As such, it has emerged as an expertise in the service of building industry. Then it has become a professional research area operating a set of analytical studies on “establishing goals, collecting and analyzing facts, uncovering and testing concepts, determining needs and finally stating the problem” (Pena and Parshall 2001, 24).

Programmers are often architects who work in programming sections of big architectural and engineering firms and some of them are non-architects specialized in programming and pre-design services of consulting firms (Kumlin 1995, 1-6). In the same period, architectural programming has become a part of architectural education. Kumlin indicates that, training in programming in the university is offered by schools of architecture actualized in two ways: either explicitly as part of the curricula, or implicitly as part of the studio process (Kumlin 1995, 5). AIA's booklets[40] launched in 1966 and 1969 provide the first official interpretations of the issue. They signify the birth of a new disciplinary framework for handling the problems of pre-design services in architecture.

3.1 From Analysis-Synthesis to Programming-Designing

As briefly mentioned in chapter two before, programming studies have emerged as an embodiment of analysis-synthesis in architecture in the 1970s. Following the footsteps of the *scientific method,* programming leads researchers to focus on the "facts," or the details of the user needs by decomposing design problem into its elements. From this perspective, design is assumed as a problem operated in a two-fold process: problem seeking and problem solving. Pena and Parshall describe how the first one, programming, enables the second:

> These are two distinct processes, requiring different attitudes, even different capabilities. Problem solving is a valid approach to design when, indeed, the design solution responds to the client's design problem. Only after a thorough search for pertinent information can the client's design problem be started. "Seek and you shall define!" (Pena and Parshall 2001, 15)

[40] *Emerging Techiques of Architectural Practice* published in 1966, and *Emerging Techiques2: Architectural Programming* published in 1969 are leading documents for the USA in that period.

There is a general assumption that there is a specialization of functions between analysis and synthesis in programming discourse. This assumption finds its equivalences in physics, neurology, and neuropsychology. Studies on the mapping of brain functions, starting in the second half of the 1800s, claim that the brain is functionally divided into two halves. “Analytical thinking is said to be based on the left side of the brain along with the logical and verbal functions. The right side handles the ability to synthetize along with intuitive and spacial capabilities” (Pena and Parshall 2001, 52). In that sense, programming clearly belongs to the left half of the brain whereas design belongs to the right. For that reason, programming must separate from design, and because they have “different qualifications,” programmers and designers should be represented by different people, or the other way round, “he or she must be of two minds and use them alternately” (Pena and Parshall 2001, 17).

The functional division of programming from designing entails a clearly separated pre-design process where the aim is “searching for sufficient information to clarity, to understand and to state the problem” (Pena and Parshall 2001, 15). One can see the effect of analysis-synthesis on the formation and structure of the keywords involved in organizing the programming discourse as follows.

analysis – synthesis

pre-design – design

programming – designing

problem-seeking – problem solving

It was in the 1970s that the idea of programming becomes a vehicle for the scientific method in architecture and settled in architectural practice, theory and education. Since then, programming has evolved as being one of the foundational assumptions of the rationalist perspective needed to realize in various other studies in design research and holds a persistent place in the history of the *DS*. Therefore, the following sections will focus on the key figures and key discursive components of the lineage of programming in architecture started from the 1970s.

3.2 Programming as Problem Seeking: William M. Pena & Steven A. Parshall

Programming enters into the architectural discourse as a novel approach not found previously in known prior art.[41] William Pena and Steven Parshall's book *Problem Seeking* as the first systematic study on the issue of programming in architecture sets the basics of conceptual and theoretical agenda in a context. The book aims to be "a living document of tools, techniques and guidelines for the future advanced programmer" (Pena and Parshall 2001, 9). Although it has been several times revised and reissued by its authors its main structure has remained the same. *Problem Seeking* is structured according to the five levels in the act of programming.They are described under five key terms of goals, facts, concepts, needs, and the problem. (Pena and Parshall 2001, 12)

Since, programming is a phenomenon that examines architecture from the perspective of the applied sciences, the discourse on programming differs from the conventional approaches of design. *Problem Seeking*, as in many other programming books, is constructed on a step-by-step, systematic, prescriptive approach. In the book, the transfer of the knowledge of programming from the expert authors to the field is conveyed through clearly and simply described methods, tools, terms, glossaries, and exemplary cases. The book has its own glossary section called "terms."[42] Even the first three terms – *architectural*

[41] Although programming shares the same epistemological framework (analysis synthesis) with the rational roots of Modern architecture, on account of new methods and technologies, programming project in the 1970s opposes itself to Modern architecture.

[42] Some of the terms under the category of "Theory and Process" are: "architectural programming," "system analysis," "scientific method," "hypothesis," "analysis," "synthesis,"

programming, systems analysis, scientific method – in the glossary show the degree of commitment to the scientific method in programming. In a detailed look at the glossary, one can easily interpret that to reach an architectural program that is "a process leading to the statement of an architectural problem," one must follow the "the principles and procedures used in the systematic pursuit of interdependent, accessible knowledge." (Pena and Parshall 2001, 100)

The idea of externalization of architectural design through the scientific method is the common denominator between the programming discourse of the 1970s and the "first generation" design research studies, namely the *Design Methods* movement. Pena and Parshall's *Problem Seeking* demonstrates the use of this approach through a programmatic framework in architecture.

3.3 Participatory Programming and Social Architecture: Henry Sanoff

Sanoff's contribution to the programming discourse (as well as design research) is of the significance. As one of the earliest researchers in the field, from the early 1970s to the present, he played a key role in developing the conceptual and methodological content of the discourse and strengthened the belief in programming as the core operational component for systematizing the design process.

"research," "operations research," "theory," "generalization," "induction," "deduction," "algorithm," "complex," "organize," "unorganized," "method," "methodology," reasonable, rational, logical, logic, framework, total design "process," and "design."
The terms under the category of "Considerations" are: "considerations," "content," "function," "functions," "functional," "activities," "form," "economy," "time," and "operational."
Some of the terms under the category of "Goals" are: "goal," "objective," "policy," "intention," "aim," "vision," "mission," "philosophy," and "purpose."
Some of the terms under the category of "Facts" are: "information," "fact," "data," "assumption," "truth," "empirical," "parameter," "objectivity," and "skepticism." Some of the terms under the category of "Concepts" are: "concept," "programmatic concepts," "design concepts," "recurring concepts," and "operational concepts."
Some of the terms under the category of "Needs" are: "needs," "wants," "requirement," "performance," and "functional requirements."
Some of the terms under the category of "problem statements" are: "problem statement," "hypothesis," "condition," "design premise," "design criteria," "abstract," and "essence." For a detailed information see (Pena and Parshall 2001)

Richard Dober in the foreword of Sanoff's book *Methods of Architectural Programming* (1977) argues that "programming is a necessary activity in any design process that claims to be responsive to user needs;" it "brings maturity to the architectural arts" (Sanoff 1977, vii). As opposed to the early modern movement's star architects, programming does not include any reference to even a single designer as architect. It rather emphasizes, above all else, "prescriptive" nature of the program as a "communicable statement of intent" on both the design process and the designer. For Sanoff "a program is a communicable statement of intent. It is a prescription for a desired set of events influenced by local constraints, and it states a set of desired conditions and the methods for achieving those conditions" (Sanoff 1977, 4).

The *Methods of Architectural Programming* is a sourcebook of architectural programming. In it, we see four main categories. The first one focuses on the explanation of program and why architecture needs programming, the second and the third clarify methods of information retrieval and its transformation into the design information; then the last one focuses on the applications of programs.

Similar to Pena and Parshall, Sanoff argues that "the sequence of phases of a design project, beginning with program, includes preliminary design, production, construction, and post completion evaluation" (Sanoff 1977, 3). One of the primary interests of programming studies are to make design socially rather than personally valid process. Therefore, as seen from Sanoff's description of the design phases, the whole idea of design settled around the issues of "participation" and "user needs." Different from Pena and Parshall, Sanoff is an active contributor of the design research discourse as well as academia.[43]

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[43] Sanoff is the principal founder of Environmental Design Research Association (EDRA.) he is the active contributor of EDRA and several periodicals such as Design Studies (DS,) International Journal of Architectural research (IJAR,) Middle East technical University

3.4 Programming as Part of the Modernist Functionalist Lineage: Donna Duerk

Another basic reference is Donna Duerk's book *Architectural Programming: Information Management to Design* (1993.) In the introductory part of the book, she points out that programming begins to show itself in architectural publications as a result of the disappointment of *Pruitt Igoe Housing* example, which is designed by Minoru Yamasaki at the end of 1960s. Duerk explicates that in the USA, 1970s represent the decision of demolishing the building blocks due to poor social and behavioral quality, and to their becoming crime scenes. The situation has an influence on the determination of programming as a standard service by the *American Institute of Architects* (*AIA*). According to Duerk, coming after the *Pruitt Igoe* phenomenon, 1980s are the years that programming courses are embraced and willingly given by architectural schools (Duerk 1993, 1). This new programming atmosphere, which she underlines, involves an appreciation and admiration to the roots and values of the functionalist architecture:

> A well programmed building is a functional building. The Pruitt Igoe example shows very painfully that a functional building last a lot longer than a building that merely looks good and is in the latest style. Good architecture is functional, meaningful and beautiful. The costliest mistakes are generally mistakes in programming – the building organization, the circulation patterns, the separation of user groups, the ease of access, and other major relationship patterns – so it pays to do a thorough job of programming. The key to good programming is asking the right questions and organizing the information so that it is readily accessible when needed. A really proficient client will have clear ideas about the desired level of excellence for the design project as well as the associated needs and functions (Duerk 1993, 1-2).

Journal of the Faculty of Architecture, The Geographical Journal, CoDesign, Journal of Architectural Education (JAE,) In light of this statement, one can state that the aim of the book is to underline the importance and role of proper programming and achieve good building via programming. Since it proposes the re-examination of the design process and design product as a main part of architectural procedures, programming as framed in the earlier part of the thesis is different from these approaches.

Duerk emphasizes that the field of programming must be in charge of building the "pragmatic foundation of design information for each design project." In this way, programming is defined as a study area, which is supplied from a pragmatic point of view and formed functional basis of design:

> Much of the inspiration for great buildings is intuitive, whimsical and based upon some rules of formalism rather than pure functionalism. Programming creates the functional basis for design (Duerk 1993, 3).

Duerk's introduction puts forward the fact that there are two kinds of approaches to modern architecture within the programming discourse in the 1970s and 1980s. The one is based on the assumption of modern architecture as a mere stylistic experimentation, and the other is the assumption of modern architecture as a rationalistic experimentation. While the first group severely criticizes the outcomes of the Modern period, the second group, including Duerk, no matter how weak or naïve the modern functionalist project was, appreciates it as a methodological approach and bears on the idea that programming is part of the functionalist lineage.[44]

3.5 Creative Programming: Robert Kumlin

As in other programming sources published between the years from the 1970s to 1990s, Kumlin's book *Architectural Programming* (1995) pictures programming as the foundation of the design process. Different from the rest,

[44] With the term functionalist lineage this study refers to a line of thought, a continuous relation and interaction between discourses aiming to rationalize and externalize architectural knowledge.

it points out the emerging theoretical framework of programming that entails programming as a dynamic and evolving phenomenon. Yet, on the main assumptions of programming, he shares the similar perspective with previous researchers. Kumlin points out that, function of the contemporary programming is to find out:

How should programming be done to achieve architectural excellence?

How can programming help the built environment be more responsive to the user's needs and the needs of the environment?

When should programming be done?

Who should program?

What is a successful facility program and what does it contain? (Kumlin, 1995, 6)

At the end of the book *Architectural Programming,* he remarks the importance of "re-structuring the entire program at the highest level of abstraction to achieve the true mission of the facility." He adds, "programming at this level is a very creative and exciting process" (Kumlin 1995, 192). With this position, he challenges the common assumption that creativity is one of the features of the design process.[45] Under such condition, creativity becomes a responsibility shared by both designing and programming. Yet, another consequence of this approach is that programming and designers are more closely linked.

3.6 Programming / Designing: Edith Cherry

Cherry, as being another basic reference to programming, reminds us of Pena & Parshall's previous category of the "pre-design services," and as they did

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[45] On creativity, Pena and Parshal underline that: "Does programming inhibit creativity? Definitely not! Programming establishes the considerations, the limits, and the possibilities of the design problem. (We prefer "considerations" to "constraints" to avoid being petulant.) Creativity thrives when the limits of a problem are known." (Pena and Parshall 2001, 19)

address the place of programming in the preliminary design phase under the "problem seeking" issue. For her, problem seeking consists of five steps:

Establish goals

Collect, organize, and analyze facts,

Uncover and test concepts

Determine needs

State the problem

As in Cherry's formulation, these steps are under the effect of four features; form, function, economy and time (Cherry 1999, 43). Through these four features, architects determine goals, organize and constitute the result of programming effort (Cherry 1999, 102).

Rather than its history, Cherry focuses on the epistemological values of programming. She argues that architectural programming is inherent in our conception of the world, and it "has always occurred at some level of consciousness." To exemplify her claim, she points out some scenarios (Cherry 1999, 4-5):

1) To finding a shelter for not to be wet under the rain, (unconscious behavior of problem solution);

2) To adding a new room to a house for a newborn baby according to the traditional local building techniques, (conscious behavior of problem solving, but unconscious design act); and

3) To decide the need of a new school building and consciously prepare a program to build it step by step by various service providers and users (school board, architectural programmer, designer, contractor, students and teachers…etc.) (conscious effort to design).

For her, each scenario illustrates a different approach to solving problems of shelter need. The main difference among them is the degree of consciousness for the people who are involved in the design process (Cherry 1999, 5).

One of the main naivetés of the early programming researchers is that they assume that analytical features of the programming phase can be transferred to the design phase without any damage or loss. However, the weakest point of the analysis-synthesis paradigm is exactly at that relation, actually a gap, between analysis and synthesis. As different from her predecessors, Cherry assumes a closer, more conscious, and a more interactive relation between programming and design. Her position is important in the sense that such relation might be a sign of the possibility of a designerly framework.

3.7 The Program is the Design: Robert Hershberger

Late 1990s saw the emergence of theorization and critical perspectives on architectural programming. As stated by Hershberger, his book *Architectural Programming* (1999) differs from others in three points: in its being educational, discursive, and especially in its emphasis on "qualitative, or value issues" (Hershberger 1999, x). Similar to previous researchers in chapter three, he defines programming as a definitional stage of design:

> Programming is the definitional stage of design-the time to discover the nature of the design problem, rather than the nature of the design solution (Hershberger 1999, 1).

Yet, Hershberger's position differs on the relation of architectural design. In the book, programming is expressed through the motto of Calvin C. Straub:

> "The program is the design!" (Hershberger 1999, 3)

Hershberger underlines that "historically, programming appears to have fallen outside of normal architectural services." He states that program or "client brief" has traditionally been viewed as a "very short list of the required rooms and their square footages with very little explanation of values of client, users, or society; purposes to be served by the building; relationships between the spaces and so on.” However, with the emergence of more complicated buildings, programming has become a professional service (Hershberger 1999, 6). Problem of complexity and qualitative issues of architecture are the main motivators for Hershberger to study on programming.

Based on that framework, Hershberger’s *Architectural Programming* focuses on the issue of architectural form. He does not exclude, ignore or despise architectural form as commonly done by programmers. On the contrary, he underlines that qualitative issues and especially form are the most vulnerable parts of architectural programming. His hypothesis is that architectural form “is not simply the result of physical forces or any single causal factor, but is the consequence of a whole range of socio-cultural factors seen in their broadest terms” (Hershberger 1999, x). For example:

> Given a certain climate, the availability of certain materials, and the constraints and capabilities of a given level of technology, what finally decides the form of a dwelling, and molds the spaces and their relationships, is the vision that people have of the ideal life. (Hershberger 1999, xi)

Hershberger prefers not to give a usual answer to the question of “whether programming and design are necessarily separated and sequential activities, and the corollary question of whether the programmer and the designer can or should be the same individual.” He, as both, architect and programmer, points out the importance of constructing a fertile dialogue between program and values of design, in this case form (Hershberger 1999, xi).

Although Hershberger points out a dialogue between programming and design, his critique does not directly include its established methodology: analysis/synthesis. On the other hand, he is determined to change conventional programmatic view. His purpose is then to make a progress toward a “program for architecture:” (Hershberger 1999, 4-5).

> A carefully conceived and executed program should promote architecture. It should not focus exclusively on "defining the problem." It should serve as a vehicle to "question the problem," to discover the nature of the "institution," to explore the values of society, client, user, and architect; to uncover constraints and opportunities, so that in the hands of a talented designer, the program becomes a guidepost for achieving architecture (Hershberger 1999, 5).

Compared to the earlier researchers and the mainstream programming discourse, Hershberger has a holistic approach to programming.

3.8 Programming Discourse in *Design Studies*

For architecture,[46] issues of program and programming in the 1970s provide a new framework grounded on the idea of reinterpreting architecture as a "science." Although understanding architecture through science is not new,[47] the context in which it occurs is.

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[46] Different from the younger design disciplines, design research's effect on architecture is established as to support architecture's self-critical revivalist perspective, which is sourced from the disappointment induced by the project of Modern architecture after the World War II, with a revolutionary vision. This has brought forward the idea of a new beginning via cutting off from the "traditional" roots of architecture in the design research field and therefore in the *DS*.

[47] From analogy to theory, philosophical and practical aspects of science play a crucial role in re-consideration of architecture. Followings are a spectrum of studies addressing the relationship between science and architecture just before the launch of the *DS*.

Alberto Perez-Gomez clarifies crucial role of scientific metaphors in shaping the foundations of the discourse of the Modern architecture, how they provide a ground for its functionalist, programmatic proposals and elevate it to a status of "legitimate form of knowledge." He points out that: "Scientific metaphors 'applied' through instrumental thinking have been common in architecture during the last two centuries, from 'functionalism' itself, a mathematical metaphor with its origins in differential calculus and the laws of maxima and minima, to more specific biological or mechanical metaphors used to describe buildings' internal efficiency or aesthetic character" (Perez-Gomez 1999, 337). Similar to Perez-Gomez, Michael Hays points out the circulation of scientific analogy and its significance within the discourse of the Modern architecture. He traces Hannes Meyer's studies reflected in his demand for "an extreme precision in thought" and architecture "as the organization of an organic whole … as a scientific communication system- a program, a set of functions and procedures, a biological process." (Hays 1999, 249) "A central strand of canonical high modernism" as underlined by Galison is the relation between science and architecture which was constructed by Vienna School and the Meyer's Bauhaus for the purpose of realization of "a modern form of life" in the late 1920s (Gallison 1990, 711-712). Based on an "antiphilosophical philosophy" of the logical positivism, the quest for constructing a modern form of life considering "new arts" and "new philosophy" as just the "different sides of a single life" resulted in a radical shift away

From the late 1960s to 1970s, “the study of design methods tended to give way to the study of the principles for erecting and manipulating models of the things or systems being designed” (Archer 1981, 31). Emphasis on the academic studies and emergence of the postgraduate education in the late 1970s, instead of the commercially funded studies and experimental teaching[48] in the 1960s, set the scope of the foundational years of the *DS*. It is the same period that design research “became heavily involved in the development of computer aids to designing” (Archer 1981, 31). The pursuit for a systematic understanding and computer involvement in design theory and practice in the

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from “decorative, mystical, and metaphysical,” toward the “streamlined and industrial” (Gallison 1990, 710,715). The vision of life resulted in the scientific orientation of architecture proposed by the logical positivists seems to be a signal for and lead to an almost organic interference between engineering and architecture which will be clearly visible in the design research discourse in thirty years later. Starting from the 1950s, architecture’s relation with science goes hand in hand with the idea of its being a theory. Architectural theory as transferred from science and especially from the scientific method (*analysis-synthesis*) is well described by John Summerson’s famous speech at the *Royal Institute of British Architects* in 1957. Summerson argues that as it is shown by the recent history of architecture, the idea of theorizing architecture is motivated by seeking a “firmer ground,” for finding the “ultimate authority,” “the source of unity” of modern architecture. With scientific theories in mind, he describes architecture as a result of the critical accumulation of architectural thought (*sui generis*) being developed phase by phase with its own dialectic starting from Alberti to the pioneers of the modern architecture. “It is a historical process advancing by a series of contradictions and reassessments” that we might call the rational architectural tradition (Summerson 1957, 229). Summerson’s idea might be roughly expressed by saying that “the only authentic source of unity in modern architecture would be found in the program.” As pointed out by Anthony Vidler, the issue of program and how it could be framed has interested another historian, Reyner Banham (Vidler 2005, 127). However, unlike Summerson’s pessimism on the realization of a unitary theory of architecture, Reyner Banham assumes the possibility of finding a satisfying answer to the relation of visual and contentional issues of architecture on the ground of the real science. Thereupon, he launched a series of enquiries on the problems of “the first machine age” of architecture in the *Architectural Review,* in 1960 (Banham 1960). For Banham, rather than the end product oriented (stylistic) modernist approaches, “the second machine age” requires the futurism of Buckminster Fuller who aims to exploit “the every benefit of science and technology” (Banham 1989, 327). In the *Utopia and Oblivion*, Buckminster Fuller emphasizes the emancipating science from its “blind flying” on instruments and the importance of reducing the “plurality of subjectively experienced pattern cognitions into conceptually reorganized patterns of generalized principles.” He makes a scientific goal-oriented definition of design by exemplifying and transforming teleological issues from various scientific domains such as behavioral studies, genetics, and computation. The “design science” he addressed and diagrammatized in his book is then based on the transformation of subjective experiences to objective and generalized principles. (Fuller 1969).

[48] Such as Hoschule fur Gestaltung at Ulm. Archer states that: “I must admit that we were much more successful at doing it than explaining it” (Archer 1981, 31)

late 1970s assumes the main framework of design research and, therefore, program to handle complexities in a truly systematic approach.

The historical background of program in architecture is deeper than the scope of the *DS*. On the other hand, since design research has an aim of cutting "traditional" design approaches and methods off from the emerging studies of design the exploration of program in the context of the design research, the *DS* enables higher sensitivity for the analysis of the present day situation.

The concept of program in the *DS* seemingly has three main sources: program coming from architecture, program coming from computation, and thought contents of program coming from design research. This third group can be classified into another two subgroups: studies that engage design from a holistic perspective, and studies that have a piecemeal, analytical approach to design.

3.9 Program Coming from Architecture

The concept of program has become apparent with the emergence of the themes "user involvement" and "participation," as the underlying motivations of design research and the *DS*. Both criticize the "traditional"[49] ways of

[49] One of the legacies of the *Design Methods* movement is a clear rejection of the "traditional" way of designing. In his famous book *Design Methods: Seeds of Human Futures* (1970), which has become one of the standard textbooks on the subject, under the second and third chapters namely "Traditional Methods," and "The Need for New Methods," Chris Jones argues what the traditional means for the *Design Methods*. With the idea of being against "traditional", he refers to a novel understanding of design as skilled craftsmanship with the aim of an "initiation of change in man-made things." The idea puts the designer forward as a "maker-of-things" over "maker-of-drawings." In the book the adjective *traditional* is used to describe "old idea of design as the drawing of objects that are then to be built or manufactured." For Jones such an approach necessitates "the principle of deciding the form of the whole before the details has been explored outside the mind of the chief designer." On the other hand, in novel situations, "designing begins by the taking-in of information. From this, a set of alternative arrangements for the design as a whole is quickly derived. [and then, the following section] is to select one of these alternatives for further development. When this design has reached the point of satisfying the chief designer the work is split up for detailed design by many people working in parallel."
For a detailed information see: (C. Jones 1970, 24)

approaching design and are concerned with developing methods and tools for decision making in collaborative design. The indispensability of program for the two motivations comes from its ability to maintain “a communicative statement of intent” between the different parties of design as well as from the need for a high degree of control required for a large number of dynamic data. As a foundation for a radically collaborative (therefore humanistic) design environment, program is described as “a desired set of events influenced by local constraints, and it states a set of desired conditions and the methods for achieving those conditions” (Sanoff 1977, 4). It is also:

> a formal communication between designer and client in order to determine that the client's needs and values are clearly stated and understood. It provides a method for decision-making and rationale for future decisions. It encourages greater client participation, as well as user feedback. [It] also serves as a log, a memory, and a set of conditions that are amenable to post construction evaluation... In sum, it is an operating procedure for systematizing the design process (Sanoff 1977, 4).

Under such arguments, program takes a complex and multi-layered role especially at the pre-design and the post-construction evaluation stages. It is based on a systematic elucidation of the design process by asking the questions of how the various types of raw data are processed before, during and after the architectural design and how they are collectively transformed to an end-product. The search for program in the *DS* also draws attention to a sensibility towards various kinds of representations of the user.

Programming finds its representation in the *DS* almost continuously in its first ten years. This was essentially related to program being the most important actor of systematizing design, which has an ideal behind the establishment of the *DS*. One of the first examples of this representation is Roderick Lawrence’s (1982) article. Introducing Broadbent as a principal critic of the ongoing participatory design studies, Lawrence develops a critical discussion by elucidating potential pitfalls of the participation and reviews previous critical positions against the participatory studies. He then, points out that the deterministic design methods and deterministic means of participation must be seen as a danger on the existence of design and the designer (Lawrence 1982, 99).

Lawrence explains the counter-participatory arguments in design research with reference to Broadbent. For Broadbent, non-participatory methods in design "have been remarkably successful," on the other hand, participatory ones are incompatible with the phenomenological approach. He also argues that collectivist approach was never intended to involve the architect and planner from the design process, but to exclude him. Participation in planning is an ideological tenet of left-wing political dogma founded upon "that 19th century version of Utopia in which all men being equal lived together in collaborative harmony" [50] (G. Broadbent 1981).

In another study published a year later, Lawrence (1983) redefines the issues related with behavioral studies and participation from the perspective of programming more clearly. His main argument is that "there is still no comprehensive methodology for the study of the interaction between people and their physical surroundings" (Lawrence 1983, 76). Participation as a goal is generally adopted by authors in diverse disciplines and has been engaged piecemeal.

On the other hand, Lawrence highlights developments of the behavioral issues in architecture for reaching a satisfactory redefinition and enrichment of research in the field.

Under this topic, we see issues of participation and user in a constant conflict with the existing architectural knowledge. Despite the facts that these issues fit a naive holistic view of the field of design and that they contain possibly

[50] It is important to note that, a futurist version of similar utopian approach underlined by Broadbent and Lawrence exists in Banham especially in his editorialship in 1960 in *Architectural Review*.

fruitful strategies for design, scholars such as Broadbent and Lawrence still interpret them to be as reductionist based on the shortsighted description of all aspects of design under the terms participation and/or collaboration. In other words, they ignore establishing an equation between architecture and these behavioral issues. Furthermore, since in participatory/collaborative approach, the decision-making process falls under the control of "utility," cultural issues are not considered. This is a failure beyond the point reached by the model proposed by Sullivan at the beginning of the last century. Reductionist formulation of design as participation/collaboration mainly falls short emphasizing and conceptualizing the place and importance of creativity in the making of form.[51]

As another major documentary contribution to the programming issue in the field, a special issue of *DS* should be taken into account. Based on a research conducted under the editorship of Purcell and under the governance of Schön (MIT), July issue of the *DS* in 1984 has a particular importance in the sense that it provides new initiatives not only for design research but also for programming. [52] The study also brings an international research atmosphere to the journal, which it relatively lacked before. Another difference is basically its emphasis on the inclusiveness of design, which incorporates areas, which the tradition of design method tends to exclude, such as history/theory and philosophy. However, the most striking of all, for the first time in the history of the journal, a group of articles (including Schön, Anderson, Andreotti, and

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[51] This area, as far as it was left to the assumption "analysis drives synthesis," the decision making process will be operated not by the layman but by the "gap" as it was formulated by Sullivan.

[52] Schön introduces the core members of the research group consisted of: Stanford Anderson, architectural historian and critic; John Habraken, architect and developer of the SAR (Foundation of Architects Research) design methodology; Gary Hack, urban and environmental designer; and Schön himself, philosopher. Subsequent members are: Aaron Fleisher, member of the Department of Urban Studies and Planning; Larry Bucciarelli, engineer; Edward Robbins, anthropologist; and Patrick Purcell, design researcher and computer technologist. There are other participants included: Dana Cuff of Rice University, USA; John Forrester of Cornell University, USA; and Gavriella Goldschmidt of the Technion, Israel. The research also has several student members: Libero Andreotti, Mitsy Canto, Mark Gross, Vivianna Metalinou and Altaf Mullah.

Metallinou) have been grounded their arguments on a phenomenological framework, rather than on scientific method.

Article of Schön, in the issue represents a significant alternative perspective in the field due to its tendency to re-engagement with the master-apprentice structure, and with the architectural tradition (as natural components of design), which was traditionally rejected by design research and by the approaches, which are based on programming.

The idea of program in Anderson, Andreotti, and Metallinou is shaped by the Lakatosian perspective. Their works are also unique in the field and the journal since they define program as a series of research programmes. As guided by a "hard core," here program is assumed to be surrounded by a "protective belt of subsidiary hypotheses which 'give' in response to unfolding discoveries and problems" (Schön 1984, 131).

The issue is also important in the interpretation of programming based on computation. Providing the second kind of approach to programming, the computation group consists of articles of Fleisher, Habraken and Gross. These studies view design as a structure consisting of rules, procedures and notations and they mainly focus on constraints. Program as having a particular importance in this conceptualization and transformation is utilized for the structuring of the aforementioned set of rules, procedures and notations. The concept is interpreted as a description of a procedure or a process that is analogous to a computer program, which leads us to a solution through a series of calculations/computations.

The computational approach takes program as factual and rule based with reference to the computational processes. On the other hand, in the phenomenological approach - (Schön 1984) (Anderson 1984) (Andreotti 1984) (Metallinou 1984) - although program is viewed as a core that controls the whole, it is taken as a flexible structure which is fed by a set of hypotheses (protective belt) surrounding the core. They define program as a decision-making mechanism, which such research tends to observe, and clarify in the works of the masters. In this sense, they do not confine design within a frame of determinist programming but rather permit creativity. While the computationalist group of studies contributes much to the understanding of computers (with reference to design) and transform the design with reference to the numeric logic of computers, the phenomenology-based group has a large potential for understanding design and design education.

The difference of these studies is that they focus on finalized studies (cases, exemplars, precedents, etc.) and try to define/describe design (processes) through previous architectural works. In that sense, they are clearly conjectural in nature. Their authors seem to believe that what comes out of past examinations can be used to produce new solutions (via reprocessing and reinterpretation). In this sense, they put emphasis on notions such as evolution, transformation, adaptation, and also reinterpretation and reevaluation of design ideas, which control the whole. The design idea is deemed holistic and not conceived through bits and pieces. For this view, this (preserving and protecting the core even it transforms, bends, and changes throughout the process) is the essence of good design which should be observed in the works (and processes) of experts, and in turn be followed the design education.

Traditionally while the scientific method tries to understand the phenomena by breaking it into bits and pieces, in this approach one never lose the idea of the whole and the whole itself. Holistic here does not refer to repetition of some pattern, form and framework without changing it, but a possibility to change, transform and bend almost everything without losing the basic idea. Data or information is utilized with respect to this structure and the process it implies. This type of conception, while permitting numeric data, does not take these as indispensable.

It is with this shift of understanding that we saw the emergence of a new critical conjectural contribution to design research. In the journal, Schön adapts Lakatos' ideas of a research program to the field of design as follows:

> Architectural designing can be understood as a kind of experimentation... Making a design move in a situation can serve, at once, to test a hypothesis, explore phenomena, and affirm or negate the move... The very invention of a move or hypothesis depends on a normative framing of the situation, a setting of some problems to be solved. In the evaluation of a move, the designer asks whether he gets what he intends and whether, on the whole, he likes what he gets. When moves function in an exploratory way, the designer allows the situation to 'talk back' to him, causing him to see things in a new way - to construct new meanings and intentions. It is only within the framework of an appreciative system -- with its likings, preferences, values, norms, and meanings -- that design experimentation can achieve a kind of objectivity. Although a designer's likes and dislikes are subjective, and may even be arbitrary, he can discover, independent of mere think-so, whether his moves have produced something he likes. (Schön 1984, 132)

Starting with a hypothesis, testing it, exploring phenomena, and affirming or negating to move… these steps are the main structure of the paradigm of conjectures-refutations. Schön is one of the first figures in design research who contributes to the development of an alternative, post positivist, design research paradigm.[53] His first published study (Schön 1984) in the *DS* is

[53] With the term post positivist design paradigm, this study refers to a counter Baconian perspective of scientific enquiry that emerged in the middle of the twentieth century. By depending largely on Karl Popper's studies on the asymmetry between verification and falsification, Kuhnian notions of paradigms and paradigm shift and Lakatosian notion of the research programmes, post positivist understanding becomes an alternative paradigm for several pioneering figures of the design research in the 1970s. Post positivist ideas enter into the design discourses, therefore into the *DS*, as coming from two geographical sources: UK and USA. Naturally, contribution of post positivist frameworks to *DS* comes primarily from the UK. As seen from the 1984 special issue of the "design research," only after the mid-1980s there emerged the USA contribution. In the context of these criteria, in the first group studies we see the names of: Bruce Archer (Archer 1979), Jane Darke (Darke 1979), Philip Steadman (Steadman 1979), Douglas Lewin (Lewin 1979), Geoffrey Broadbent (as being the reference of other studies such as in Robert Fowles, Reg Talbot and Patrick Lawrence (Fowles 1979) (Talbot 1981) (Lawrence 1982), and in the second group we see the names of: Donald Schön (Schön 1984) (Schön 1988), and Stanford Anderson (Anderson 1984).

mainly a written report of a protocol analysis study made at MIT. It focuses on the interpretive operations of a phenomenological[54] understanding of the design. As being an observer, he takes notes about the review processes of some students in the studio and investigates whether, the cases are appropriate for explaining in a phenomenological framework.

As another example of conjectural approach in the journal, Anderson reviews architectural knowledge from a Lakatosian perspective and claims that "Lakatos' methodology of scientific research programmes may provide an explanatory and normative model of design processes" (Anderson 1984, 147).

As opposed to the a-historical, a-cultural dominant paradigm of the (naïve) scientific method, and its main proposals that "architectural design should be changed all over!," "it should become science!"[55] Lakatos presents a counter argument. For him, since both architecture and science are "constructions of culture," they are not alien to each other. In both fields," research program is built around a particular problem situation" which means that both are derived from strongly "temporal and historical" context. (Anderson 1984, 148). The structure of research programmes is explained by Anderson:

> In the course of a research programme there is a series of theoretical states. Each of these theoretical states retains a common element, and it is the constancy of this common element, which identifies the series as a single programme (Anderson 1984, 148).

The most significant contribution of Lakatos comes from his remarks on the critical conventionalism[56] involved in the nature of programme. By following Lakatos, Anderson states that, the "conventional element of science has

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[54] With the phenomenological approach to the architectural design, Schön means that "designing is a reflective conversation with materials whose basic structure-seeing-moving-seeing- is an interaction of designing and discovering." (Schön 1992, 154)

[55] Scholars of architectural programming tradition such as Pena & Parshall (1969,) Sanoff (1970,) Duerk (1993,) Kumlin (1995,) Cherry (1999,) and Hershberger (1999.) bear on that proposition.

[56] Critical conventionalism of programme is derived from the union of non-critical hard core, and critical, changeable, auxiliary hypotheses.

invaded the very core of the scientific enterprise. Convention is an aspect of that which assures the maintenance of the programme"(Anderson 1984, 148). This position of being opposed to the positivist roots of design research, being opposed to starting from scratch each time, is not the accustomed way of describing design; it is even against the roots of design research. Presumably it is this very shift in position, which provides a link between architectural knowledge and contemporary inquiries of design as well as link between architectural historians like Stanford Anderson and design research.[57] Only after the emergence of the *DS*, examination of the fruitfulness of paradigms has become possible. That is why, *DS*' early issues and the "design research" special issue launched in 1984 are very special in both understanding a call for a paradigmatic shift in the program and in design.

Issues of program and programming as coming from architectural issues in the *DS* seem to be oscillating between the two paradigms: the scientific method and post positivist conjectural paradigms. Although being part of its foundational aims, conjectural approaches, with the dominance of computer-biased studies,[58] more and more become remote from affecting the main structure of the *DS*.

3.10 Program Coming from Computation

The quest for transforming architecture to "nothing but reasoning" (Y. Friedman 1975, xi) through the scientific method, casts the architect as an "indispensable middleman," "a translator of the specific needs of the client into

[57] It is also this shift in position, which provides radical extremisms of the conception of science. In Libero Andreotti's study, exact sciences and relativism, i.e. "radical anarchistic theories" of Paul Feyerabend, pointed out as the two extremes of the conception of science (Andreotti 1984, 159-160). On that point, it is worth remembering that since *DS* was founded on the ruins of the *Design Methods* movement, it is not surprising that it still includes a large amount of studies closes to the Baconian, exact sciences. On the other hand, Feyerabend's *Against Method* (1975) is referred only by a handful of post positivist approach.
[58] With the term "computer-biased studies", this study refers the rebirth of the *scientific method* within the field of computation and design research's suppression on behalf of a comfort zone created by the extremely analytical procedures of the mainstream computation studies.

a language comprehensible to the skilled tradesman" (Y. Friedman 1975, 2). Friedman's formulation of architecture is an exact importation from information theory. According to that:

> Every science, every discipline or system, is essentially based on information. We can sum up the specific nature of a science or an art by defining the following points: 1) "how (or by whom) the significant message was sent, 2) how it was transmitted, and 3) the message which reached the recipient." (Y. Friedman 1975, 6)

Since the 60s, design has been studied from the point of view of information systems and knowledge-based approaches. In the 70s and especially in the 80s, "formalization, representation and manipulation of knowledge in computers have made it possible to construct knowledge-based design systems" (Coyne, Rosenman, et al. 1990). Such systems are believed to have the potential to produce fundamental changes in design. How this assumption shapes the mainstream description of an information based model of design, as different from the traditional one, can be traced in Friedman:

> In the traditional process, as we have seen, the mechanism worked this way: the architect (or the planner) and the builder were only the "channel" by which "information content," or the "message," that is, the specific needs of the user, were relayed to the finished building. This process was a simple one, made up of a *transmitting station* (the future user), a *channel* (the architect and the builder together), *a receiving station* (the hardware, or finished building, and information return or *feedback* (the usefulness of the product made available to the client). This system allowed no corrections, no adjustments in case the feedback was unsatisfactory…. [But] when this system was altered to serve an increased number of "future users" it became fundamentally different.

The difference focuses on two interrelated points. The first one is that handling a much varied and complexified information and utilizing it towards a finished product opens up a new unknown research area. The second one is that such a situation obliges the role of a traditional architect to change. As underlined by

Coyne, the role of computers in design has been largely developed as a remedy for these two issues.

> Information technology is a medium for the "transmission, conservation, and increase of data, information and knowledge…We need computers to cope with the vast amount of data that is being generated. The data is generated by a technological system in which computers are totally implicated…technologies are implicated in our whole way of being. (Coyne 1995, 31)

Computational roots of architectural design are far more before the invention of the electronic digital computers, which were completed in the late 1940s. As it is traced through the works of Carpo (2001) (2003), March (1999), and Wittkower (1989), in the natural sciences, Ptolemy (Almagest - AD100-170), Copernicus (astrological calculations - 1543), Napier (logarithmic tables - 1619), Newton and Leibniz (fluxions, calculus - 1670s) would be considered as the earliest examples of the computationalist paradigm (Liddament 1999). There are some non-architectural studies focusing on the task of numerical/digital understanding of the architectural objects. They would be taken as the earliest representatives of the issues of the computationalist paradigm such as: discovery of order in the ancient Egyptian Babylonian and Greek civilizations around the third millennium BC ((Wittkower 1989); treatises of the master architectures of the Renaissance, especially Leon Battista Alberti in 1452, Sebastiano Serlio in 1545, Vignola in 1562; reinterpretation of the classical orders in Palladio's works in 1570 and Claude Perrault's treatise in 1683. Overall, their pursuit of the numerical preciseness in the representation of the visual architectural objects might be taken as the earlier examinations of computational reasoning in architecture.

As distinct from the above mentioned more general framework, the foundation of the theory of computer science as we know today was mainly laid out by Kurt Gödel in 1931, and Alan Turing in 1936. Behind the electronic computing there were computing engines which were developed by Charles Babbage around 1792-1871. The date for the first working electronic computer was 1946.

Following these developments, the combination of studies of computation and design begins in the early 1970s. Technical and programmatic contributions of Allen Newell and Herbert Simon were in the 1950s and their theoretical and design related contributions were at the early 1970s.Within such studies, Newel & Simon argued that design can be taken as a generalizable problem solving act and computation can become a direct source to the production of design knowledge. The short retrospective analysis below provides a foundational ground for the study of computer in design.

As being the fundamental constituent of the rational tradition of architecture since the eighteenth century, adaptation to the computational and knowledge-based new environment with the emphasis on participation and collaboration was not a challenge for the architectural program. [59] On the contrary, it was almost a reborn, after the abandonment of the *Design Methods* project in the early 1970s. The rebirth even brought feeling of relief after its being initially cut short as a static, irrelevant, mechanistic framework for architectural design.[60]

Lately, program and programming is generally used as a concept that involves computerized processes and methods, by various fields such as: systems theory, knowledge based design, information theory, information technology, computation, digital design, CAD, CAAD, DAD, engineering design. Approaching from such fields can makes some changes in the traditional conception of architectural program. However, what is hard to change in them

[59] Although *Design Methods* movement describes itself as a novel approach, Broadbent claims the opposite. He points out that "behaviourists were characterized as latter day functionalists wanting to observe human behaviour by empirical methods, to quantify it, to set up models of man/environment interactions and to use these as a basis for designing." (Broadbent 1979, 42)

[60] Presumably, that was this feeling behind Archer's mind when he begins his article with a salutation of "Design methodology is alive and well, and living under the name of Design research." in the very first issue of the *DS* in 1979.

seems to be their noncritical “computationalist” understanding of design settled in the framework of analysis-synthesis.

Rational problem solving (with the computerization and digitalization of design) is one of the most pervasive and influential paradigms currently active in the area of design research. The term “computationalism,” coined by Liddament in 1999, points out the increasing effects of computer in design by means of rationalization since the 1960s, and how computers becomes the carriers of scientific rational approaches in design.[61] The main method of computationalism is “to render problem solving processes (including design problem solving) amenable not only to algorithmic methods but also to various forms of generalizable problem solving heuristics (which might eventually be reducible to algorithms[62])” (Liddament 1999, 42).

With this in mind, if we focus on the programming discourse in the *DS*, what we will see is a good number of computationalist articles in the journal, from the very first issue to the present day. Even in the first year of the journal, between the mid-1979 and 1980, computer as a contributor to design, together with the task of programming can be observed throughout the issues as the main theme. Linking computers to design clearly is one of the main missions of the *DS*. The journal seems to build on the idea of planning a future vision of

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[61] In the design research discourse, the term “computationalist paradigm” is first used by Liddament in 1999 for expressing one of the most pervasive and influential paradigms operating in the contemporary design research. It refers incorporating computation as part of the problem solving process. “Computationalist techniques are paradigmatic examples of a particular kind of language-game, and their utility is evidenced by the very ubiquity of their employment throughout a wide range of disciplines, including the domain of design. But ...they are traditionally rooted in an epistemology which cannot, as we approach the end of the twentieth century, be made to fit our growing understanding of the nature of language and its role in the development of our conceptual framework “ (Liddament 1999, 55-56).

[62] In Merriam Webster, following the definitions of “algorithm” is given: “a procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation; broadly : a step-by-step procedure for solving a problem or accomplishing some end especially by a computer”, “a procedure that produces the answer to a question or the solution to a problem in a finite number of steps. An algorithm that produces a yes or no answer is called a decision procedure; one that leads to a solution is a computation procedure. A mathematical formula and the instructions in a computer program are examples of algorithms.”

design on the existing twenty years of computer experience in the field. By looking at the number of the computationalist articles in the very first issues of *D*S, it can be easily said that *DS* aims a closer designer-computer relationship. Doubtless, the primary component of this vision is good old-fashioned idea of program.

For example, John and Carroll's article, "The Psychological Study of Design," is a study that is structured with the intention of examining design, exactly in this field. In a similar fashion, in 1980, in the fifth issue, Sydney Gregory reviews Yourdan's book, *Managing the Structured Techniques*. He points out the importance of advancing programming methods in design via computation, and identifies "structured programming" as having quite a potential for improving the field:

> Structured programming as such provides a design approach to reduce difficulties with large systems... Programming techniques bear a strong affinity to design methods...Here, in the case of programming, is substantial evidence in favor of specific programming techniques which lends colour to the possibility that design methods of a comparable character may indeed be of value to the user. This "is a subject worthy of further exploration (Gregory 1980, 316).

Alwyn Jones presents us the concept of computer programming as a new tool and a component of system analysis newly infiltrating participatory design. "System analysis" was established in the mid-1960s, Jones claims that system analysis has potential to contribute to design and that "systems analyst, in spite of his title, is in fact truly a designer." The reason for this might be that system analysis deals with the problem of "how to reach creative types within the framework of known procedures?" System analysis then is "a good-old-fashioned disciplined approach to work, with new logical techniques relevant to the science of computer programming" (A. Jones 1980, 180).

Charles Eastman's article "Information and Databases in Design," in the same issue, defines the link between design and computer from an information processing perspective. Eastman claims that “designing can be studied as an information processing task,” and argues that the transfer of information storage, management, and processing techniques, have a great value to develop “manual” design.

> One way to understand designing is in terms of information processing. A designer transforms a design problem into a solution by applying operations, using semantic criteria to guide him. This view suggests that a 'natural' relation exists between design and the various computer tools for information management, such as databases (Eastman 1980, 146).

Eastman mentions programming languages, such as PASCAL and ALGOL 68. While he explains how programming is developed to answer existing problems, stresses the importance of following them closely. His closing words have a foresight on the relation of computer and architecture; on why architecture needs to learn new techniques; and on how essential an in-depth understanding of computation by architecture:

> Eventually, I expect that almost all architecture will be done at graphic consoles and that these devices will be as common as drafting tables. However, much is unknown about how such a reality will operate. It is important to note that most of the basic computer science issues needed seem resolved, if only we learn how to use them well (Eastman 1980, 151).

In 1980, Berger published an article titled “Artificial Intelligence and its Impact on Computer-Aided Design,” in which he lists the advantage and disadvantages of artificial intelligence (AI) in design. In the next issue of the same year, Gero’s article “Computer-aided Design by Optimization in Architecture,” re-examines design and analyzes how computer-aided optimization is relevant to it. In another article, based on the idea that “any problem that can be defined as computationally, can be solved by optimization,” Gero, tries to re-define decision-making procedures in design. As part of his inquiry on computation, in the article, he focuses on “dynamic programming optimization” and “multi-objective design” (Gero 1980, 227).

Cooley's article in the fourth issue claims the importance of the contribution of computers to design and yet, warns designers of the possibility of their becoming Trojan horses, which invite Taylorism to design, and damage the creativity grounded on human-centered tacit knowledge. As seen from the examples, since the beginning of nineteen eighties, the task of transforming computer-aided design from theory to practice is highly popular theme in the *DS*. Rzevski's "Validation of Design Methodology" article can be considered in this category (Rzevski, Woolman and Trafford 1980).

Emphasis on programming, which we observe more or less in almost each article of *DS* between the years 1979 and 1980, can be detected in the following issues as well. In *DS*, from the first issue to the present day, researchers like Sydney Gregory, Charles Eastman, Patrick Purcell, Anthony Ward, Richard Coyne, Nigel Cross, and many more other names focus on these issues repeatedly. In that sense, it can be stated that programming issue in design research and the *DS* is not belong to a specific period. It is one of the core issues in the field. In addition to individual articles, programming has been highlighted in various special issues of the journal from 1984 to the present. The themes of the special issues are concentrating: Information Technology (1984), Design Coalition Team(1986), Analyzing Design Activity (1995), Design Cognition and Computation (1996), Descriptive Models of Design (1997), Digital Design (2006), Participatory Design(2007), and Interaction Design and Creative Practice (2008).

The issue of "Digital Design" has a special place for the programming literature for its manifestal character in describing the role of computer and computation in architectural design. The term "digital design"[63] there refers to

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[63] In the context of architecture, the term "digital design" mostly indicates a field which we are so familiar to hear to be expressed as "revolutionary," "new," "nonexistent before," and "dissimilar to any old or traditional ways of design" (R. Oxman 2006) (R. Oxman 2008) (Chu 2006) (Lynn 1999) (Kolarevic 2005). As part of the design research tradition, it rather constructs a safe heaven, an autonomous, free, trial and error zone. It requires its own

an advanced position for computation and challenges traditional means of designing in architecture.

The first study in the issue is Özkaya and Akın's "Requirement-Driven Design: Assistance for Information Traceability in Design Computing". In reference to standard documents of *American Institute of Architects*, authors define design as a requirement-driven rational process and investigate on how requirement management task is overlap with the pre-design stage of design, another word with programming (Özkaya and Akın 2006, 384).

They describe programming as an inseparable part of design. They emphasize that it is "a process of problem identification, information collection, and information organization resulting in a communicable statement of intent" (Özkaya and Akın 2006, 385). Özkaya and Akın define programming as "problem definition" and a "statement of intent," like Pena and Parshall.[64]

The second article in the issue is a radical manifesto by the issue editor Rivka Oxman. Two years later, yet in other DS article, Oxman manifests that the maturity of digital design[65] is sufficient to carry the flag of a revolutionary position in architecture. She discusses "current developments in architectural discourse, design theory, digital design models and techniques and their

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subjective history defined differently and separately from traditional theories and histories of design.

64 Such reference indicates that there is a continuous, organic relation between architectural programming literature and design research.

65 Digital design or digital architecture is the result of the years of experiencing with the digital media in design. Although it started as a sub-category, a category that focuses on using and experiencing of the digital media in design, since less than a decade it has started to cover and transform the whole design area. Today digital design is more and more recognized to be a powerful base for an initiative argument on the need for a theory of design. Naturally, the focus of such a theory is on increasing the power of the digital media and their impacts on design. Over the last decade, pioneering approaches to a digital architectural educational agenda has been launched in a large number of new graduate programmes throughout the world, but primarily at Columbia, Harvard, MIT, Penn, UCLA, the AA, and the University of Applied Arts in Vienna. For about ten years now digital media has been rapidly developing and challenging the conventions of design (Steele 2001) (Liu 2002) (Kalay 2004) (Kolarevic 2005) (R. Oxman 2008). On the other hand, conceptual and theoretical framework of the digital design is still unformulated (R. Oxman 2006).

relations to design pedagogy" as a way of proposing a new framework for design.

Oxman argues that since the term digital design refers to the last ten years of significant changes in the conceptualization and application of digital procedures, the previous efforts are not enough to explain it. In that sense, it is important to conceive the distinction between computer-aided design (CAD) and the digital architectural design (DAD). For her, the difference is much more than simply terminological.

> While principles, theories and methods of CAD have been basically grounded on imitating paper-based design, the novel concepts of digital design models are re-introducing a different medium of conceptualization, replacing paper-based media (R. Oxman 2008, 106).

Oxman highlights the radical changes experienced in digital design mainly in three categories: (R. Oxman 2008, 101-103).

Related to the design media: encountering new forms of knowledge, new scientific foundations, and new models of design;

Related to the architectural knowledge: digital design and digital design models as a form of architectural knowledge are emerging as a significant ideational resource for design and design education;

Related to the processes, certain capabilities of generative and performative processes are enhancing. The enhancement is affecting the sequence of conventional design. The sequence is affecting the relationship between the conceptualization and materialization.

As stated by Kolarevic (Kolarevic 2005), digital technologies aim to enable "a direct correlation between what can be designed and what can be built;" to integrate design, analysis, manufacture, and the assembly of buildings around digital technologies and to give an opportunity to fundamental changes in the relationship between conception and production; to change architectural practices in the conceptual realm (a new digital continuum, where design is through construction); to challenge the historic relationship between architecture and its means of production; and to bring to the forefront the issue of the significance of information, communication, application, and control of information in the building industry.

The main argument of the digital design discourse is that computational tools encourage designers/users to think computationally which more and more become an alternative for the designers and challenge the traditional design thinking. On this base, digital design conventionally is being positioned as the opposite of the traditional paper based design. Until recently, allowing this claim without questioning was so common by the researchers. Today, because there is no persuasive amount of research on such opposition (there are just *a priori* assumptions), emerging wave of researchers argue that to clarify what is distinctive and different in the digital design, one has to clarify traditional paper based design as well (Liddament 1999)(K. Dorst 2008).

As a result of the analyses above and considering the usage of programming from its initiation up to the present day, it can be said that in general, programming more and more becomes the key element of digital design in the sense of a pure, technology-bounded computational design approach. From the 60s onward, such approaches increasingly rank among the highest popular ones in design research and demand a radical mission to reformulate design all over again.

3.11 Thought Contents of Program Coming from Design Research

Design research literature does not have a fixed programmatic content anchored to the traditional concepts of rational architecture such as function and program. The issue of program is not established on a conventional form-function dichotomy either. Rather the rationalistic or programmatic concepts exist as divided, fragmented in a variety of sources and widely scattered through an expanded field of design research. Hence, programmatic content in the design research exist as continuous re-assembling of concepts by the leading design research media part of a wider transdisciplinary meta-framework.

The purpose of this part of the study is to investigate the core themes of architectural program. Through a content analysis of the *DS* journal, the study analyzes some words and groups of words. [66] Based on the word search, the study covers the course of three decades and nearly 1600 articles published in the *DS*. The study is assumed to be the base for a more detailed understanding of the policies of the *DS* as well as the design research society's tendency of approaching the issue program. It also helps establish a framework for interpreting the thought contents of program within the *DS*. At the same time, it is an analysis for obtaining a sub-web of a more detailed, specialized information of "architectural program" involved in the medium.

The content analysis considers the two core epistemological models of architectural program. As mentioned earlier, these are analysis-synthesis and conjectures-refutations. Within this two-fold framework, it is observed that some terms surrounding the idea of program are originated from the modern architectural literature such as "function," "brief," "requirement," "program;" and some terms spring up from the computationalist discourses such as "programming," and "constraints." [67]

The scope of the analysis covers a range from the general structure of the *DS* to the level of the individual article. The results are organized from the general to

[66] See, Appendix-A

[67] Here the main aim is to cover a wide area and at the same time to understand unidentified program-based research field in the *DS*. Therefore, all the keywords have their sub-group search terms consisted with several different usages of the term. For example, for the keyword "program," both program, programme, programmes, programming, and research programme were searched and for the keyword constraint, both constraint, constraints, and design constraints were searched.

a more specific use of the terms, according to whether the term is in the title, or in the keywords, abstract, or content. Results are analyzed in three ways: the first gives the dictionary definitions of the main keyword groups; the second is a table that shows the numerical results of the search activity; the third is a table that shows the articles, which use the selected keywords in their core discussions.

In the second analysis, instead of a direct search of the keyword program, there are some parallel, closely related search terms. These are assumed to help to understand a wide and unidentified program-based research field in the *DS*. As seen from the tables, the sub-group of a search term consists of several different usages of the term. For example, for the keyword "program," both "program," "programme," "programmes," "programming," and "research programme" were searched similarly for the term "constraint," all of "constraint," "constraints," and "design constraints" were searched. Brackets {} were used for searching an exact word. Each search group was categorized according to the place of the word in the article using four different filters that are all fields, titles, keywords, and abstracts.

As a result, the first table gives general information on the field. The second table on the other hand, points out the core discussions of the field. The dictionary definitions in the first group guides in general use of the keywords and help the first set of tables.

The contribution of this study is providing the state of program by using the content analysis through the *DS* between 1979 and 2010.Unlike other reviews, which relie heavily on quantitative observations;[68] this analysis is part of a qualitative study aiming to give support multiple readings of the *DS* for understanding the state of architectural program. Such a study is assumed to help also to interpretation of the *DS*. It planned to find out probable

[68] As in (Chai and Xiao 2012)

mechanisms of the program-based tendencies in the *DS* and denote a meaningful body of programmatic content as filtrated through various design research agendas.

3.11.1 Program[69] & Programming[70]

Although in general "program" refers to a specialized understanding related to architecture, the study shows that in the design research literature, the issue of program has not developed on the basis of a well-understood subject matter or set of methods and principles used solely by design. The term rather links design with other fields such as computer sciences, and biological sciences etc.

In general, the word programme is used for referring to planning, scheduling, or pursuing a research topic in the field of design. At the same time, it signifies another specialized use in design. According to this use (App. Tables 9-10- 12-13) the whole design process is interpreted as a series of research programmes.

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[69] In the Oxford English Dictionary following the definitions of "program"
1 : a public notice
2 a (1) : a brief outline or explanation of the order to be pursued or the subjects embraced in a public exercise, performance, or entertainment; especially : a printed or written list of the acts, scenes, selections, or other features composing a dramatic, musical, or other performance with the names of the performers (2) : an order of exercises or numbers b : the performance or execution of a program; especially : a performance broadcast on radio or television
3 : programma 2
4 a : a plan of procedure : a schedule or system under which action may be taken toward a desired goal : a proposed project or scheme b (1) : a plan determining the offerings of an educational institution : curriculum (2) : a plan of study for an individual student over a given period : schedule
5 : a catalog of projected proceedings or features : prospectus, syllabus
6 : a printed bill, card, or booklet giving a program; specifically : a dance order
7 : a statement of an architectural problem and of the requirements to be met in offering a solution
8 : a coherent sequence of incidents, images, thoughts, or feelings providing the background for an instrumental composition that may be inferred by an interpreter or listener, or suggested by the title of the work, or supplied in the form of a poem or exposition
9 a : a plan for the programming of a mechanism (as a computer) b : a sequence of coded instructions that can be inserted in a mechanism (as a computer)

[70] In the Oxford English Dictionary following the definitions of "programming"
the planning, scheduling, or performing of a program
1 : the process of instructing or learning by means of an instructional program
2 : the process of preparing an instructional program

This idea can be summarized as a transfer of Lakatos' methodology of scientific research programmes to design (Anderson 1984).

Unlike program, the word "programming" refers to a specialized technical use (mostly computer oriented). Unlike "program" which has the wide spectrum of meanings, "programming" refers to a more definite, methodological, procedural type of activities. Comparing to the word programming, program has a much broader connotation and therefore, although it is smaller in number (App. Table 9), specialized means of use of programming are broadly recognized by the researchers in the *DS*.

3.11.2 Constraint[71]

According to its dictionary definitions, "constraint" is conceived both as something active (a force) which directly controls one's decisions and behavior, and as, something like a passive filter which passively regulates, (or rules out) a misconduct, or mismatch without imposing (or demanding) an active control over design process.

Within the context of design research, the general tendency is to take the term in its first conception. Conventionally, design is viewed as "constraint satisfaction" (Archer, 1970) (Coyne, Rosenman, et al. 1990) and constraints are in a sense are often conceptualized as active agents (or sometimes pointers) of design.

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[71] In the Oxford English Dictionary following the definitions of "constraint"
1 a : the act or action of using force or threat of force to prevent or condition an action b : the quality or state of being checked, restricted, or compelled to avoid or perform some action c : a constraining agency : a constricting, regulating, or restricting force : check d : a restriction or limitation that contains a motion or other process (as the action of a cam in machinery)
2 : compulsion by circumstances : the force of necessity : exigency
3 a : control over one's own feelings, behavior, or actions that is exercised either to feign or repress b : the sense of being constrained, checked, or inhibited : embarrassment
4 : the restoring force on an ion in a crystal per unit displacement constituting a measure of the forces acting between ions in a lattice

Focusing on the context of the *DS*, research shows that the word constraint appears in a high number of (515 articles) in the journal, (App. Table 16). One third of the articles use the term and nearly all use it in the design specific sense of the word. In 1984, Gross and Fleisher define design on the ground of the idea of constraint (Gross and Fleisher 1984). They argue that "constraints frame the expertise, the preferences, the context, persons, places and institutions, the circumstances, and purpose and resources [That's why design is] an exploration of fixes that meet the constraints" (Gross and Fleisher 1984). Such a specialized understanding of the term constraint comes from the *Design Methods* movement, and it is frequently used in the *DS*. It is consistent with the interest in integrating computers and software programming in design. As App. Tables 17-18 show, the idea of solving design problems with defining the constraints (constraint-base design) is still one of the most widely used approach in the *DS*.

3.11.3 Brief[72]

For the word brief, there were 497 articles found. App. Table 19 shows that, similar to the word constraint nearly one third of the articles use the term brief. Yet, on the other hand, only one-fifth of the search results have a specialized connotation in design research literature. Clearly, nearly all the articles in *DS* used design brief in the conventional sense, as a plan or outline of a design

[72] In the Oxford English Dictionary following the definitions of "brief"
1 : a formal or official letter or mandate: as a : breve 3; especially : brieve b dialect England : a statement of the causes of a person's poverty used as a petition : a begging letter c : a papal letter that is less formal than a bull and is signed by the secretary of briefs and sealed with the pope's ring d obsolete : dispatch 2 e : a letter patent formerly issued by the English sovereign as head of the established church authorizing a collection to be made in the churches for some specified purpose
2 : a brief written item or document: as a : a short usually concise article (as in a newspaper) b : a short version : synopsis, summary c obsolete : catalog, list d : an abridgment or concise statement of a client's case made out for the instruction of counsel in a trial at law called also trial brief e obsolete : memorandum, invoice f : abstract of title
3 a : a plan or outline of an argument; especially : a formal outline with logically related headings that sets forth the main contentions with supporting statements or evidence b or brief of argument : such a plan in behalf of a client that often has considerable detail dealing with the facts or the law and is presented to a trial or appellate court, an administrative or international tribunal, or to a legislative body c : a case at law

project. This means that in disaccord with the claims for a revolutionary new design understanding, the conventional design epistemology of analysis-synthesis is still in progress.

On the other hand, as seen from Nina Ryd's article (Ryd 2004), (App. Tables 20-21) design brief is also used to emphasize the question of "how a brief document should be formulated to encourage innovation and change." As such, it becomes a part of the second-generation design methodologies, which included the issue of evaluation.

3.11.4 Requirement[73]

For the word requirement, there were 745 articles found. (App. Table 22) shows that more than half of the articles use the term. Design requirement is one of the core concepts of collaborative, participatory and integrated design approaches. With the word requirement, the studies refer to complex information procedures and their control. It is also an important part of the computationalist paradigm. For example, in 2010, Ball, Onarheim, and Christensen describe "easy-to-handle" and "complex-to-handle" requirements examined in breath-first and depth-first searches in the solution space of various design processes. Situation of "epistemic uncertainty" triggered by requirement complexity is proposed to decrease by using computational solutions (software design strategies) by the authors (Ball, Onarheim and Christensen 2010).

[73] In the Oxford English Dictionary following the definitions of "requirement"
1: something required: a : something that is wanted or needed : necessity

3.11.5 Function[74]

From the 1960s to the present, in light of the discourses of a rational/systematic design, design research has evolved in particular issues such as design process, design needs, users, participation, collaboration, requirements, systems design, and programming. Since then, we have been witnessing a new understanding of inductivist design as a substitute for the narrow functionalist approach. The study shows that throughout this process while the term function has lost its previous special position, various other terms gained value. The words functionalism or functionalists on the other hand, are used as a past knowledge in explaining background of the design research history.

Parallel to that, for the word function, there were 861 articles found. The use of function does not always refer to a specialized meaning. The word functionalism has almost no place in the *DS*. In the *DS*, function is often used in the meaning of:

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[74] In the Oxford English Dictionary following the definitions of "function"
1 a : professional or official position : occupation b obsolete : those engaged in an occupation
2 : the action for which a person or thing is specially fitted, used, or responsible or for which a thing exists : the activity appropriate to the nature or position of a person or thing : role, duty, work, use, purpose
3 obsolete : bodily or mental action : behavior, performance
4 a : an impressive and elaborate religious ceremony b : an often formal public or social ceremony or gathering (as a dinner or reception)
5 : one of a group of related actions contributing to a larger action : operation: as a : the normal and specific contribution of any bodily part (as a tissue, organ, or system) to the economy of a living organism b : syntactic relation (as subject, predicate, qualifier) c : a feature of meaning distinguished as characteristic of a type of word d : the contribution (as of an element, trait, activity) to the consistency or equilibrium of a culture
7 : any quality, trait, or fact so related to another that it is dependent upon and varies with it
8 a : an expression which contains a variable term and whose meaning or truth is determined when concrete values of the variable are specified b : a propositional or sentential function compare predicate 1b c : the rule, law, relation, or operation denoted by such an expression
9 : characteristic behavior of a compound due to the presence of a particular atom, group of atoms (as an amino group), or mode of union of atoms (as a double bond); also : the atom, group, or arrangement causing such behavior
10 : the performance or fulfillment of a function : functioning
11 : an organizational unit performing a group of related acts and processes : activity

> -the action for which a person or thing is specially fitted, used, or responsible or for which a thing exists: the activity appropriate to the nature or position of a person or thing: role, duty, work, use, purpose, and
>
> -bodily or mental action: behavior, performance and,
>
> -an organizational unit performing a group of related acts and processes: activity

As an exception to these, in 1998, Rosenman and Gero discuss why design needs function. They argue that "design is a purposeful human activity in which cognitive processes are used to transform human needs and intent into an embodied object" (Rosenman and Gero 1998). They argue that understanding function is vitally important for understanding design.

Nathan Crilly (2010) aims to expand the meaning of function. He argues that "function is often employed and sometimes defined in such a way that it only relates to how artefacts can be used to satisfy physical goals" then he adds that "However, we have seen that both in the design and philosophy literature there are many definitions of function that will (at least implicitly) admit the non-technical." (Crilly 2010). With such a view, Crilly proposes a total understanding of design indexed to various kinds of mathematical functions as well. Following the idea, describing everything in functional terms, describing a matrix of functions of both technical and non-technical accounts of artefacts, "permits us to view all artefact use within the frameworks offered by functionalist accounts of technology, biology, society, culture and art" (Crilly 2010).

The design research tradition prioritizes program-based research agenda as a substitute for the older rational paradigms of design. The study shows that the new substitute is mainly embodied as an assemblage of the keywords:

program, programming, constraints, brief, requirement, and function. The keywords provide an umbrella of sub-networks for the evolving rational computational perspectives in design research and in the *DS*.

CHAPTER 4

THE DESIGN STUDIES JOURNAL

Architecture inquires: how can a certain purpose become space; through which forms, which materials? All factors relate reciprocally to one another. Architectonic imagination is, according to this conception of it, the ability to articulate space purposefully. It permits purposes to become space. It constructs forms according to purposes. Conversely, space and the sense of space can become more than impoverished purpose only when imagination impregnates them with purposefulness. Imagination breaks out of the immanent connections of purpose, to which it owes its very existence
—Adorno 1997

As stated by Adorno (1997), the relationship between “purpose” and “design” is not as simple a matter as at first thought. It is one of the fundamental issues of architectural design. Since 1960s, design research has dominantly viewed design process to be inductively operated from analysis to synthesis while listing the collected relevant factors. According to this perspective, design is described as an activity, which, by way of purpose, sets “performance limits [optimization]” on collected factors (Darke 1979, 37). In the early 1970s, design research has been challenged by a reinterpretation of the analysis-synthesis approach by the empiricist, behavioral perspectives. These perspectives have focused on considering user, participation and collaboration as a challenge to the sole architect as well as to the optimization idea popular in the previous period. This time, purpose and design meet for finding a “satisficing” solution distilled from a highly complexified design environment. Almost in the same period, there emerged a shift of understanding design and a shift from analysis-synthesis to the Popperian paradigm conjectures and refutations. For the new paradigm, purpose and design meet to approach design from a conjectural *hypothetico-deductive* perspective, to approach design from *first principles.*

Design research have witnessed three generation of evolution in epistemological framework of design until the first issue of the journal *DS* appeared in 1979. Birth of the journal signifies not only the beginning of an important contribution to the literature of design research but also beginning of a critical juncture, a turning point between one paradigm and the other, namely analysis-synthesis and conjectures-refutations.

4.1 The Launch of *Design Studies:* From *Design Methods* to Design Research

The term "design studies" both refers to an academic discipline that aims to understand and systematize the complex character of design activity by developing principles, procedures and techniques, and the title of a journal founded in the UK in 1979. It was launched as part of the foundational objectives[75] of the *Design Research Society* (*DRS*) at the end of a period of a joint journal project titled *Design Research and Methods* (*DMG-DRS*) and initiated in collaboration with the *Design Methods Group* (*DMG*) in the 1970s.

The origin of *DRS* can be traced back to the first *Design Methods* Conference held in London in 1962. Together with *DMG,* the society was one of the main bodies constituting the *Design Methods* movement. Throughout the 1960s, the movement proposed, "hard-edged, objective, rational, quantitative and systematic form of design methods" (Fowles 1979, 16) and "from subsequently

75 As stated by their web page, fundamental objectives of the DRS are: recognizing design as a creative act common to many disciplines, understanding research and its relationship with education and practice, advancing the theory and practice of design.
As updated by its organizing committee, the program of DRS underlines: encouraging the development of scholarship and knowledge in design, contributing to the development of doctoral education and research training, sharing knowledge across the boundaries of design disciplines, facilitating networks to exchange and communicate ideas, experience and research findings among members, disseminating research findings, promoting awareness of design research, organizing and sponsoring conferences, and publishing proceedings, encouraging communications between members internationally, responding to consultative documents, collaborating with other bodies, lobbying on behalf of members' research interests, recognizing excellence in design research through awards, sponsoring email discussion groups and a monthly emailed newsletter.
For a detailed information see, (DRS 2012)

ill-founded conceit, [they] staged a series of polemic situations in the hope of arriving at some conclusive solution" (G. Broadbent 1969, 10).

In the late 1960s, they were severely criticized by designers as well as their most passionate members such as Christopher Alexander and Chris Jones (G. Broadbent 1969, 10). "In a very short time, the optimistic advocates of design methods became doubters and critics" (Fowles 1979, 15). With all these in mind and as part of such a context, *DS* seem to be the transformation project of *Design Methods* to something else. This something else was the emergence of second and third generation methods. As part of this refreshing atmosphere, *DS* was claimed to be the first (Cross 2007, 3), as well as unique in approaching the design research field:

> *Design Studies* is the only journal to approach the understanding of design processes from comparisons across all domains of application, including engineering and product design, architectural and urban design, computer artifacts and systems design. It therefore provides a unique forum for the analysis, development and discussion of fundamental aspects of design activity, from cognition and methodology to values and philosophy (Cross, Design Studies 2012)

From the beginning of the first issue to the present day, *DS* has had only two chief editors: Sydney Gregory (1979-1984), and Nigel Cross (1984-present). They both were the attested chair holders at DRS in different periods. For the first five years, the editorial board of *DS* consisted of: Sydney Gregory (Management), Reg Talbot (Management), James Powell (Architecture), Barrie Evans (Building Engineer), and Nigel Cross (Architecture). After Cross' editorship in 1984, Patric Purcell (Architecture), and Ken Wallace (Engineering) took the place of Talbot and Evans. International advisory board included some of the pioneers of the *Design Methods* movement such as Bruce Archer, Christopher Jones, and Geoffrey Broadbent.

4.2 The First Issue

The first issue mainly consists of an editorial, a salutary article declaring the mission statement of the journal, the body of articles and book reviews. Although *DS* is an international journal, in this issue, and most of the issues in the early years, nearly all articles are from the UK.

In the first issue, the editorial part opens with a reminder from *A Study of History* of Toynbee. By referring Toynbee's "new country" Sydney Gregory, emphasizes a change of paradigm from *Design Methods* to a hopeful "uncertainty." His closing remarks are also containing similar feeling of uncertainty, and expression of an "adoption problem" for an "unknown" future:

> In introducing our new journal we open a reverse caricature of Pandora's box. Everything that flies out first is labeled 'hope,' but at the end, something is left which is 'uncertainty.' What will be the shape of our new world of design? (Gregory 1979, 2)

Gregory's is clearly not a mission statement, but a sense of a new and unknown paradigm. The mission statement of the journal comes with Archer's article. Archer's "Design as a Discipline" presents us two interrelated short articles: "Whatever Became of Design Methodology?", and "The Three Rs." In the first, he announces that "Design methodology is alive and well, and living under the name of Design research" (Archer 1979, 17). The article actually starts as a personal review of Design Methods, even a confession. Then, when he uses the term "designerly way of thinking and communicating" for the first time, it turns into a vision and mission statement. Archer indicates that in the new conception after the *Design Methods* movement, designing is an "alien mode of reasoning" and hence,

> there exist a designerly way of thinking and communicating that is both different from scientific and scholarly ways of thinking and communicating, and as powerful as scientific and scholarly

> methods of enquiry, when applied to its own kinds of problems. (Archer 1979, 17)

After describing design problems as "ill-defined," he points out the most significant characteristics of such problems by comparing their programmatic qualities. Accordingly, he explains that the shift of paradigm in design research is actually a shift in the conception of program.

> An ill-defined problem is one in which the requirements, as given, do not contain sufficient information to enable the designer to arrive at a means of meeting those requirements simply by transforming, reducing, optimizing or superimposing the given information alone. Some of the necessary further information may be discoverable simply by searching for it, some may be generateable by experiment, some may turn out to be statistically variable, some may be vague or unreliable, some may arise from capricious fortune or transitory preference and some may be actually unknowable…like any other ill-defined problem, is not the statement of requirements nor is the solution the means ultimately arrived at to meet those requirements. The problem is obscurity about the requirements, the practicability of envisageable provisions and/or misfit between the requirements and the provisions. The solution is a requirement/provision match that contains an acceptably small amount of residual misfit and obscurity…the design activity is commutative, the designer's attention oscillating between the emerging requirement ideas and the developing provision ideas as he illuminates obscurity on both sides and reduces misfit between them. One of the features of the early theories of design methods that really disenchanted many practicing designer was their directionality and causality and separation of analysis synthesis. (Archer 1979, 17)

Archer's declaration of the new paradigm through ill-defined problems and their effects on the first generation methods clearly indicate a direction for the *DS* journal. In the second short article, Archer claims that in this new period, Design must be declared as a third discipline aside from the Science and Humanities. Following issues show that the first and second missions are to be the main objectives for *DS*. The journal takes the responsibility of the discipline and pursues issues such as given first design professorships, first

PhD programs, indexing and documenting produced knowledge, enabling communication in the design society. In 1982, Nigel Cross follows Archer's mission statement and wrote a review article on the issue of "Design as a Discipline" to fully propagate the idea.

In the first issue of *DS*, three articles focus on the third generation Popperian paradigm of conjectures-refutations. The first and the most affective one is from Jane Darke, "The Primary Generator and the Design Process;" the second one comes from Robert Fowles, "Design Methods in UK Schools of Architecture;" and the third one is from Philip Steadman, "The History and Science of the Artificial." Other articles employ some second and third generation topics in their arguments. These are ill-defined problems, participation (Johnson 1979) (Pessant and McMahon 1979), intuition, creativity (C. Jones 1979), sketching (Thomas and Carroll 1979). Some first-generation topics that appear are appropriate systems for high standard guarding (Booth 1979), engineering design (Tarnowski 1979).

Since it is born into a pre-paradigmatic period between rational design paradigms and conjectural design paradigms, *DS* can be read as both a retrospective critical confrontation of rival paradigms, and prospective propositional accumulation of texts.

4.3 On the Means of Rationality in Design Research Tradition

The need for rationality as the meta-framework of *Design Methods* was studied by Coyne and Snodgrass in 1995. According to them, the rationalistic problem regime as exemplified by the writings of the *Design Methods* movement consists of six interconnected problems: coping with complexity, being systematic, enabling communication, enabling the processing of information, formulating methods and models, capturing knowledge (Coyne and Snodgrass 1995, 34).

However, if we take into account what Archer declared in the first issue of the *DS* in 1979,[76] we should revise Coyne and Snodgras's *Design Methods* from a specific historical period starting from the early 1960s and well into the early 1970s to a more expanded one in which we are still living. Such an expansion in the field implies that firstly, design research is an expanded version of *Design Methods* ideals, secondly, there are three periods of establishment, collapse and revival of *Design Methods*, and thirdly, the need for rationality as the core idea of the movement should be reconsidered in light of conjectural contributions.

This section looks at the rationalistic problem regime to clarify the rational ideals inherent not only in the earlier period of *Design Methods* movement but also in today's design research discourses. It focuses on the six problem areas to decipher the place and role of program in design research and the *DS*, especially in the prevalent rationalistic tendencies within recent computationalist discourses.

First problem area is to cope with complexity. Without a doubt, complexity is one of the most important concepts of the foundational sources of design research. In the "Preface to Third Edition," of *The Sciences of the Artificial* (1969), Herbert Simon declares one of his new chapters as a remedy for the brief explanation of complexity in the previous editions. Three points in motivating the growing need to understand complexity are presented by Simon:

> Much of the motivation for it is the growing need to understand and cope with some of the world's large-scale systems - the environment, for one, the world-wide society that our species has created, for another, and organisms, for a third. (Simon 1996, 174)

76 "Design methodology is alive and well, and living under the name of Design research."

Simon describes complexity as a system with a large number of parts and with many interactions:

> In such systems, the whole is more than the sum of the parts in the weak but important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole. (1996, 183-184)

Reviewed in three temporal stages, this century has seen recurrent bursts of interest in complexity and complex systems. "Holism" "gestalts" and "creative evolution" in the post World War I era; "information," "feedback," "cybernetics" and "general systems" in the post World War II era; "chaos," "adaptive systems," "genetic algorithms" and "cellular automata" in 1990s. Without an exception, all of these concepts have made their way to design research and practice. A good quality of article in the DS and in the design research focus on these issues. Complexity in that sense still maintaining in the body of research problems that open investigation via programming.

Second problem area is being systematic. For the design research tradition, being systematic mainly refers to the will to scientize design. Buckminster Fuller invented the concept "design-science" to express the need for a revolutionary conception of design as described from the point of view of science (Fuller 1969).[77] Although systematization was grounded on a

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77 Although he was not fully indulged into the Design Methods movement, Fuller's pioneering contribution was always felt within the design discourses concerning the relation between science and design. His concept, design-science is one such case. With it, Fuller proposes a science biased analytical and utilitarian approach to the world and design and emphasizes the importance of emancipating science from its "blind flying" by "permitting its assumption of the prime social, direct, conscious, sensorial responsibility" (Fuller 1969, 306). On that basis, his recommendation of a curriculum for design-science consists of the following studies: synergetics, general systems theory, theory of games, chemistry and physics, topology, projective geometry, cybernetics, communications, meteorology, geology, biology, sciences of energy, political geography, ergonomics, production engineering (Fuller 1969, 334). It is not a surprise that Fuller is one of the earliest figures that question the role of planning and architecture in relation to science. Long before Eastman (1980) and Oxman (2008) wrote in the *DS*, he predicts that "with the computer storing and retrieving all the latest data on elevator shafting, electrical harnesses, plumbing, and manifolds, and doing the drawings, architecture and planning as now taught will be obsolete" (Fuller 1969, 329).

reductivist understanding of science-design relation in the 1960s,[78] it has become open to critical new interpretations especially after the 1970s. From the very first issue to the present day such approaches have become parts of the identity of the *DS* journal. In 1979, in the first issue of the *DS*, Bruce Archer points out that the English education system is wrong in compartmentalizing education into the Science and Humanities, and should open up to another area called Design.

> Thus design, in its most general educational sense, where it is equated with Science and the Humanities, is defined as the area of human experience, skill and understanding that reflects man's concern with the appreciation and adaption of his surroundings in the light of his maternal and spiritual needs. In particular, though not exclusively, it relates with configuration, composition, meaning, value and purpose in man-made phenomena. (Archer 1979, 20)

Third problem area is enabling communication. It is described by Coyne and Snodgras with reference to Chris Jones's *Design Methods* (1970). As another foundational reference for design research, the book mainly focuses on complexity in design. The issue of communication as part of complexity interrelates with the issue of externalization of the design knowledge both for the designer and for the wider community affected by design decisions. This causes a problem that should be solved by rationalization and collaboration. In this sense, this approach provides the basis for approaches such as user, collaboration and participation. On the other hand, in design research and the *DS*, focus on communication is studied through empirically (protocol studies and observation of design process by various methods) and theoretically (studying on representation of design models). While the first group enables information coming from the field, the second group processes the information and interprets them to build satisfying generalizable frameworks.

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78 The principal inventor of the term "design science" which was initially used in The Design Method conference in 1965 can be deemed as Buckminster Fuller who tries to relate design with science.

The fourth problem area is enabling information process. It underlines the problem of using knowledge and information (or data) that becomes more complex and gain variety. Coyne and Snoodgrass (1995, 37) explain this issue as follows: “To match the growing complexity of problems, there is a growing body of specialist experience. This information is hard to handle; it is widespread, diffuse, unorganized.” The topic refers where the computation enters into the field and takes a major role in programming.

Fifth problem area is formulating methods and models. It is “the means to understanding and control, and the chief weapons against the deliberating effects of complexity and chaos” and it addresses the essential goal of design research –to understand and control the complexity and chaos in design (Coyne and Snodgrass 1995, 37). Tradition of generation of methods in design research can be placed under this title. Although, the second-generation methods put emphasis on the “less formal” and are critical of the first-generation, both generations followed the belief in methods and that the designer should be “methodical,” as their common ground. Typical to the field of design research “to be methodical” generally refers to a conception of design as “analysis, synthesis and evaluation.” Coyne and Snodgrass explain the model as a flow diagram where analysis -defining the problem- leads to a synthesis -seeking a solution- and the evaluation of the results feeds back in a loop.

> A common variation on this theme is the model of design as analysis, synthesis and evaluation, often depicted spatially as a flow diagram. Analysis leads to synthesis, and evaluation is situated on a feedback loop to evaluation again. Often this is interpreted as "define the problem," "seek a solution" and "evaluate the result." This evaluation may lead to a reappraisal of the problem definition and a number of iterations. (Coyne and Snodgrass 1995, 38)

As explained previously, a Popperian alternative to this approach is conjectures-refutations. The model is principally introduced to the field of design research by Broadbent and different from the analysis-synthesis-evaluation, it is basically an outcome of the second-generation critical period. Both fed by and established upon the tradition of design research, these two distinct (if not opposing) approaches define design from different point of views. The basic problem with analysis-synthesis-evaluation was its lack of potential in addressing and adapting itself to the issue of complexity and its two consequences indeterminacy and flexibility.

> the formal structure of problem solving as a transition through a space of states; each changed by means of operators; and the whole system heading towards a set of goals. This is a reasonable description of a puzzle or game. There are legal moves, a clear objective to win, and a clear starting state. By way of contrast, design is a "wicked" or "ill-defined" problem domain in that the rules keep changing, the goals are formulated as the design proceeds, and the starting state may be different each time (Coyne and Snodgrass 1995, 39).

According to Coyne and Snoodgrass (1995, 39) both first and second generation approaches, although they address some certain aspects of design quite successfully, fail to cope with issues such as creativity.

There have been various attempts in the history of architecture and design research to reconsider and reinterpret rationality in design. However, if we review functionalism and its follow-up discussions on program from the framework provided by design research, we discover that the sixth problem area (capturing knowledge) in the field very well overlaps inductivist methods developed by the program-based approaches in the 1960s.

> Broadbent highlights the malaise afflicting architectural design in the 1960s. The problem was basically one of general user dissatisfaction. The professional elite was not providing what society wanted. Buildings were considered uncomfortable, inefficient, unattractive, and aloof from their cultural, social and environmental context. (Similar accounts can be given for other design areas.) One category of problem regime is that furnished through Cartesian rationalism; the other is the derived counter culture of romanticism.

> The rationalistic problem regime is exemplified by the writings of the design methods movement-researchers who applied the success of numerical analysis and operations research to design immediately after World War I and into the 1960s. (Coyne and Snodgrass 1995, 34)

Majority of the design research society interprets capturing knowledge in a teleological positivistic context and as a substitute of conventional means program. For such an understanding, the basic responsibility of the task is to collect and process data by using certain calculation methods. As we discussed in the previous chapters, expansion of such activities by covering certain stages or the whole design process defines the state of programming today. In the context of such view, program is an advanced (or transformed) version of "brief." Capturing knowledge in this sense are essentially developed by and to serve for the certain from of problems as defined by analysis-synthesis. However, as originated from the analytical problem solving motivation in design research tradition, and in the *DS*, capturing knowledge is expected to be changed radically and went under a different interpretation within a conjectural framework.

4.4 Two Rival Design Paradigms in the *Design Studies* Journal

This part of the study focuses on the programmatic conceptions of two rival design paradigms within the *DS*. Namely analysis-synthesis and conjectures-refutations, they will help us understand the design research tradition and clarify emergence of a novel understanding of design as well as program.

In order to reach out sources of alternative conceptions of program in design research, it becomes necessary to differentiate the programmatic structure of the former (analysis-synthesis) from that of the later (conjectures-refutations).

4.4.1 Analysis-Synthesis

> Bacon held that, to prepare the mind for the intuition of the true essence or nature of a thing, it has to be meticulously cleansed

> of all anticipations, prejudices, and idols. For the source of all error is the impurity of our own minds: Nature itself does not lie. The main function of eliminative induction is (as with Aristotle) to assist the purification of the mind… Purging the mind of prejudices is conceived as a kind of ritual, prescribed for the scientist who wishes to prepare his mind for the interpretation (the unbiased reading) of the Book of Nature: just as the mystic purifies his soul to prepare it for the vision of God. (K. Popper 2005, 279)

In *The Logic of Scientific Discovery*, Popper warns us against the existence of "myth of scientific method" instilled in the explanation of Baconian scientific inquiry. He argues that on the basis of the problem there is the Baconian conception of scientific method which argues that scientific inquiry "starts from observation and experiment and then proceeds to theories" (K. Popper 2005, 279).

In recent history, the architectural counterpart of Baconian scientific enquiry is the *Design Methods* movement. The movement and its evolution is important in two senses: First, it defines design on Baconian inductivist foundations and thus sees designing as programming; and second, in the 1970s, as being affected by the Popperian counter-paradigm, it has revised its previous program-based perspective of design toward a conjectural programming. On the other hand, in the early 2000s there has been a recent revival of interest in inductivism and programmatic conception of design. The idea of search for a program-based architecture that could assist architects in their quest for the logical explanation of the design decision processes has been strongly influenced by the general euphoria associated with computerized design and the super-analytical nature of computers.[79] As architectural design became more and more computerized, it has been reduced to a matter of a process

79 Popper also draws our attention to the fact that today; the Baconian paradigm affects not only traditional sciences, but also affects newer sciences and scientists. (K. Popper 2005, 279)

whose structure contains: analysis, synthesis, and evaluation[80], or shortly, analysis-synthesis.

The ideas central to the conception of the growth of knowledge in the scientific method are mainly developed by Francis Bacon and Rene Descartes in the 17th century. While Descartes declares that "all the laws of nature follow with necessity from the one analytic principle" [81] (K. Popper 2005, 451), Bacon puts forward experimental and rational as opposed to the prejudice-based "dogmatical" method. The main features of empirical study as explained by his famous analogical inference in creation of the scientific method are structured on the comparisons among spiders, ants and bees (Bacon 1905, 76-77). [82] For Bacon, science neither relies heavily on the powers of the mind like spiders, nor just experimental like ants. By correlating the two, it transforms nature into something else: bees.

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80 In the mainstream application of analysis/synthesis paradigm, the term evaluation does not refer making design decision throughout the design process, it refers a post analytical stage concerns to detect weather there are improper quantifiable results coming from the design process. The procedure generally called: evaluation, post occupancy evaluation, or design evaluation.

81 Cartesian method is described by Mendel on the basis of four rules:

"the first was newer to accept anything for true, which I did not clearly know to be such.

The second, to divide each of the difficulties under examination into as many parts as possible, and as might be necessary for its adequate solution.

The third, to conduct my thoughts in such order that, by commencing with objects the simplest and easiest to know, I might ascend by little and little, and, as it were, step by step, to the knowledge of the more complex.

And the last, in every case to make enumerations so complete, and reviews so general that I might be assure that nothing was omitted." (Mendel 1947, 57)

82 The first publication of *Novum Organum* was published in 1620. On below you can see the exact version of his exemplification, which is placed under Aphorism no: XCV. (from Devey edition, 1905).

"Those who have treated of the sciences have been either empiricist or dogmatical. The former like ants only heap up and use their store, the later like spiders spin out their own webs. The bee, a mean between both, extracts matter from the flowers of the garden and the field, but works and fashions it by its own efforts. The true labor of philosophy resembles her, for it neither relies entirely or principally on the powers of the mind, nor yet lays up in the memory the matter afforded by the experiments of natural history and mechanics in its raw state, but changes and works it in the understanding. We have good reason, therefore to derive hope from a closer and purer alliance of these faculties (the experimental and rational) than has yet been attempted."

Bacon’s analysis-synthesis method or naive inductivism as called by Bamford is the common traditional view of scientific method. [83] Starting from the former to the latter it draws a straight line between verification and theory. In 1960s, by adapting design to research, the *Design Methods* offered a parallel perspective on design. According to this view, and not far away from Bacon’s views, the whole design process was characterized as:

> empirical (that is based upon evidence obtained in the real world), objective (that is, free from the influence of value judgments on the part of the observer), and inductive (that is, moving from the observation of specific instances to the formulation of general laws) (Archer 1999, 4)

Program-based[84] perspectives in architecture are usually put forth as vanguards of a scientific, progressive design research ideal and of objectivity against tradition design history and theory. The reason for such radical positioning is based on the assumption that design must be systematic, rational and factual. The epistemological structure in which the idea of program-based architecture appears is called analysis-synthesis. The following structure shows the four operational stages of Baconian analysis-synthesis as transformed to the design methodology.[85]

Briefing (programming, data collection)

Analysis (breaking the problem into pieces, formulation of performance specifications, identification of constraints)

Synthesis (ideas generation, putting the pieces together in a new way, design development)

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83 (Bamford 2002, 246)

84 In the study, since analysis-synthesis refers to a program-based understanding of architectural design, such approaches will be called program-based; and similarly, since conjectures-refutations refers conjectural nature of architectural design, such approaches will be called conjectural.

85 Stages and explanations are combined from the studies of Chris Jones and Geoffrey Broadbent by Greg Bamford.

> Evaluation (check against performance specifications and constraints, testing to discover the consequences of putting the new arrangement into practice) (Bamford 2002, 247)

By following advancements in the philosophy of science, some of the design researchers in 1970s, demanded a complete disengagement from the Baconian paradigm. Unlike the strong belief in analysis-synthesis inherent in the *Design Methods* movement, they described the scientific method and the design process as incommensurable. For them, exercising the Popperian paradigm opens up a promising area for new interpretations to untouched problems in the field such as: creativity, uncertainty, subjectivity, and relation with past design knowledge.

4.4.2 Conjectures-Refutations

The Popperian view is basically grounded on the idea of the falsifiable nature of scientific knowledge. It starts with the hypothesis that if we do not know, "we can only guess. And our guesses are guided by the unscientific, the metaphysical (though biologically explicable) faith in laws, in regularities which we can uncover - discover" (K. Popper 2005, 278) and "if observation shows that the predicted effect is definitely absent, then the theory is simply refuted" (K. Popper 1957, I). As such, in conjectures-refutations, the success of science does not depend on rules of induction, but "luck, ingenuity, and the purely deductive rules of critical argument" (K. Popper 1957, VIII)

> Scientific theories were not the digest of observations, but that they were inventions-conjectures boldly put forward for trial, to be eliminated if they clashed with observations; with observations which were rarely accidental but as a rule undertaken with the definite intention of testing a theory by obtaining, if possible, a decisive refutation. (K. Popper 1957, IV)

The conjectures-refutations model assumes design as a matter of generating ideas, and then, testing them, modifying and improving when necessary. The

Popperian design process can be interpreted from the two different scalar levels. First, it can be described as a "short-term sequence from the inception to design to the completion of the building," or from P1 to P2. Second, it can be described as a "long-term cycle where the stock of existing buildings influences our perception and definition of P1 and where the completed building, P2, adds to the stock, thus being part of P1 in the next sequence" (Brawne 1995, 12). In the end, the overall pattern of a Popperian process works such as this:

> We start with a problem which is normally defined by a client but is simultaneously modified by the architect's perception of that and similar problems; we then go on to produce the first sketches, the tentative solution and almost immediately start a process of criticism which is partly self-criticism but equally criticism by others including the client, consultants, the eventual users and so on. This error elimination sequence is repeated and may involve a changed or even new recognition of the nature of P1. Only after such rigorous testing do we produce the information required for the creation of the building which becomes P2 (Brawne 1995, 12).

To summarize, the models of analysis-synthesis and "conjectures-refutations,"[86] are the two separate branches of the rationalist tradition. The first one is derived partly from Baconian account of the scientific method and the second one originates from Karl Popper's account of the scientific method. Bamford summarizes in three points from the Popperian approach criticizes the Baconian: First, "The idea that scientific inquiry begins with observations or facts is false." Because it is an attempt for an "explanation about what we do not understand," scientific inquiry begins with problems. Second, "there is no logic or method of discovery that will conduct us, and certainly not in the orderly fashion." Unlike the Baconian view, "scientific theories are imaginative constructions which go well beyond whatever they were designed to explain." Third, unlike the analysis/synthesis, conjecture/analysis includes

86 Popper's conjectures and refutations might have different names such as: "conjecture/test" or "conjecture/analysis," or "hypothetico-deductive theory."

error. Thus, "criticism, or flushing out error is the engine" of the conjectural understanding of the science. (Bamford 2002, 249-250)

In light of these two paradigms, the present study argues that, conjectures-refutations is a significant turning point for understanding architectural design especially for architectural program. From the point of view of the conjectural paradigm, a well-known inductivist (program-based) assumption of "design starts from facts"[87] is a myth. The actual procedure of science and therefore design operates with conjectures and conjectures are not derived from factual understanding of the world. Induction (a method of obtaining knowledge through verification) makes design decisions only probable rather than certain.[88] Yet, designing (and especially starting to design) requires firm decisions. Such decisions do not come from probabilities derived from observation statements (analysis,) they derives from unjustified anticipations, guesses, tentative solutions to our problem or as described by Hillier, Musgrove and O'Sullivan from "pre-structures" (Hillier, Musgrove and O'Sullivan 1972) or Darke's "primary generator" (Darke 1979).

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87 Design starts from facts in the sense that it starts from pure observational empirical information, or put it simply from analysis. As a good example of this sort in architectural design, one might examine Christopher Alexander's "the realization of the program." For him:
"Finding the right design program for a given problem is the first phase of the design process. It is, if we like, the analytical phase of the process. This first phase of the process must of course be followed by the synthetic phase the realization of the program…The starting point of analysis is the requirement. The end product of analysis is a program, which is a tree sets of requirements…the program is made by decomposing a set of requirements into successively smaller subsets." (Alexander 1967, 84)

88 By following Hume, Popper points out that "induction cannot be logically justifiable." He then, explains that why induction cannot operates on scientific growth of knowledge. He claims that:
"The probability of a statement (or set of statements) is always the greater the less the statement says: it is inverse to the content or the deductive power of the statement, and thus to its explanatory power. Accordingly, every interesting and powerful statement must have a low probability; and vice versa: a statement with a high probability will be scientifically uninteresting, because it says little and has no explanatory power. Although we seek theories with a high degree of corroboration, as scientists we do not seek highly probable theories but explanations; that is to say, powerful and improbable theories. The opposite view--that science aims at high probability--is a characteristic development of verificationism: if you find that you cannot verify a theory, or make it certain by induction, you may turn to probability as a kind of 'Ersatz' for certainty, in the hope that induction may yield at least that much."
For a detailed information, see Popper's argument on the relationship between probability and induction. (K. Popper 1957, X)

4.5 Conjectural Approaches in the *Design Studies* Journal

Those among us who are unwilling to expose their ideas to the hazard of refutation do not take part in the scientific game.
—Popper

As discussed in the above section, conjectures-refutations is a method that refers to Karl Popper's conjecture for the growth of scientific knowledge. In this study, however, conjectural approaches do not solely refer to the reconsideration of design as solely derived from Popper's view of the scientific method. It refers to a line of thought within the *DS* journal immersed in the idea of an alternative paradigm for understanding design as developed mainly by a bunch of scientist-philosopher including Karl Popper, Thomas Kuhn, and Imre Lakatos.

The idea of conjectures and refutations, as an alternative to the conventional scientific method was transported to the design research field mainly by Hillier, Musgrave and O'Sullivan's article "Knowledge and Design" in 1972. The new paradigm came to prominence in architecture at a time when design research was often threated skeptically[89] and for a long while, modernist architecture has been the object of popular antipathy. Following Robert Fowles's words, in the 70's we see, "the hard-edged, objective, rational, quantitative and systematic form of design methods has undergone a variety of transformations to become variously accommodated in a variety of forms and in a variety of contexts" (Fowles 1979, 16). In this period, the worldview of analysis-synthesis was reviewed, evaluated and then labeled simply as

89 Bamford explains the existent skeptical approach to the deification of the scientific method in design research in the late 1960s. For him, as being similar with the "cargo cult" phenomenon, "dominance of science in thinking about method" is absurd. The story is that in the southwest Pacific Ocean, pre-industrial tribes believe that the cargoes left behind by the Japanese and American cargo planes during World War II are gifts from their deities. After the end of the war when cargoes cease and goods ended, tribes engaged in ritualistic practices that mimic what they see when the cargoes came, but no other cargo arrives.

unsatisfactory. In 1979, as part of such evaluations Broadbent announced Popper's conjectures and refutations as the new third generation methods.

In 1972, a report for the state of the art of design research was prepared. In it, Donald Grant points out that, starting with the Portsmouth Symposium held in 1967, there is an emerging feeling that "architecture should begin to develop techniques and approaches unique to their own problems and to depend less on techniques borrowed from other related fields like operations research and engineering design[90]" (Grant 1972). The pioneers of this idea are the organizers of the symposium, architects Anthony Ward, Geoffrey Broadbent, and social scientist Horst Rittel.

Geoffrey Broadbent explains the rationale behind his and Ward's rejection of operational research in the "Foreword" of *Design Methods in Architecture* (1969). On the design methods and the operational research (OR), He states that:

> although design in architecture has a great deal to learn from this approach-and has a lot to offer to it- it is also different in kind from many other kinds of design, because it is so complex and, above all, because it deals in environmental matters. So the Porthsmooth Symposium was intended to mark the beginning of a new phase of thinking in architectural design method and, on the whole, I think this was achieved. (G. Broadbent 1969)

Horst Rittel and Melvin Webber as the inventors of "generations" model in design methodology bring into existence the need for a turning point in the development of the design research field known as *Design* Method. They state that the second-generation differs from the first in several important ways, including "abandoning the step-by-step structure of the first generation."

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90 Grant explains that "approaches to design methods in engineering design are typically characterized by a clearly stated and organized series of steps in a functionally related sequence. The tendency is toward a standard, step-by-step format for problem solving. In environmental design methods, Rittel rejects this analysis of the design process into functionally related steps and proposes an alternate model." (Grant 1972, 11-12)

Although Broadbent and Rittel agreed on the insufficiency of the first generation methods, they clearly disagreed on the second one. In 1977, Broadbent, argued that the second generation described by Rittel and Webber does not proper to design. After discussing why participation and collaboration under the Marxist ideals empties the content of architecture, he rejects the premises of the second generation (G. Broadbent 1979, 43). On the other hand, he is hopeful for the coming of a third generation. As pointed out by him, the pioneers of the third-generation are Landau,[91] Hillier, Musgrove, and O'Sullivan.

After explaining the basics of the theories of both Popper and Lakatos, Royston Landau notes that Popper's *conjectures and refutations* and Lakatos' *scientific research programmes* are extremely useful for architecture, planning and design as well as the social sciences.

He merged with Popper and Lakatos to a degree that proposes an alternative perspective on one of the architecture's unsolved problem: form-function (or form-content). At first, he indicates context of the solution. Then, he points to the crucial point that is sources of the operational rules. He points out a question, which reflects an epistemological difficulty that is "where do we look for the specifics of architectural thinking?" In the domain of knowledge or in the formal domain? His answer is to favor both domains: that of knowledge and the formal one. Because, especially for architecture, both domains are essential. The domain of knowledge is critical because it includes technological prerogatives, functional prerequisites, economic/utilitarian criteria etc. The formal domain is critical because it includes "formal rule structures whose source may derive from historical categories of style or from the rules of former models within the context of history." Developing

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91 Although Landau is the earliest (1965), design research's acquainted with Popper is mostly possible through Hillier, Musgrove and O'Sullivan's article published in 1972. On the other hand, there is no chance for Landau to not to know design research. Existence of Landau (as both being well aware of design research discourse and yet alternative) might be the indication of another group of researchers who want to be outside of the design research cycle.

operational methods for a domain of knowledge as well as for a formal domain are important but such research involves examining a different set of issues from those we explore now. But most important of all, throughout the design process "axiomatic demands made by his or her own hardcore" control the designer (Landau 1989, 70).

After Bruce Archer's mission statement, Jane Darke's "primary generator" in the first issue of the *DS*, is like the precursor of contribution of the third generation conjectural approaches to design research. Her study is important in the sense that it exemplifies how conjectures and refutations be used in architecture.[92] She describes the study as "a plea … for the use of subjective rather than scientific methods" in the analysis of public housing, and as an examination of "a new paradigm" (Darke 1979, 36).[93] As she posits, the

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92 It is important to note that Broadbent's "third generation" is accepted and used only by architectural studies. This might be explained with Broadbent's claim that "architecture is different in kind from many other kinds of design because it is so complex and, above all because it deals in environmental matters." (G. Broadbent 1969, 9) Although Broadbent do not mention in detail, the source of complexity in architecture mostly comes from the formal issues (the issues which link architecture to culture and history, and the issues which link architecture to its own past knowledge) in design process. In that sense, the similar critique comes from the field of architectural history. In Typology and Design Method Colquhoun states that: "The application of general laws is a necessary ingredient of the form. But it is not a sufficient one for determining the actual configuration. And in a world of pure technology this area of free choice is invariably dealt with by adapting previous solutions. In the world of architecture this problem becomes more critical because here the general laws of physics and the empirical facts are even less capable of fixing a final configuration than is so in the case of an airplane or a bridge." (Colquhoun 1969, 73)

93 The Popperian paradigm results in an offensive strong resistance, mostly even contemptuous, by some researchers within design research. Two issues later, DS published a strong opposition coming from Robin Jaques, who is the future chair holder of DRS, to Darke's study in the "Letters to the Editor" section. Some extracts taken from his letter are on below:

"In her article ...Jane Darke's speculations about design methods and the significance of her findings on primary generators both obscure the worthwhileness of the central work and misdirect its interpretation. Apart from any debate on whether designers ought to work from one paradigm or another, there is a more fundamental complaint which must be made about the conclusions to the paper. Clearly affecting these is her image of some sort of British Standard Mad Design Scientist, rigidly applying a single mechanistic antihuman procedure to every project... I suggest that Mad Design Scientists should join Frankenstein's monster in frightening those afraid of the dark(e)...if this conjecture can be refuted, which I doubt, there is another explosion in the petard yet. If 'good' architects use primary generators when they produce good architecture, can't they and the rest also use them when they produce all the poor-to-disastrous schemes? As an argument supporting the advocacy of more subjectivity in design it is likely to be strongly supported by your local prima donna. I have nothing against problem is that "many descriptions of the design process have been on an analysis-synthesis model which does not correspond to the design process as seen in practice."[94] Her research indicates that the most problematic part of analysis-synthesis is its purely programmatic conception of design process. According to that, in the previous paradigm "the designer was to start by exhaustively listing the relevant factors, then to consider the interactions between these factors and a set of performance limits on those factors." As such, the whole paradigm is based on a powerful belief that non-quantifiable factors in design would progressively be "transmuted, through research, into quantifiable form." She adds that "one hoped-for consequence of this would be the possibility of transferring much of the process to the computer, which would not be limited by preconceptions and would thus produce a better solution." Such an expectation gives way to excessive mystical tone in design research and gives rise to the idea that "the synthesis of various factors would almost automatically generate a form, with minimal need for the designer to exercise subjective judgments"[95] (Darke 1979, 37).

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subjectivity. Some of my best friends are subjective. However we should not confuse the fundamental influence of subjective values in design with the issue of whose subjective judgments are to generate the design approach. Ms. Darke's concern for users and the public could perhaps be served by the conclusion that their subjective judgments rather than the architects should be the variety reducing factor at the generative stage of scheme design." (Jaques 1980, 131)

94 As different from the first-generation and second-generation discussions, where the problem is in replacing insufficient methods with the new one, Darke's criticism of previous approaches comes not from methodical issues but from much deeper epistemological issues. That's why conjecture-analysis is introduced as a method of a new paradigm rather than the newest method.

95 Darke's analysis directly corresponds with Colquhoun's critique of the functionalist doctrine in modern architecture. In his well-known article "Typology and Design Method" Colquhoun emphasizes modern architecture's problem with subjectivity. By emphasizing the dangers of mere quantification, he states that: "From the examples of the statements made by modern designers it would seem that it is indeed never possible to state all the parameters of a problem. Truly quantifiable criteria always leave a choice for the designer to make. In modern architectural theory this choice has been generally conceived of as based on intuition working in a cultural vacuum… What appears on the surface as a hard, rational discipline of design, turns out rather paradoxically to be a mystical belief in the intuitional process." (Colquhoun 1969, 73)

Instead of a program-based introduction (such as brief), Darke proposes a conjectural way to enter into design.

> The idea of a primary generator was found to be a useful way of conceptualizing a particular stage in the design process, that stage that precedes a conjecture. Therefore, an elaboration of Hillier's work proposed, to one of *generator-conjecture-analysis.* (Darke 1979, 38)

Objective of Darke's "primary generator" at the beginning of architectural design is to "form a starting point for the architect, a way in to the problem, he does not start by listing all the constraints." It helps to generate initial concept "by becoming aware of ideas that are acting as generators." It is a "component of designer's 'cognitive structures'" (Darke 1979, 38-39).

In the first issue of the *DS* journal, Philip Steadman's "The History and Science of the Artificial" and Robert Fowles' "Design Methods in UK School of Architecture" are the other studies that include Popperian paradigm to their content to gain or analyze a new perspective. Steadman focuses on the evolutionary aspects of the literature and Fowles traces the recent transformations in the theory and teaching of the *Design Methods* in the UK schools.

In 1982, Cross reviews the new discussions[96] in *DS* and comments on design as the "third area"[97] of education together with the sciences and arts & humanities. He defines design by contrasting it with the other two. In 2001, he

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96 Nigel Cross' contribution is the third one in a series being published in DS, which aims to establish the theoretical bases for treating design as a coherent discipline of study. The first contribution in the series was from Bruce Archer, in the first issue of the DS, and the second was from Gerald Nadler, in Vol 1, No 5. It might be interesting to note that Nadler's contribution do not enter into a dialogue with Archer's as opposed to Cross'. In his study, Nadler simply sets up a framework for a collaborative design theory. The only relation of his study to that of the Archer's is his note at the last sentence stating that: "Such a theory is thus a necessary basis for a discipline of P&D [planning and design]. I hope this description of the phenomenon of P&D contributes to practice as well as to defining a discipline." (Nadler 1980).

97 The idea that "there is a third area in education concerned with the making and doing aspects of human activity," is based on the assumption that English educational system is misclassified into the insufficient classes namely: Science and Humanities (Archer 1979).

categorizes and explains different takes on the relation between design and science. In his 2006, book, he brings together a selected series of works concerning “designerly ways of knowing”[98] by tracing a coherent thread, and laying out some of the network of arguments and evidence.

Expressing the maturation of the “Design as a Discipline” project, Cross’ “designerly ways of knowing” is not just a particular concern for the relation between design and science. It is a proposal for a design-biased paradigmatic shift in understanding design research and as such, a challenge to the conventional program-based approaches inherent in the design research tradition. The designerly ways of knowing is a “reorientation from the instrumental aims of conventional design education, towards intrinsic values” (Cross 1982, 221). But, above all, it is a path for understanding *DS* under his editorship.

For Cross, autonomous relation between science and design begins from the “search for scientific design products” in the 1920s, and then shifts into a “concern for scientific design process” in the 1960s and 2000s. The *Design Research Society Conference* held in 1980 is an important benchmark in re-formulizing the desire to “scientize” design and to pursue further than simplistic comparisons of the two cultures.

Cross comments on the differences between the conceptions of the design-science relationship and categorizes them under the following headings: “scientific design,” “design science,” and the “science of design.” In that order, “scientific design” is described as a reflection of the reality of modern design practice which is “distinct from pre-industrial, craft-oriented design;” “design science” is described as a “systematic design” whose aim is to formulize the coherent, rationalized, and scientific design procedures to follow; and “science

98 The notion is developed by Cross especially under the titles of the “Designerly Ways of Knowing” (1982), “Designerly Ways of Knowing: Design Discipline versus Design Science” (2001) and Designerly Ways of Knowing (2006).

of design” is described as similar to the “design methodology” which is “the study of principles, practices and procedures of design.”

For Cross (1982), because it describes the whole design process as a scientific activity, “design science” is rather a controversial category compared to the others. He points out that the most fundamental critique of this category comes from Donald Schön who proposed a “constructivist paradigm” as opposed to the “positivist doctrine” underlying the “design science” movement. Schön also criticized the “science of design” for being ignorant of the “messy, problematic situations” of design. Cross emphasizes that Schön’s critiques give way to a new field of inquiry called “design thinking research” which shapes the 1990s. Schön’s approach as underlined by Cross is a starting point of the discussion of “design as a discipline” as opposed to “design as a science.” The main argument is that whether the relationship between science and design should be positivist or constructivist. Following Schön, Cross concludes that, rather than the positivist reductionism, the constructivist paradigm of searching for the epistemology of design provides designers a healthier relationship with science and a chance to build their own intellectual culture.

4.6 Designerly Programming

Being part of a critical revaluation of design research, notion of “designerly ways of knowing” puts the dominant paradigm of analysis-synthesis into question and focus on the unusual quality of design problems posed by Rittel, and Webber.

> …design problems are ill-defined, ill-structured, or ‘wicked’ (Rittel and Webber, 1973). They are not the same as the ‘puzzles’ that scientists, mathematicians and other scholars set themselves. They are not problems for which all the necessary information is, or ever can be, available to the problem-solver. They are therefore not susceptible to exhaustive analysis, and there can never be a guarantee that ‘correct’ solutions can be found for them. (Cross 2006, 7)

The main feature of the designerly approach seems to be its opposition to the program-based conception of design mostly represented by the separate functional domains of “problem seeking” (programming) and “problem solving” (design). It emphasizes importance of “problem framing.” Problem framing not only gives us a chance for reconsideration of design, but also it provides us a chance for revaluation of program. As indicated by Cross, under the problem framing perspective,

> Designing involves ‘finding’ appropriate problems, as well as ‘solving’ them, and includes substantial activity in problem structuring and formulating, rather than merely accepting the ‘problem as given’. (Cross 2006, 77)

If we search through the program related concepts within the discourse of designerly ways of knowing, we see that there is kind of a mutual exclusiveness between the discourse and the program-based conception of design. For instance, Cross indicates that in his proposal of designerly approach, “designers are not limited to ‘given’ problems, but find and formulate problems within the broad context of the design brief” (Cross, 2006, 80). Confrontations with the program (let us say design brief) may reflect a general response of the conjectural paradigms. In this context, Cross’s study is reviewed concerning how designerly ways of knowing encounters with the conventional program-based approaches in design research field. Cross’s first confrontation with program focuses on the idea of design or design brief as design optimization. He interprets such solid dedication to design brief as the ill-conceived and misguided attempt.

> ...design is not a search for the optimum solution to the given problem, but that design is exploratory. The creative designer interprets the design brief not as a specification for a solution, but as a kind of partial map of unknown territory (as suggested by Jones, 1970), and the designer sets off to explore, to discover something new, rather than to return with yet another example of the already familiar.(Cross, 2006, 32)

His second confrontation focuses on irrelevancy of the assumption that there is a direct causal relation between brief and end-product. Instead of such attempt, he proposes more indirect relation and stresses importance of seeking a dialogue between the brief and the visual explorations of the design from the beginning to the end of the design process.

> Sketching is fundamental, as a kind of 'dialogue' situation for the designer. But why is it necessary for designers to draw at all? One obvious reason is that the end point of the design process usually requires a drawing, or a set of drawings, that provide a model of the object – the building or the product – that is to be made by the builder or manufacturer. That is the designer's goal – to provide that model. If, given the brief for a new product, the designer could immediately make that final model, then there would really be no need for a design process at all – the designer would simply read the brief and then prepare the final drawings. (Cross, 2006, 34)

And finally, his third confrontation focuses on the necessity and difficulty of developing a novel approach on program on the context of designerly ways of knowing.

> The formulation of appropriate and relevant problem structures from the ill-defined problem of a design brief is not easy – it requires sophisticated skills in gathering and structuring information, and judging the moment to move on to solution generation. (Cross, 2006, 79)

As part of the conjectural line of inquiry, designerly ways of knowing emphasizes several issues concerning inefficiencies of conventional program-based design approaches. Firstly, program has had no success in supporting a designerly process within the framework of analysis-synthesis; secondly, at no stage in the design process is there any indication that program has sole-power over design; thirdly, design heavily involves abductive reasoning and visual handling of the thought process while the inductivist program-based approaches cannot respond to such kind of processes and put an unbridgeable gap between program (design reasoning) and form; and lastly, design demands a critical reconsideration of past design works, whereas such an unconventional conception of program far exceeds the limits of program-based approaches.

CHAPTER 5

"*CONJECTURES AND REFUTATIONS*" AS A BASE FOR ARCHITECTURAL PROGRAM

In 1960s, the idea of providing a scientific basis for architecture was grounded on an extended and interdisciplinary understanding of Design[99]. This approach, while sidelining traditional authorities of design such as art, philosophy and history, included natural sciences especially biology, physics, mathematics; applied sciences and technology bounded new domains such as engineering, IT, computation; and finally behavioral and operational sciences such as management, psychology, and cognitive sciences. The main motivation behind such design research for architecture -as for other design fields- has been to make design knowledge sharable and transferable. The notion of generalizable transferable objective knowledge as opposed to an architectural culture and tradition requires further attention. Program as we know today is largely the result of this atmosphere and, the *Design Methods* vision raised in the 1960s. It is part of the evolutionary history of inductivism built and settled in design research.

Architecture, as in other branches of design, is affected from the new, liberated,[100] techno-futuristic atmosphere.[101] As discussed in detail in Chapter 3, one of the most significant effects of such a perspective was the

99 This autonomous and all-inclusive state of design can be described as Design with a capital D.

100 Liberated in the sense of Banham that it discarded its cultural load.

101As described in reviews of the period, besides new technological advancement and unprecedented needs, conditions that foster the atmosphere since the early 1960s are: individual studies and manifestoes, conferences, ascientific journals, books, separate design schools, and PhD programs, in short, all the components that make up the academia. For a detailed information, see: (C. J. Jones 1968), (Ward 1969), (G. Broadbent 1979), (Bayazit 2004), (Cross 2007).

foregrounding of program as a concept, tool and activity over everything else. Yet, on the other hand, in the same period, emerged a counter-framework, a paradigmatic, conceptual understanding of design, which gives a group of architectural theorists an opportunity to reconceptualize architectural design as distinct from the *Design Methods* atmosphere. Following the post-positivist, and especially Popperian epistemology, in such framework the architectural idea is prioritized as the guiding element, or *schema*, of design process. As such, after relinquishing the authority of decision-making, architectural program has been redefined as a *passive agent*, which does not imply or point to a certain solution, and does not demand a total control of the design process as opposed to its inductivist counterpart.

This chapter focuses on the ideas and historical roots of the Popperian counter-paradigm namely "conjectures and refutations" in design research and in the *DS.* It analyzes how the paradigm critically builds a layer of a new structure for architectural program.

5.1 Conjectural Roots of Architectural Program in Design Research and *Design Studies*

In the spring of 1963, Royston Landau organized a symposium at the *Architectural Association* School in London on the subject of "the context for decision making in the arts and sciences." Symposium papers were published in the *AA Journal* [102] in 1965. The event brought together young academics[103] from both the UK and the USA at the time Landau was a visiting professor at the MIT.

102 AA Publications has a long tradition of publishing. AA Journal is precedent of today's AA Files (together with AA Notes, Arena and AAQ)

103 The group comprised of Royston Landau, Stanford Anderson, Ernst Gombrich, William Bartley, and Jack D. Cowan. As the older member of the group, Gombrich's role was to make links between the basis of Popperian decision-making and issues derived from conventional art history and theory.

As opposed to the inductivist positivistic perspective dominant in those years, the group preferred to discuss the issue of technology in the context of architecture and questioned the effects of rapidly increasing technologies -such as computers- on architecture. They clarified the role of technologies in decision-making procedures of design and focused on the epistemology. Decision-making was discussed under four major headings, these are: art history and theory (Gombrich); mathematic, logic and computation (Cowan); history, philosopy and epistemology of science (Bartley); history, philosophy and epistemology of architecture (Anderson, and Landau).

In general, the initiation of the post-positivist canon and especially the conjectural understanding of science within design research was referenced to Broadbent (1969), who is the founder of the title “third-generation” and harbinger of the new conjectural approach, as well as to the notion of "Knowledge and Design" by Hillier, Musgrove and O’Sullivan (1972), who are the pioneers of explicating the possible conjectural methodology. Yet, the epistemological roots of the position comes from a rather disengaged group of Anglo-American academics who have strong ties with the philosophy of science as well as modern art and architectural history and theory.

This chapter focuses on the decision-making symposium of 1963, which frames an earlier effort based upon the post-positivist challenges to positivist rooted design research. The symposium occupies a unique position between two categories of decision-making. One category is distilled from the historical cultural context of art and architecture led by traditions (paradigms) which are nearly completely avoided by the design research literature. The second category is distilled from rather abstract mathematical inductivist decision-making procedures (programs). The symposium is important and should be foregrounded not just for its historical uniqueness but also for its potential of stepping over epistemological and positivistic obstacles indoctrinated in the design research tradition[104].

Following parts focus on the Popperian theory of conjectures and refutations, as discussed in *The Context for the Decision Making Symposium* in 1963. They highlight a number of problem areas, such as inductivism, anti-traditionalsm, historicism, selection, elimination, computationalism, and programming as planning and total control. As such, they open up core discussions of the Popperian decision-making framework in architectural design and provide guiding principles for the reinterpretation of architectural program.

5.2 The Hen or the Egg?

Which came first, the hen (H) or the egg (O) – the hypothesis (H) or the observation (O)-? William Bartley's question at the symposium targets the epistemological basis of conjectures and refutations.

In 1960s under the category of "the growth of knowledge," theory of learning in science was historiographically and critically reappraised, historicised and theoreticized by post-positivist philosophers' of science.[105] Such a critical attitude launched a questioning mode of thought towards earlier explanations of scientific production. Against the pure inductivist rationalism of the earlier studies in the field, such concern foregrounded concepts – such as discovery and creativity - that we are used to see quite frequently within the discourses of artistic realms. Especially in the 1960's, the framework has some consequences in architecture.

Compared to other disciplines, that contribute to design research, architecture seems to be the most promising one for a critical reconception and reviewing of the phenomenon. As part of such a perspective, Bartley focuses on what has

104 Although design research still describes itself as young, and in its experimental stage, since the 1960s it has grown rapidly and quickly reached accuracy of quite autonomous well-defined system of studies, that means it becomes a tradition.
105 (K. R. Popper 1965), (Kuhn 1970), (Lakatos 1978), (Feyerabend 1975)

been shifting in science and its direction. Before giving a quick answer to the "hen or egg" question, he clarifies changes in the main course of the philosophy of science and assists us to recognize where we should look carefully at the beginning of a design process. He points out that contrary to the traditional assumption that "empirical observations *precedes* hypothesis," scientists start with "problems." They start with studying when they have "worries" about something. They then (far from having a pure hygienic mental attitude) examine, and re-examine problems with their many aspects and test them in many different ways (Bartley 1965, 216).

To clarify how the scientist's mind works counter-inductively, he exemplifies the role of conjectures in solving problems. He emphasizes importance of "working on a problem" and explains that scientist begins to solve a problem only when he/she has a conjecture, (a hunch, a speculation). He/she continue to solve it only after considering the variety of difficulties that the conjecture posed. Thus, in a conjectural framework, to solve a problem, scientist needs to be better acquainted with it. To understand a problem involves understanding its difficulties. In such a process, the success may not always be goal. Sometimes (and mostly), scientist learns from experienced unsatisfactory solution procedures. This means that unsuccessful solutions teach scientist a lot (Bartley 1965, 216).

Following Popper, Bartley observes that the inductive mechanism comes into play only to test or to critique conjectures rather than for verification:

> It is at the *end* that experimentation and observation play their role in science; and this role is not to support or verify theory, but to *criticise* it. Rather than involving a 'bucket theory of the mind', Popper's view involves a 'search-light theory of science'. (Bartley 1965, 216)

In the Popperian approach, design is described as a process through which the scientist/designer proceeds from old problems to new ones by means of conjectures and refutations. As such, unlike the process-based inductivist model, in the Popperian model the emphasis is on the product (conjecture). In such a view, since we do not induce theory from observation, relationship between them cannot be explained via verification. Theories arise from conjectures. This means that logical relation between theory and observation is falsification, (testing) and not verification. (Bartley 1965, 217)

Unlike Bartley's Popperian description of design, the history of architectural programming in design research shows that program (or the inductivist content of design) largely and primarily takes place at the beginning of the design process[106]. Within such a framework, design is assumed as a *hygienic* verification process appropriate to the Baconian and Descartian *bucket theory of the mind*. According to this pattern, the ultimate goal of general design research is roughly described as to develop programming until it covers the whole design process, that is, until all uncertainties in design process are gone. On the other hand, the *Hypothetico-deductive* theory of science proposed by Popper (in 1934), can avoid these difficulties. At the same time, the theory introduces several issues in architectural design as well as science these are: *problem, tradition, experimentation, observation, imagination, prediction of the future, probability, and scientific controversy*. The issues also provide the necessary basis for a reevaluation of program within this context.

5.3 A Tradition-Inclusive Scientific Method

Similar to Bartley, Royston Landau brings the problem of inductivism to the fore at the symposium. Following Bartley's introduction, which discusses place and role of induction in the philosophy of science, Landau focuses on the Popperian approach to design. He uses induction as a starting point of his pursuit for a "structure for architectural ideas" and argues that in a general sense, induction exists in the relationship between our world of description and

106 Remember the previously discussed analysis-synthesis model

world of experience. In architecture, therefore, it exists in the relationship between design and facts.

> A study of the problem of induction is a study of relationships, but in the pursuit of an understanding of these relationships, it is necessary to rearticulate and redefine exactly what is being related. (Landau 1965, 7)

As previously discussed in Chapter 4, Landau compares and exemplifies both the “conceptual” (Popperian) and inductive (Baconian) approaches in design. He analyses Thornley’s “design method in architectural education” as the clear example of the conceptual method and emphasizes 1960s popular “sieve map”[107] method of landscape architecture as one of the representatives of the inductive approach. The examples illustrate the key stages of the two. In Thornley’s case, design proceeds through the following stages: 1. accumulation of data; 2.the isolation of a general concept or ‘form;’ 3.the development of the ‘form’ into the final scheme; and 4.the presentation of the final scheme (Landau 1965, 8).

> Here the design is not an accumulation of facts or reading of the book of nature, in Bacon’s sense. Thornley confirms his view of Design as a conceptualizing process by adding that, ‘it is essential that the student should be trained to adopt a conceptual approach to the design of buildings and that the process of slow accretion of parts and a progress from plan to section to elevation to site to decoration should be discouraged.’ (Landau 1965, 8)

On the other hand, in the “sieve map,” design proceeds mainly through two stages: 1. the collection of facts and 2. distillation of facts:

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107 “Sieve map” is a map-overlay method developed by landscape architect Ian McHarg. His method influenced landscape architects of the twentieth century in the sense that it opened a new vision and developed a scientific (Darwinian) approach (namely the creative fitting theory) and connected “design” and “nature” in the 1960s (Herrington 2010). Jean Forbes describes “sieve map” as “a single map upon which numerous areal distributions are shown superimposed... It quantifies the areal distributions by small units of area—kilometre squares. These quantitative scores for each square are aggregated so that the characteristics of the square's land are summarized by one numerical description. The mapping of these numbers permits the planner to read directly and easily the spatial distribution of the varying land characteristics.” (Forbes 1969)

> In contrast to the conceptual view of design is a method often recommended as a design procedure, which has been called, in its Town Planning version, the 'sieve map process'. In this procedure we go out and collect our facts about the town, we overlay our facts, one upon the other, and we can thus 'sieve' out the answer. This is remarkabley close to the Baconian inductive method, which believes that theories follow from facts, the implication here being that design follows from facts. This is very different from Thornley's 'conceptual approach' in which the problem requirements are constrained within and are subject to the controlling concept, whereas in the sieve map process a design becomes a distillation of facts. (Landau 1965, 8-9)

Landau states the atomistic basis of the inductivist model as one of the problems of inductivism and as one of the significant differences between the conceptual model and inductivist model in describing design. He asks that "is design in architecture a summation of a particular set of facts, or does it, like a theory in science, go beyond this?" (Landau 1965, 9). He emphasizes that contrary to the logic of sieve map process, content of design is greater that the content of the facts. Therefore, design is not only a summation of the facts as argued by atomistic theories.

Another problem that Landau points out is that the logically inductivist approach has no contact with the phenomenon of the unquantifiable (such as formal and psychological problems). Uncertainties and unquantifiable issues cannot be represented by programmatically. From the perspective of conceptual design then, he criticizes the inductivist belief that one day when technology is advanced enough, there will not be any unquantifiable (untouched or undescribed) areas in design and in any other complex human activity (Landau 1965, 9).

Landau's critique of inductivism does not mean that design contradicts any procedures sourced from the inductivist methodology. On the contrary, it means that inductivism has a special place in design. However, to understand how and when to use it, the designer first has the problem conceptually in his/her mind. In this context, it is nothing but the problem, the idea, which makes the decisions possible by eliminating unsuccessful proposals throughout the design process while letting the others live. It guides the designer, in each case in a different manner, through two kinds of sources: previously acquired data and new information (Landau 1965, 9).

Within an inductivist approach, selection is either assumed to be an automatic procedure following the collection of information (as in the functionalism of the *Modern Movement*)[108] or an untouched, glorified area of information related with an unlimited, context-free pool of probabilities (as widely exemplified in the computationalist programming studies today).

On the other hand, Landau argues that, as seen from the structure of the design problems[109], new information (requirement) and previously acquired knowledge (tradition) are different categories of forces effective on the designer.Therefore; their effects on selection are different.

> 'in order to solve a problem we require a certain amount of *previously acquired knowledge*' and we might note that by this characterization the previously acquired knowledge form no part of the problem requirements. (Landau 1965, 9-10)

Landau describes *problem requirement* and *tradition* as the main forces, which act on a designer. They are described by him as the core elements of the conceptual approach and as constituents of the main difference from the inductivist approach. Problem requirements are the unknown facts of design problem (conditions and the data). Tradition on the other hand is a collection

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108 Such an attitude was severely criticized by Alan Colquhoun in his "Typology and Design Method."

109 Landau describes problems in reference to George Polya. According to him, problems in mathematics break up into two: problems to find and problems to prove. Problems to find (including design problems) have three parts: the unknown, the conditions, and the data. Difference between the inductivist approach and conceptual approach is in their treatment of these categories. In the inductivist approach, they are all merged together and in the conceptual approach, each category is carefully separated.

of known past answers to similar problems (answers, models) (Landau 1965, 10).

Different from the inductivist approach, which includes only requirements, Landau describes architecture as a combination of requirements and tradition. From such a perspective, the inductivist critique shifts “our attention from the collection of data and from the relationship between design and data” by indicating that “a building is the response to its problem requirements in the light of a tradition” (Landau 1965, 10). It is this shift, which underlies the case for a radical reevaluation of architectural program and questions program-based model of design derived from the assumption of direct relation between data and design. As opposed to the program-based model, the conceptual Popperian model suggest that “when we design a building we do it by formulating a problem, then inventing a solution, and then adapting and modifying the solution to meet the conditions of the problem” (Landau 1965, 10).

Such an understanding challenges the context of program on which the design research is based. Firstly, it brings an end to anti-traditionalism as one of the misconceptions of the *Modern Movement* and the *Design Methods* movement. Secondly, it re-engages tradition with design and design research, and uses it as a tool, which “makes us aware of the state of our knowledge” (Landau 1965, 10). Tradition in this context “is the term which covers all the conventions, ideas and points of view which have been arrived at by the society in which we live, and from which all future developments must spring” (Landau 1965, 10). In reference to Popper, Landau points out the vitality of tradition for our growth of knowledge:

> It is important to understand the all-pervasive character of tradition, because we are not only influenced by what has been achieved before us, but we have also acquired from our tradition our mechanism for development and criticism. Also tradition satisfies human psychological needs so that expectation is not

> continually thwarded, and it is this need for coherency and comprehension which give rise to tradition. (Landau 1965, 10)

Landau argues that, as part of the notion of the "scientific approach to architecture," induction is becoming more and more a chronic problem for design. Advocates of science in architecture, "who might be called designers-from-facts," traditionally use pure inductivist arguments and methods. On the other hand, after having experienced the negative effects[110] of induction, to recommend a scientific method for architecture then "we distinguish carefully whether we are using a twentieth century or a sixteenth century points of view" (Landau 1965, 11). In reevaluating our design models to include tradition, caution is also needed to recognize the extremes immersed in architectural history. One should eliminate the two extreme positions: the "die-hard-Traditionalist" and the "die-hard-Inductivist." [111]

5.4 Tradition vs. Science

Landau argues that traditions are like theories; they explain and they predict. They therefore establish the game rules for architecture as well as help to establish the continuation of that set of rules (Landau 1965, 10). Stanford Anderson takes the argument further and brings the Popperian approach to the center of architecture by repeating the Popperian question of why "go around and observe" is a bad advice for the science students. The answer is the gist of Anderson's article and a gate to understand at which point the post-positivist philosophy of science come into contact with architecture and the architectural program. It leads Anderson to the origin of the Popperian argument that he has

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110Landau indicates that danger of inductivist approach lies in its serious misrepresentation of the Picture. (Landau 1965, 11)

111 Landau describes these two extreme positions as the "problem rejectors" and "strange bedfellows" and explains them:

"The first extreme is the die-hard Traditionalist who does not recognize that problem exists; he is unaware that new problems are always being discovered by architects, demanding the critical re-examination of traditional solutions.

The opposite extreme is the die-hard Inductivist who does not believe that problem exist; he is the disciple of Bacon, who believes that if you collect your facts, the answer is simply a matter of rereading the architectural 'book of nature' with an open mind." (Landau 1965, 11) been concerned with in the decision-making symposium: the role of tradition in science. As in other branches of design, for architecture, to have a firm scientific basis primarily depends on the degree of consciousness in the area towards the use of past knowledge, tradition (paradigm) rather than towards the use of factual collection of information (program)[112]. In this context, the advice Popper gave to students of science gains importance. He points out that if we start afresh in every new generation, then we die we shall be about as far as Neanderthal man. In contrast to the rationalist claims, we must carry on a certain tradition for progress. Existing knowledge only tells us "where and how other people started and where they got to go" (K. Popper 1969, 331). It informs us about previous theoretical framework, a system of coordinates, through which we make progress.

Anderson argues that first, tradition is a necessary ground upon which we operate and second, a critical understanding of tradition is a necessary aspect of any rational and fruitful context for decision-making. In that sense, since "the quest for certainty is a mistaken quest," we have to learn from our mistakes and decision-making is not an exception (Anderson 1965, 326-327).

Anderson's study in general focuses on the relation between the two previously discussed models (induction-based design model, conceptual or deduction-based design model) and the functionalist ideals of the *Modern Movement.*[113] On that, he clarifies rationalistic attitudes against tradition in architecture.

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112 In "Program vs. Paradigm " Rowe discusses the issue in detailed. (Rowe 1982/83)

113 In his article, Anderson directly refers Banham, actually he refers a certain critical position in approaching tradition. At the foreword to the 2000 edition of Los Angeles: The Architecture of Four Ecologies Vidler explains what 'trad' means for its creator Banham. He indicates that: "Indeed, LA turned out to be precisely the vehicle needed to blow up what Banham had earlier called 'trad' history, precisely because it defies the 'trad' city as a city, and the 'trad' place of architecture on the streets and squares of the 'trad' city; precisely because Los Angeles was a city where the structure of the regional space was more important than individual grids or fabric; precisely because of its semi-self-conscious 'pop' culture; precisely finally, because it represent to 'trad' historians everything a city should not be, was possible to write the kind of history of it that was everything a history of architecture should not be." (Vidler 2009, xxxvi-xxxvii)

> The critical attitude towards tradition permits us to acknowledge the unrelenting influence of tradition upon us without viewing it as an irrational cosmic force, which we can only accept. Popper has characterized conventional traditionalism 'as the belief that, in the absence of an objective and discernible truth, we are faced with the choice between accepting the authority of tradition, and chaos; while rationalism has of course, always claimed the right of reason and of empirical science to criticize, and to reject, any tradition, and any authority, as being based on sheer unreason or prejudice or accident.' (Anderson 1965, 329)

While introducing Popper's preliminary theory of tradition, Anderson emphasizes that tradition "is not a mere accumulation of knowledge, an undifferentiated catalogue of past events, but rather a vital body of ideas, values," and more. Tradition does not support conventional traditionalism. Since "there is no hallowing of any thing or event simply because it occurred in the past," denials of tradition are in this context "futile" (Anderson 1965, 328-329). Tradition provides us to reach and use "horizon of expectations" innate in man. From this perspective, it is related with "man's need to introduce structure and regularity into his natural and social environment."

Anderson exemplifies two extreme cases, two kinds of negative approaches in disregard of the present situation of architecture in the 1960s. For him, the two positions similarly diagnosed the case as "incurable and proposed cultural euthanasia" (Anderson 1965, 330). The first position as exemplified in Pugin -who removes himself from the contemporary situation by complete withdrawal to an earlier position; and the second position as exemplified in Banham, and futurism -who achieves the same removal by stepping into the future (Anderson 1965, 330). After diagnosing the situation, Anderson argues that since a novel situation would only observed by us in a context, these positions are problematic and incommunicable.

5.5 Learning from the Piecemeal and the Slow

In the symposium, art historian Ernst Gombrich approaches the problem of decision-making from another angle. He investigates old towns, which are accepted as beautiful, and simply asks, what makes them beautiful, if it not total planning? He approaches the problem from one of the most powerful traditions of architectural decision-making and yet he does not incorporate and utilize art history through a variety of dogmatic, automatic answers as described by inductivists. What Gombrich emphasizes is that the so called "beauty" of old towns might teach us how we should think about design. In his book, *Topics of Our Time* (1991) similar to Popper, he gives advice to students of architecture and calls their attention to the dangers of totalitarian approaches.

> the demand of "all or nothing" which may appeal to the young must be countered on the part of mature humanist by the reminder that we must practice little humility. You may perhaps discern in this advice the voice of Karl Popper and you would be right. He has convinced me that neither in the sciences nor in the humanities must we aim at total solutions, but what we still have the right to go on asking and searching, because we can learn from our mistakes. (Gombrich 1991, 39)

"The secret magic of old towns" then, comes from their historical randomness an "unplanned growth." The very conditions of an old town or a church (as the cases of slow and unplanned growth) may sometimes be productive of qualities that are hard to imitate by deliberate planning but , they might teaches us that "each extension, each new building was certainly governed by practical considerations, but these need not exclude an instinctive attention to the appearance of things" (Gombrich 1965, 297).

Today design research mostly sees history of art and architecture as history of styles that is largely removed from our actions and therefore our judgments. Yet, as discussed by Colquhoun, and Scruton, the inductivist approach, instead of proposing something new, fled the area of judgment and open design-decision to potential hazards. [114]

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114 In his famous essay "Typology and Design Method" (1969), Colquhoun delineates anomalies affecting the design process proposed by the functionalist doctrine. He points out that the general body of doctrine embedded in the rationalism of the Modern Movement consists of a tension of two contradictory ideas: "biotechnical determinism" and "free expression." As in the extract below, He accuses functionalist doctrine for being deterministic and for giving way to unintentional form production resulted in free expression.

What seems to have happened is that in the act of giving a new validity to the demands of function as an extension of nature's mode of operation, it has left a vacuum where previously there was a body of traditional values…What happens on the surface as a hard, rational discipline of design, turns out rather paradoxically to be a mystical belief in the intuitional process.

The paradoxical consequence is the result of a deterministic or "self imposed limits of modernism" which is rooted in the functionalist doctrine. Similar to the biotechnical determinism in design, Colquhoun remarks on the dangers of teleological approach inherent in modern movement's interpretation of history. At the introductory part of his book Essays in Architectural Criticism (1981) Colquhoun points out that architectural theory has always considered one of two interpretations of history. While the first interpretation impels architecture toward eclecticism according to which "all styles are possible," second interpretation accentuates functionalism according to which "all styles are forbidden." The new formalism, which is developed under the second interpretation, shares with the evolutionary view of history and rejects the stylistic and metaphorical devices of traditional architecture. Colquhoun states that under such perspective

It has been held that history is a process of evolution in which systems of cultural value only possess a relative truth. What appears absolutely true in one epoch is seen in the next to have been contingent. Thus, each epoch erects its own self-justificatory system of values. This relativist view entails the vision of a utopian future, rather than that of an exemplary past, and attributes to history a purpose and a telos.

Colquhoun indicates that "the critique of modernism is based on the assertion that there is no absolute causal connection between architectural forms and the economic and technical basis of modern society." Therefore, Zeitgeist or "the belief that there was such an absolute connection came from an interpretation of history according to which there was assumed to be a complete coincidence between the objective conditions of life and artistic style in each period of history" is a fallacy originated from the "historical determinism."

By focusing on the second interpretation Colquhoun points out that the "strong" theory of the Zeitgeist whose aim is to expose the Modern Movement should be exposed as "a stylistic preference, a particular taste, a set of meanings binding together a certain group of architects at a certain time."

By criticizing the historical and biotechnical determinism inherent in the functionalist doctrine, Colquhoun exposes a string of fallacies ignored by the functionalist design and historiography. His emphasize on the "functionalist vacuum" left in the form-making process discloses the fallacies and implies that, as oppose to what they argue, "there is a close relationship between the pure functionalist or teleological theory and expressionism."

With the examples of "piecemeal" and "slow," Gombrich similarly warns designers about the potential pitfalls of planning. For him, to overcome the problem, one should understand that design process is a "making, matching and remaking" process that is design begins with a "schema," an idea or a concept, which is a kind of "scaffolding" and then continues with the modification and correction of that schema.[115] At the heart of Gombrich's thesis is the idea that "wherever an artist deviates from the conventional schema, he must also rely a little on happy chance. The *what* can be planned, the *how* newer fully foreseen" (Gombrich 1991, 101).

On the other hand, "how far can the modern planner hope to recapture the secret of old cities without relapsing into the false historicism and and a wasteful romanticism?" is another question (Gombrich 1965, 293). According to Gombrich, we might no longer approach design with a vague nostalgia, or with some standard beauty in mind, yet the modern architect can learn from past works. Past works might assist the designer in criticizing his/her decisions and therefore lead to a closer approximation of the "happy results" that marked the growth of the old towns.

Similar to Colquhoun, Roger Scruton also clarifies the issue. In his book The Aesthetics of Architecture (1979,) Scruton tackles the issues of aesthetic nature of architecture. He writes about according to which criteria selection, evaluation, decision-making, and enjoyment are defined and describes functionalism as one of the basic approaches addressing to these problems. He discusses, that the evaluation problem in architecture, which involves questions like; "what is to enjoy a building?," "what kind of experience derived from the contemplation of architecture?," "what is taste?," "are there rules which govern the exercise of taste?," cannot be answered only in a mental field. He argues that "it is indeed impossible to abstract from our knowledge of a building's utility, and cast judgment on it in some 'pure' aesthetic void" (Scruton, 1979, 38.) Therefore in the evaluation process, the architectural object itself should be in the process as much as the mental constructs. On that he gives the example of sense of jealousy. He points out that how it is not possible to understand the sense of jealousy, by isolating it from the object that it directs; and again how it is absurd just to have a reason to be jealous without an object, similarly in architecture, assuming an abstract mechanism of evaluation is impossible and absurd. From this point of view, although functionalism has a proposal for evaluation of architecture, that is superficial (Scruton 1979, 3).

115 Evolutionary interpretation of Gombrich's model has been studied by Hakan Anay. For a detailed information see, (Anay, Two Evolutionary Models for Reconceptualizing Architectural Ideas and the Architectural Design Process 2008).

5.6 Thinking and Computing

From Leibniz (1666) to Babbage (1864) the idea of mechanized rationalization or in other words building mechanical calculating engines has developed. Later, differential analyzer or analogue computers and soon after digital computers came. Digital computers have developed as we know them and entered into our life when really long and fast computation is required. This means that if computation process becomes complexified, computation needs automatic control methods and leave human operator out of the process as opposed to simpler operations like using a desktop calculating machine.

Such exclusion brings to the fore problem of decision-making throughout the computation processes. The problem increases and becomes much more complexified under the brain-like computers model. Turing's famous question of 'What is thinking?' in computers underlines a fast grooving interdisciplinary field within which automated brain-like decision procedures are studied. These studies can be viewed in two main categories: first, studies under the problem of interaction, organization and control between multiple computation processes and second, studies under the problem of taking novel/unaccustomed decisions for engaging advanced, creative processes.

Why an intense history of computation is a must for the community of the decision-making symposium can be found at the introduction part of Jack Cowan's article in which Landau makes a special emphasis on computers and computation as a new tool and new potential for the future of architectural design. Landau argues that creative use of computer will be successful, only if it is demanded and controlled by the profession itself not the vice versa. To benefit from "imaginative use of computer," architectural education should develop in that direction and architects have to learn "creative mathematics" (Landau 1965, 251).

The discussion of the possibility of making design-decisions through computation gives attention to creativity and issue of transfer of past knowledge (tradition) in making decisions. Unlike the prevailing computationalist agendas, which are operating through a futuristic outlook and inductivism, based on programming, the symposium focuses on a counter perspective that is the issue of how paradigmatic thinking is possible with computers.

Cowan's contribution is informative and introductory in the sense that he only gives brief information about the developments of computation, such as how complex programs uses heuristics, what is artificial intelligence or brain-like mechanisms, what is cybernetics and information theory. On the other hand, it is part of the first visible attempt to develop a conjectural design approach considered in conjunction with computation.

In the context of computation, "programme" in general implies that "particular computation is to be performed." It is the "specification of what and how" providing the control system of a computer. On this basis, the digital computer is thus, a more advanced system, an "*automaton*[116] and yet, it "must adhere slavishly to a particular set of instructions" (Cowan 1965, 252).

After explicating how it works, and in what direction it is developing, Cowan puts to the fore pros and cons of computers and computation - how it operates through programs, how it might assist design, and how it could remain helpless in the face of creative activities such as design. He concludes that from the point of view of computation, decision-making is interpreted as "the selection from a number of alternatives, on the basis of a number of (hopefully) well-defined criteria" (Cowan 1965, 257).

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116 Turing formulated the notion of a computing automaton. The Turing test is an experiment that Alan Turing proposed as a way of deciding whether a computer can think. His abstract model builds the basis of the discussion of the theoretical basis of the possibility of an equation between computer and designer.

From the Popperian perspective, all these mean that design research needs a viewpoint to describe computation as part of the issue of program as settled in a wider conjectural framework of design. This perspective keeps the reverse idea out that is design needs a viewpoint based on computation.

Since computers still need particular set of instructions to operate, and programs still are the specifications of what and how, the framework that Cowan introduced in 1965 is still valid at least for issues of creativity, unprecedented responses, and uncertainties. Since then, although computers have been more and more involved in design, the state of program in design research is best described inductively and its role is best understood as part of the second-generation ideals that is "to liberate the designer from routine procedures and to enhance his decision-making role"[117].

5.7 A Brief Prominence: An Idea of Conjectural Program in *Design Studies*

As discussed in the previous chapters, the launch of *DS* have made an effect on the state of design research by indicating problems of conventional design methods but at the same time by acclaiming existence of new directions including conjectures-refutations. This part of the chapter briefly reviews a series of systematic discussions on the post-positivist directions in the journal appeared four years after the manifestal first issue and twenty years after the decision-making symposium organized in the *AA School*. In July 1984, under the editorship of Patric Purcell, we see a special emphasis on "design research" in *DS* with the focus on program of design research conducted at the *Massachusetts Institute of Technology*. The issue, as emphasized in several times, was a compilation of *loosely coupled* family of research projects (Schön

117 In 2001 Nigel Cross re-evaluates Turing's question of "can a machine think?" By emphasizing that "think" means "design," he reviews the state of computation in design and comes to the same conclusion that Rittel and Webber came thirty years ago. That is the role of computer is "to liberate the designer from routine procedures and to enhance his decision-making role." On the other hand, as opposed to his first conclusion, he proposes another way and prioritizes option of learning how to think from computers. (Cross 2001)

1984, 131) (Schön 1988, 131) presented at an invited two-day workshop organized by Donald Schön at MIT in January 1984. The studies were gathered from the diverse disciplines such as architecture, environmental design, planning, engineering, computer science, philosophy, and anthropology. As different from the mixed research groups in general, *Design Theory and Methods Group*[118] of MIT managed to investigate, at least initially[119], all key sensitivities[120] highlighted by conjectures-refutations agenda set in the mid-1960s in the *AA Journal*[121]. In the issue, most of the papers exemplify that previously theorized post-positivist interpretations of design may have methodological implications for the advancement of design research.

In the papers of Stanford Anderson and his students -Andreotti and Metallinou- issue of conjectures and refutations was reopened, this time with the emphasis on a Lakatosian interpretation of architectural design. In the first article,[122]in the *DS*, Anderson constructs the main framework of Lakatos's model by reinterpreting "architectural design as a system of research programmes," and in the second article[123], he exemplifies how it might work.

Anderson proposes that our knowledge and other cultural forms, including design, are to a degree *arbitrary.* Yet on the other hand, design research, at least throughout its first and second generations, avoided this fact. In the first-

118 The founding members of the group are: Stanford Anderson, Aaron Fleisher, Mark Gross, John Habraken, Gary Hack, William Porter, Patrick Purcell, Edward Robbins, and Donald Schon from MIT's School of Architecture and Planning, and Louis Bucciarelli from MIT's School of Engineering.

119 Until the year of 1988, some original members of the group, including Anderson, have already dropped out. And group diversity in the sense of relation with architectural history and theory has weakened.

120 Such as: relation with past design knowledge, past works, tradition, describing design-decisions as part of a non-deterministic,counterfactual approach,…etc

121 The main figures behind continuity and consistency of contents of the two pioneering work seems to be Stanford Anderson and Donald Schön. Anderson who is both a contributor of the decision-making symposium and a founder of the Design Theory and Methods Group; and Schön whose studies are on post-positivist and especially Kuhnian theory of growth of knowledge, had no difficulty in importing the post-positivist agenda into the core issues of architecture.

122 (Anderson, Architectural Design as a System of Research Programs 1984)

123 (Anderson, Architectural Research Programmes in the Work of Le Corbusier 1984)

generation design was conceived to be a "nonarbitrary process," and in the second-generation arbitrariness was "not eliminated but rather diffused" (Anderson 1984, 147-148). After the failure of a "rigorous and infallible" design procedure and of a "participative" one tested by the first and second generation design methods, the main question should be: "where will we locate the arbitrariness embedded in our practices, and how will we seek to deal with it rationally?" (Anderson 1984, 146).

Roots of the idea went back to the decision-making symposium held in *AA School* in 1963. As discussed in the previous parts, the symposium unconventionally provides an alternative ground for analyzing main problems of existing trends in design research by setting out foundations of the dominant paradigm. In the symposium, focus was on Popperian theory of conjectures-refutations as an alternative perspective concerning clarification of background and structure of the existing problems. On the other hand, in 1980s, as seen from the studies of Anderson and in other sources as well,[124] there emerged an interest and attention to Lakatos's model in order to develop a detailed conception of decision-making suitable for architectural design.

Lakatos's model became a preference because of its detailed restructuring of the *refutations* part of Popperian theory[125]. According to the model, a *research programme,* which refers to a more complicated conception of theory, holds together a *hard core* of unattackable statements, principles, protected by a body of of *auxiliary hypotheses*. While *hard core* operates through rules of *negative heuristics*, which keep researchers away from damaging principle statements of the program, *protective belt* operates through rules of *positive heuristics*, which lead program towards novel conjectures. (Landau 1982, 306)

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124 Royston Landau's studies on Lakatos's research programmes are even earlier from Anderson's. See: (Landau 1981), (Landau 1982), (Landau 1987), (Landau 1989)

125 For Lakatos, refutation is not a simple rejection as naïve falsificationsim put. Continuity of theories is much more complex phenomenon than previously thought. The main question of the idea of the research programs studied by Lakatos is that: upon what objective basis a theory is preferred over the other. For a detailed information see, (Lakatos 1978)

Programmatic understanding of theories has a potential of making significant contributions to an alternative conception of design that has been developed since the mid-1960s by challenging indoctrinations of design research. The effects of the idea can be summarized in three points: First, it gives researchers a chance to overcome some of the limitations of previous studies and refine their approaches. Secondly, it encourages researchers, more intensely than before, to provide clear alternatives to impoverish existing the problematic conception of architectural program. Finally, by characterizing "complex connected events," it provides "ways of comparing alternatives, which for the researcher may provide a preliminary step to decision-making" (Landau 1982, 308).

In the application of the Lakatosian model, Anderson focuses on some works of Le Corbusier. He analyses *promenade architecturale* and the *Maison dom-ino* as two rudimentary programs conceptualized and used in Le Corbusier's projects. He traces both concepts throughout the works of Le Corbusier and sees that they yield a series of brilliant works of "increasingly rich implication" (Anderson 1984, 153). The analysis provides Anderson to examine main structural elements of Lakatosian conception of program on real cases. In addition to Anderson's study, Andreotti and Metallinou make analyses by applying the perspective to some other architectural cases. Andreotti focuses on Kahn's *Exeter Library* through his *form-design* concept[126], and Metallinou analyses the career of the Greek husband-and-wife team of Dimitris and Suzanna Antonakkakis[127].While Anderson and Andreotti's studies are limited to the design processes of one or several cases, Metallinou examining the phenomenon from a larger context. She makes an investigation of series of works as "particular programmes of sequential development" within the framework of a larger research programme: *regionalism.*

126 (Andreotti 1984)
127 (Metallinou 1984)

As seen from the studies, while Lakatos's notion of research programme sets a pattern by which one can analyze, construct or reconstruct architectural concepts and artifacts through an explicit logic of the process, it is a model among others, which allow us to explain architect's theories and works in accordance with a hierarchical structure between design-concepts and design-decisions.

Another significant interpretation of the architectural program in *DS* in the same issue comes from Donald Schön. Schön approaches design from a more specific perspective: from "making a design move." As described by him, a *move* (or *hypothesis*) "depends on a normative framing of the situation, a setting of some problems to be solved" (Schön 1984, 132). Only within the framework, *evaluation* is possible, and only through such framework, the designer achieves some kind of *objectivity* -independent from whether or not her/his judgments are based on arbitrary or even subjective criteria (Schön 1984, 132). "Talk back" occurs when the designer asks, "whether she/he gets what he intends." As part of the evaluation, *talk back* provides the designer to "see things in a new way" and "construct new meanings and intentions" (Schön 1984, 132). Overall, Schön puts a special emphasis on the conceptual basis of design and stresses "the need for representations that capture the 'fullness' (of associated ideas and images), the context dependency, and the transformability of types" (Schön 1988, 132).

As seen from the described process of *making a move* or *hypothesis*, design-decisions are largely *hypothetical* and *conceptual*. They are part of the *normative framing of the situation*, *constructed* by the designer at the beginning of the design process. They are *tested* repeatedly and *reinterpreted* and *reevaluated* continuously under different lights throughout the various decision-making processes. Finally, their existence requires an assessment and reassessment of process within the context of previous design-decisions be it from the individual designer or former successful designs. As such, making a design move or in other words to test a hypothesis as described by Schön is fully compatible with the conjectures-refutations model.

By analyzing the solution process of a given studio assignment at the MIT, Schön not only pursues research question of "what happens in design inquiry when there is a conflict of frames and perspectives?" He also exemplifies how design proceeds hypotetico-deductively by deriving the process from a framework of prioritized decisions (conceptual and/or artifactual).

The main points of the Lakatosian framework on architectural program as stated first by the studies in the *AA Journal* in 1963, and then in the *DS* in 1984 are summarized as below:

Design is contained in *ideas*, not in *collection of information* or *facts*. (Therefore, it is beyond rationalism and relativism)

It is primarily a *conceptual, ideational* activity.

Therefore, post-positivist approaches prioritizes formal domain as *container of ideas*

Similar to growth of knowledge, growth of design knowledge is derived from reinterpretation/rereading of past design knowledge or in other words it is derived from design culture (conceptually and/or artifactually).

A key for opening up these issues lies in the concept of *program*.

Design as similar to a *research programme* is being controlled by the demands of its *hard-core* (conservative)

On the other hand, it also explores the new possibilities heuristically by the *protective-belt* of *auxiliary hypotheses* (progressive)

And finally, design as similar to a research programme is derived in part from historical and cultural conventions (hard-core) without disregarding the specifics of a particular designer, and is also derived from inventions and discoveries (heuristics).

5.8 On the Nature of Architectural Program with Reference to *Conjectures and Refutations*

From 1960s, when it first appeared in the discourses of the design research as a positivist equation of design/science, until our time design and science relation has evolved (Cross 2001). On the other hand, in applied studies, the positivist roots of the tradition have almost remained intact[128]. Central to the science and design relation, the issue of conceiving design as a non-deterministic process was the agenda of the second-generation. However, reconceptualization of the idea as a shift from programmatic to paradigmatic understanding was the agenda of the third-generation. Although they are part of the core trait in shifting understanding of design in the late 1970s, third generation ideas on the other hand, has always been taken as a non-standard conjecture, a too radical shift in representing the entire Design discipline, and it has been condemned as a more suitable hypothesis for architecture compared to the others. The reason behind these might be seen in the fact that the conjectural critiques of the 1970s were largely sourced from the field of architecture and compared to the previous revivalist renovative approaches; the conjectural reconsideration demanded a paradigmatic focus, which resulted in a more radical shift from the core assumptions of the program-based design research. The inductivist approach as the stereotypical representative of the "scientific method," as the assumption of acquiring knowledge through objective collection of observations, nurtures the field's resistance to the conjectural paradigmatic understanding of design in two ways. First, in design research in general there is an assumption that the paradigmatic turn is to reverse the fundamentals of

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128 One of the explanations of this situation is to be found in Kuhn's concept of "normal science" which brings a sharp distinction to the description of structure of scientific process between Kuhn and Popper. "Normal science" as explained and be warned as "dangerous" by Popper is the "activity of the non-revolutionary" a state of being "not-too-critical." For more information see, (Popper 1970, 52)

the project of design research. It is in a way turning back to the past, to the traditional pre-scientific understanding of design and therefore a failure. Second, the techno-utopian and futuristic stances as design research ideals deemed the paradigmatic understanding as a irreconcilable, and opposing paradigm[129].

Theories often influence other domains, which were not originally formulated for. Starting from the middle of the 20th century, post-positivist theories of knowledge have provided a base for the criticism of the foundational Cartesian view of knowledge. For design research, which caught the tail-end of the positivist tradition, the post-positivist third generation caused a traumatic (unexpectedly soon) re-evaluation. Indeed, the crisis in *Design Methods* was triggered by the pride in the factual, analytical thinking and the wish to make induction the main tool for design. For the post-positivist perspective, design as “congeries of conspicuously disparate parts” was led to a quite problematic, unfitting, explanation (Rowe 1982/83). Yet, the paradox is that despite the diagnosed problems throughout the 1970s, design research is still reluctant to continue with a more fitting epistemology (third-generation). Instead, it prefers to stay in the inductivist realm and focus on to develop rather restorative methodologies (second-generation).

As a result of these, considering the architectural program, the state of design research today seems to still house two opposite positions. On one side, there is a framework, illustrating design primarily as a collaborative, participatory, interdisciplinary programming activity and the designer as a passive translator, on the other side, there is another framework describing design as a primarily conceptual, ideational, cultural phenomenon and the designer as a more active, independent expert guesser, conjecturer, or speculator. First one reads design

129 Similar attitudes can be followed within functionalist ethics in the discourses of the Modern Movement in architecture.

as the rise of programming, second one drawdowns of the level and position of programming in design.

CHAPTER 6

CONCLUSION

6.1 Why Do We Need to Reconsider Architectural Program?

The nature and role of program in architecture have been studied in different periods, with different emphasis and focus by different authors. However, it is gradually related to devising a planning scheme and method for the accomplishment of a series of measurable objectives and mostly placed at the opposite of or distant to intuitive, creative processes and uncertainties. On account of that, program-based approaches tend to define design as a process of analysis-synthesis, and design product as an automatic consequence of analysis, or as a support for a successful leap from analysis to a form of free expression.[130]

From the 1960's onwards, we saw an increasing influence of the science and technology based perspectives on design.[131] This has four main consequences for the current state of architecture: First, architectural design, rather than a subject discussed by architects and architectural theorists has become a subject of interest from the outside -from behavioral and cognitive sciences, mathematics, physics, philosophy of science, linguistics, epistemology, management, and most significantly computer sciences. Second, as a result of

130 For a detailed discussion about functional models and program issue in architectural design see: Louis Sullivan, Dankmar Adler, John Summerson, Reyner Banham, Colin Rowe, Alan Colquhoun, Stanford Anderson, and Anthony Vidler.

131 "Postwar, an emerging discourse of computer-related technologies contributed to reconfiguring representations of architecture, engineering, product and urban planning in the US and UK. The collective driving these changes became known as the Design Methods movement. Together with trajectories of though in psychology and psychiatry, discourses materializing from such fields as cybernetics, operations research, information theory and computers altered design processes and education." (Upitis 2008, 3)

emerging tendencies such as “aspirations to scientise design,”[132] and keeping in pace with the cutting edge technology, *conventional* academic disciplines[133] have lost ground to the high-technology chasing younger design fields[134] in the use of and participate to the emerging design research literature. Thirdly, architectural design is now studied and modeled as a process oriented (program-based) rather than product oriented (paradigm-based) phenomenon. Finally, such developments have led to a strong revival of interest in a previously popular research agenda: program.[135]

6.2 Epistemological Mismatch between the *Scientific Method* and Design

Similar to the early years of the *Modern Movement*, in the age of digital technologies, design research is witnessing challenging revisionist and revolutionary manifestos on design. Although studies are unique in their progressive use of technology, the epistemological contents of the majority of ongoing design research still depends on the well-known, problematic, inductivist logic called the *scientific method*. The issue was discussed in detail in late 1950s and early 1960s on the context of modern architecture. Hence emerged two rival epistemological paths: program-based design model and paradigm-based design model. [136]

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132 Cross explains the situation as having a will to establish close relations between science and design. The position can be summarized as “the application of novel, scientific and computational methods to the novel and pressing problems of the Second World War- from which came civilian developments such as operations research and management decision-making techniques.” (Cross 2001, 49)
133 In his review article “A View of Nature of Design Research” Bruce Archer emphasizes that in the early 80’s design research has been transformed to a wider collaborative atmosphere by giving an end to the domination of “more conventional academic disciplines” these are: architecture and planning. (Archer 1981, 33)
134 Product design, management, engineering…etc.
135 At this time, it is being liberated from the “heavy burden of historical backwardness” of Architecture.
136 In the 1960s there are mainly two types of critical approaches toward Modern architecture addressing its inductivist, scientifically oriented discourse. One is sourced from Popperian approach (Rowe, Colquhoun, Anderson) and the other is sourced from the neo-functionalist approach (Summerson, Banham, Fuller).

In 1950s both pros and cons of functionalism in architecture converged on the fact that the positivist epistemology behind the functionalist project failed. It is this experience that made architecture a more willing recipient of the emergent approach than any other design field when an alternative post-positivist epistemology was finally imported to the design research in mid 1960s. Since then, a post-positivistic Popperian framework emerged in design research and especially in architectural theory. It affected the design discourse by focusing on the following arguments that, design is incompatible with the model described by the *scientific method*, that design is not teleological and deterministic, and that, design does not point to a process which is described as an unbreakable chain of cause and effect as modeled in well-formed problems in the early 60's "design science" campaign advocated in the *Design Methods* movement. From the Popperian perspective, design is rather to deal with "ill-defined" problematic situations whose solutions are "implicit in the artistic, intuitive processes" which lead designers to "situations of uncertainty, instability, uniqueness and value conflict" (Schön 1991, 49) .

The changing of epistemologies in design research resulted in both a novel conception of science and an alternative design model. As a consequence, despite the apparent "scientific" bias associated with the *Design Method* movement in the 60's, 70's were the years of critical skepticism and awakening period, and in parallel to the notions of *design as a discipline* and *designerly ways of knowing*, 80's were the active contribution period for proposing a more coherent model of design accompanied by an alternative conception of program.

6.3 *Design Studies* & Studies of Program

"In introducing our new journal we open a reverse caricature of Pandora's box. Everything that flies out first is labeled "hope" but, at the end, something is left which is "uncertainty." What will be the shape of our new world of design?

— Gregory, 1979

DS was launched in 1979 to mark the beginning of a new phase of thinking in design methods[137] and provide a research ground in response to limited range of topics, and a closed circle of authors of the prior *Design Methods* tradition. In the first issue, the chief editor Sydney Gregory celebrated the opening of a new phase for the design methods tradition and expressed his belief in advancement of the design methods idea. For him, as being challenged with many new tools and issues, at this stage, design and the *DS* should be accepted as a liberating "new country." In the editorial, the new era of design research was heralded with bold statements: "We have had a dream. We have the capability. There is a challenge. We have a world to win" (Gregory 1979). With the vision of a "new country" for design, Gregory pointed the design research society to a challenging mission that is to pursue the paradigm shift in the field of design research and study on a more inclusive, complex, and loose model of design. Emerging intellectual atmosphere motivates the development of ideas that have a potential to lead to the idea of reconsideration of program within the design research realm.

For architectural program, the paradigm shift in design research in the late 1970s can be defined by three main constituents, these are: re-evaluating design as part of a science and technology based effort, reconsidering

137 Design Studies journal is part of the Design Methods movement. In the very beginning of his article "Whatever Became of Design Methodology?" Bruce Archer states that: "Design methodology is alive and well, and living under the name of Design research." (Archer 1979, 17)

architectural theory by focusing on program, and, taking architectural design as a phenomenon that requires a redefinition in response to the changing conception of program and programming.

It is seen that there are two main groups of researchers in design research who value program. The first group represents those who are specialized on a special form of programming, optimization, which is fully integrated with the various branches of market economy. For this group, programming is a professional career that emerged in the 1960's. The other group represents researchers in academia and operates within a wider design research perspective. This type of researchers emerged in the late 1960s. Although the first group operates only through analysis-synthesis, the second group operates through both analysis-synthesis and conjectures-refutations.

On the other hand, researchers adhering to the conjectures-refutations model are considered a minor group within the total population of the design research community. Their research is mainly based on critiques on the dominant conventional model of design research that is analysis-synthesis. Based on the evidence in architectural programming literature in the 1970's, they argue that for the analysis-synthesis model, a basic design task starts with a presumption of an analytical phase, which deals with collecting facts to define problem, which are then listed as requirements, and redefined sequentially as a prescription, or a road map, towards the most fitted solution.

Although the conjectures-refutations model argues that design does not operate through analysis-synthesis, such purely abstract mathematical processing makes analysis-synthesis as the most appropriate model for representing computational processes. At this point, because it was tested and falsified in the modern project of functionalism, the idea of design as programming as the future research topic of design research was also criticized from the perspective of conjectures-refutations.

Programming as a way of addressing the design process appears as highly regarded research ground for design research as well as for the *DS*, from the very first issue to the present day. Although in general, in the field, program and programming are at the background of the major discussion of design, in computer-based studies, they move forward and become more visible. Even in the first year of the journal, the task of integrating computer to design goes in parallel with the hope of a full-computerized design process. Computer and design relation, which clearly is one of the main missions of *DS*, seems to shape the future vision of design as built on "programming." What has been happening in computational studies is that there has been a growing awareness of the integration of computers to design. However, from the perspective of the *DS* ideals discussed previously, there is also some confusion and controversy over the nature of design research. As we witness in the notion of digital design, one of the dangers in computational studies is that, while declaring that the digital design is unprecedented to demand a secure, experimental playground for computation, researchers of such studies will avoid a critical attitude and fall easily back on the analysis-synthesis as a method that is inappropriate to developing an advanced understanding of design.

As opposed to the purely inductivist first-generation approach of analysis-synthesis reemerged in the design research, the second-generation takes a modest approach on consideration of program. It launches a revisionist agenda targeting the weaknesses of analysis-synthesis. As such, with the emphasis upon issues such as complexity and probability it pursues computer-aided design. Rather than aiming at the first-generation computer-based design approach, it proposes a computer-designer cooperation in design decisions. On the other hand, it does not fully abandon the idea of a fully computerized future.

Finally, the third-generation demands a radical change in the role and position of program. Unlike analysis-synthesis, conjectures-refutations model argues that the design process starts with conjecturing and program comes later to test, to falsify the conjecture. In parallel to that, it prioritizes past design works, paradigms, instead of program. In this model, priority is based on the designer's role, on conjectures, guesses, hunches, which are distilled through past works.

6.4 *Design Studies* & Critical/Conjectural Design Models

> *There exist a designerly way of thinking and communicating that is both different from scientific and scholarly ways of thinking and communicating, and as powerful as scientific and scholarly methods of enquiry when applied to its own kinds of problems (Archer, 1979)*

At the fortieth anniversary of the *Design Research Society* (*DRS*)[138] Nigel Cross retraces Bruce Archer's impressive introductory statement "Design as a Discipline" (Cross 2007, 3). The title had then intended to reach out and assign a mission to the young society in the first issue of the *DS* in 1979. The title is the core of a new approach and a declaration of a will to create a new state in design research. As being the motivating force, a slogan, an integral part of the agenda of the reform proposals in design research and in the *DS*, the idea of *Design as a Discipline* has a significant place for the advancement of critical design models. It is mainly a loose proposal for design research claiming that "the establishment of design as a coherent discipline of study in its own right, based on the view that design has its own things to know and its own ways of knowing them" (Archer 1979, 17).

As described in *DS*'s first issue, main principles of the new state can be summarized:

138 The Design Research Society was founded in the UK in 1966. The origins of the Society lay in the Conference on Design Methods, held in London in 1962, which enabled a core of people to be identified who shared interests in new approaches to the process of designing. It is the founding body of the DS.

Design is on par with and distinct from *science* and *humanities* (Archer 1979, 17).

Since it was not motivated by the "value-laden structure of design process," *Design methodology* approach, or *the study of methods*, was limited and problematic. *Design* on the other hand, is a more appropriate term in representing an advanced scholarly methods of inquiry for "a coherent discipline of study in its own right" (Archer 1979, 17).

Therefore, trying to *bending* methods of *alien mode of reasoning* imported from mathematical and logical models is problematic (Archer 1979, 17).

Design is a unique field that includes developing and solving *ill-defined problems* via *constructive* thinking (Archer 1979, 17). And finally,

Different from the verbal language system, it studies on the development of *nonverbal notations* in converting or externalizing design ideas (Archer 1979, 18).

To enter the new stage as described by Archer, first, design research is expected to have a critical approach to its object of study and second, it is expected to abandon blindfold commitment, obedience to the previous indoctrinated model. Finally, it is expected to work persistently on understanding weaknesses of the model to advance the field.

With the notion of *designerly thinking and communicating,* Archer severely criticizes the conventional scientific method of analysis-synthesis and sets of new goals for design research to pursue more convenient design models including conjectures-refutations (Archer 1979, 17). With the theory of *designerly ways of knowing*, Nigel Cross is the heir to the critical attitude in design research and in the *DS*.

6.5 The Idea of Program behind the Slogan: *Designerly Ways of Knowing*

> *The scientific method is a pattern of problem-solving behaviour employed in finding out the nature of what exists, whereas the design method is a pattern of behaviour employed in inventing things of value which do not yet exist. Science is analytic; design is constructive.*
> *—Gregory, 1966*

> *Designing is a process of pattern synthesis, rather than pattern recognition. The solution is not simply lying there among the data, like the dog among the spots in the well-known perceptual puzzle; it has to be actively constructed by the designer's own efforts.*
> *—Cross, 2006*

With these two statements -one a comparison of the scientific method and design, and the other a commentary on an exaggerated analytical model of the design process - it might be possible to understand the mission of the *DS* and therefore its relation with the issue of program.

After Bruce Archer's (1979) and Gerald Nadler's (1980) papers, "Designerly ways of Knowing" (Cross 1982) is the title of a third paper in the *DS* in the series being published under the main category of *Design as a Discipline*. It is mainly a reconsideration of the mission statement introduced by Archer with the words "designerly way of thinking and communicating" (Archer 1979, 17). The *designerly ways of knowing* provides Cross, as the co-editor and then the chief-editor of the journal, to focus on the main issue that is converging of design research movement to the discipline of design (Cross 1982, 226) and to study by examining it from many viewpoints on several occasions in the years: 2000, 2001, and 2006.

During these years, *designerly ways of knowing* approach operates as Cross puts it a "personal touch-stone theory." Through the principles it assigned Cross periodically reviews the field and underlines problems while proposing a framework for a *designerly* way. From this perspective, in general, the main problem of design research in 1982 is that, *designerly ways of knowing* is not yet mature enough to be applied to teaching. Another problem is that there is not yet a clear framework to provide strategies on how to develop a designerly research tradition in the field. For the first problem, Cross proposes an urgent focus on design education[139] and for the second problem, he proposes to reconsider design research phenomenon as a *research programme* in the sense in which Lakatos has described it for science (Cross 1982).

In the years of 2000 and 2001, Cross reconsiders the situation and makes his second review of design research. He exemplifies the foundational idea of *design as a discipline* by Donald Schön's studies. While placing Schön's *reflective practice* as opposed to the problematic *science of design* approach developed by Herbert Simon, he finds a good case for the education issue

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[139] Studies on design education are always part of the critical conjectural perspective. Before Nigel Cross, in the *DS*, there were presented several other educational studies with the focus on design. For example, in the first issue of the DS, in 1979 Bruce Archer in his introductory article clearly asks, "If there is a third area on education, what distinguishes it from Science and the Humanities? What do Science and the Humanities leave out?" (Archer 1979). With this question, he points out a different, *designerly* (as later coined by Cross) way of approaching the problem. For this view, the third area (or in other words design) does not fit into the definitions of Science and Humanities, but into "collected body of practical knowledge based upon sensibility, invention, validation, and implementation" (Archer 1979, 20). Such an idea is grounded on areas of human experience, skill and understanding by means of "man's concern with the appreciation and adaptation of his surroundings in the light of his material and spiritual needs" (Archer 1979, 20).

In the same issue, Philip Steadman points out the difference between scientific method and the design method. He gives reference to Popperian "world three" and warns us that architectural knowledge is not , with certain areas of exception (such as building science), of an "organized, explicit, communally available and, most important, scientific nature" (Steadman 1979, 54).

In parallel to Archer and Steadman, Robert Fowles reviews the design methods in UK Schools of Architecture. He focuses on the special history of *Design Methods* and its design ideals represented by the Ulm School. He reports an ongoing transformation in design methods while questioning the failure of the demystification project in the Ulm.

In parallel to the conjectural studies, there are studies, which focus on various sub-educational-themes. For example, Gasparski emphasizes the importance of praxeology (preparation for action) in design education (Gasparski 1979). Fox points out importance of category of action-based studies as developed in an educational perspective (Fox 1981).Berger and Granville discusses artificial intelligence and computer-aided design as part of design education (Berger 1980) (Glanville 1980). Anita Cross studies design education as part of general educational theories and policies (A. Cross 1980). The other foregrounded subject in education is creativity (Rickards 1980). Besides the theoretical studies, there are also empirical studies on design education (Simmonds 1980).

pointed in his previous review in 1982, and draws for *DS* a framework explaining how and to where the design research should head. In this review, Cross criticizes *interdisciplinarity,*[140] a method proposed for the *Science of design,* as an approach incompatible with the principles of *designerly ways of knowing*.

Archer's and Cross's persistent critiques indicate the depth of the roots and effects of analysis-synthesis tradition in design research. Cross's third last review of the field comes with a book titled *Designerly Ways of Knowing* dated in 2006 in which recalls three main components of design knowledge: *people, processes,* and *products* (Cross 2006, 100-101). He recalls them since he thinks to avoid any one of them, especially the product, threatens design research. According to Cross, because "design work entails the use of precedents or previous exemplars," design knowledge also resides in products (Cross 2006, 101).

His other critique is on *non-design* disciplines such as psychology and computer science:

> Researchers from psychology or computer science, for example, have tended to assume that there is 'nothing special' about design as an activity for investigation, that it is just another form of 'problem solving' or 'information processing'. However, developments in artificial intelligence and other computer modelling in design have perhaps served mainly to demonstrate just how high-level and complex is the cognitive ability of designers, and how much more research is needed to understand it. (Cross 2006, 102)

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140 The concept interdiciplinarity as described by the Simon refers that "the science of design could form a fundamental, common ground of intellectual endeavor and communication across the arts, sciences, and technology." "They can carry on a mutually rewarding conversation about the content of each other's Professional work… they can carry on such a conversation about design, can begin to perceive the common creative activity in which they are both engaged, and can begin to share their experiences of the creative, professional design process." On that, Cross states that: "Design as a discipline, therefore, can mean design studied on its own terms, and within its own rigorous culture. It can mean a science of design based on the reflective practice of design: design as a discipline, but not design as a science." (Cross 2001, 54)

The last critique is on disinterestedness in design research toward theories of design.

> Another of the dangers is that researchers adhere to underlying paradigms of which they are only vaguely aware. (Cross 2006, 102)

As discussed in the previous chapters, to understand design through product or through precedent (first critique), to reject that design is simply information processing (second critique), and finally to make links between present and past knowledge via concepts (third critique) all together create the main arguments of the counter-paradigm conjectures-refutations.

Within the design research discourse, which has been developing since the 1960s, the issue of program generally appears in background. *Designerly ways of knowing* as the evolving mission of the *DS* directs design research towards counter-analytical models, and especially conjectures-refutations, through which program can be reconsidered.

6.6 Conjectural Programming

> *The designer knows (consciously or unconsciously) that some ingredient must be added to the information that he already has in order that he may arrive at a unique solution. This knowledge is in itself not enough in design problems, of course. He has to look for the extra ingredient, and he uses his powers of conjecture and original thought to do so.*
> *—Levin, 1966*

Program is an indispensable phenomenon for design. It is in general, "a communicable statement of intent" (Sanoff 1977, 4) constructed between the designer and design product.

Throughout the evolution of the *Design Methods* movement, first we saw program as a separate analytical pre-design stage, and then, as a meta-database and meta-scheduling mechanism to control the design process from the beginning to the end, and sometimes as a deterministic experimental model, a meta-algorithm for reaching out automated design ideals. However, neither of these solutions fit well to the subject matter of a well-known campaign studied under conjectures-refutations and under the motto of *Designerly ways of Knowing* in the *DS*.

From the first issue in 1979 to the present day, pioneers of the conjectural approach in *DS* have pursued a conjectural design model.[141] They have succeeded in changing some of the surface manifestations targeting the relationship between science and design, and proposed “a science of design based on the reflective practice of design: design as a discipline, but not design as a science” (Cross 2001, 54). They have provided a constructive, self-critical and evolutionary approach within the design research tradition. However, throughout this campaign, program was rarely brought to the front as a prime component of the model. It is rather placed at the background of the discourse. Hence, to go a step further in understanding and teaching design, we need more research and enquiry: first into the *designerly ways of knowing*; second, into the scope, limits and nature of programmatic abilities embodied by way of design, and third into the ways of enhancing and developing these abilities through education.

In this context, as Cross indicates, we can stick to a research programme, “in the sense in which Lakatos (1970) has described the research programmes of science. At the core of the programme is a “touch-stone theory” or idea – in this case the view that “there are designerly ways of programming”. Around this core is built a “defensive” network of related theories, ideas and knowledge. In this way, both program and “designerly ways of knowing” discourse can develop a common approach.

141 See: Geoffrey Broadbent, Jane Darke, Donald Schön, Stanford Anderson, and Nigel Cross

6.7 Concluding Remarks

The primary objective for this work was to develop a context for discussing architectural program as an outcome of conjecture and refutation rather than analysis and synthesis. This motivation emerges in and for a contemporary setting, and the primary interest of the study is to form a background that the current discussion in the field of architectural design seems to be missing. Looking at the evolution of the Design Methods movement in architecture has been refreshing in terms of breaking away from the usual references of design research field. For architecture, first, the early modern period and then, 1960's, represent an interlude between the past and present states of research on design in terms of how design knowledge can be externalized and used. Thus, the period sets a frame for understanding the origins of the current ideas.

A secondary objective for this dissertation was to emphasize the importance of program for architectural design. First, the early design research context including the *Modern Movement* and the *Design Methods* movement and then late 1960's agenda including the mottos *design as a discipline* and *designerly ways of knowing* is emphasized. The dissertation points out two parallel lines of reasoning in design research since 1970s: a conception of architectural program that operates on the model of analysis-synthesis, and conception of architectural program, which operates on the model of conjectures-refutations. The study investigates program through these lineages in the journal *DS*.

As different from the positivist analysis-synthesis model, post-positivist conjectures-refutations model characterizes design as a phenomenon. It proposes a direction to go, where it is possible to derive a set of values that will be most useful in developing a conjectural program. In that sense, the following points can be outlined for the *conjectural* conception of program:

Program can only be conceived within a strong epistemological framework. It cannot be grasped in a situated perspective.

Underlying structure of a *conjectural program* consists of two interrelated but logically distinct mechanisms: *hard-core* and *protective belt.*

Similar to a *research program,* in design, the first step is to set *hypothesis.* It is conceptual (not analytical) and yields *hard-core* of the design program. Hard-core (or *design idea*) is the one which is protected by programmatically throughout the design process (or processes). It is *inviolable* however; it is open to *uncertainties,* which means that design idea comes from anywhere and in any conceptual form.

Protective-belt is creative, innovative part of the program/design. It is from where designer explores and extends. It is what the program/design is looking for. It seeks out better and new results As opposed to hard-core, in protective-belt; hypotheses are *auxiliary* and open to critical scrutiny and revision.

Though they operate differently, the hard-core design idea and auxiliary hypotheses belong closely to one another. If the auxiliary hypotheses are strong enough to make a revision on the main hypothesis of design, revision results in an entirely new hypothesis/program.

A program is tested consecutively in a different context. It is examined as to whether there is an increase or decline in power, whether the program is *progressive* or *degenerative*. Yet, success is not necessarily (or directly) related to the progress. Degenerative programs may sometimes result in new *moves*.

Although artifacts are more than the fulfillment of programs, (since they are open to other interpretations) they may serve as the sources of past knowledge through which designers can access past experiences. Yet, while a program is open to conventions, arbitrariness and relativity, it avoids pure conventionalism, full arbitrariness and absolute relativity.

Within the conjectural framework of program, the designer is an important figure. Designer is the *conjecturer,* the starter of the design process. Since design is problem of *continuity of the designs*, a design does not simply begin as in the model of *analysis-synthesis* (as satisfying listed requirements). To begin a design, to *move*, to *hypothesize*, it is necessary to assume quantities of background knowledge. For these reasons, conjectural program gives priority to the active designer over its other passive forms proposed by the analysis-synthesis. In addition, it gives priority to academia, media, critics and historians as the makers of discourse.

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APPENDIX A

CONTENT ANALYSIS FOR THE DESIGN STUDIES JOURNAL

Table 1 Ideals and main subject areas of *DS*

DESIGN STUDIES	Ideals	Covers the subjects
	To be an Interdisciplinary Forum	design management
		design methods
		participation in planning and design
	To be a leading medium	design education
		AI and computer aids in design
		design in engineering
		theoretical aspects of design
		design in architecture
		design and manufacturing
		innovation in industry and design and society

Table 2 DRS Chairs

Honorary President		DRS / Chairs		
	dec.	Name	Year	Field of the Study
	60s	**John Page**	1967-69	Building Science
	70s	**William Gosling**	1969-71	Electrical Engineering - System Design And Aircraft Industry
		Chris Jones	1971-73	Industrial Design And Ergonomics
		Sydney Gregory	1973-77	Chemical Engineering
		Thomas Maver	1977-80	Architecture (Building Performance)
	80s	**Nigel Cross**	1980-82	Architecture, Industrial Design
		James Powell	1982-84	Building Science, Industrial Design
		Robin Jaques	1984-88	
		Bruce Archer	1988-90	Mechanical Engineering
Bruce Archer 1992-00 (Mechanical Engineering)	90s	**Sebastian Macmillan**	1990-94	Architecture (Business)
		Conall O'Cathain	1994-98	Architecture (Sustainable Design)
Richard Buchanan 2000-06 *Analysis Of Ideas* and *Study Of Methods*	2000s	**David Durling**	1998-06	Furniture and Industrial Design
Nigel Cross 2006- Architecture, Industrial Design		**Chris Rust**	2006-09	Industrial Design
		Seymour Roworth-Stokes	2009-	Industrial Design (Design Research Management)

Table 3 Members of the introductory editorial board of the DS between 1979 and the early 80s

Editorial Boards of DESIGN STUDIES from 1979 to 2010				
Early 80s (1979-1981)	**General Editor**	**Sydney Gregory**	Design Science	UK
	Co-edts.	**Reg Talbot**	Management Science 'Department, University of Manchester Institute Science and Technology	UK
		Dr. James Powell	School of Architecture, Portsmouth Polytechnic	UK
		Barrie Evans	Design Research Society	UK
		Nigel Cross	Design Discipline, Faculty of Technology, Open University	UK
	Int. Adv. Board	Professor Bruce Archer	Head of Department, Department of Design Research, Royal College of Art	UK
		Dr. Nigan Bayazit	Architectural Design Methods, Istanbul Teknik Universitesi, Mimarlik Fakultesi	Turkey
		Professor Geoffrey Broadbent	Head of School of Architecture, Portsmouth Polytechnic	UK
		Professor Richard Foque	Houtzijde 22, B 2418 Lille	Belgium
		Dr. Eng. Wojciech W.Gasparski	Design Methodology Unit, Praxiology Dept., Polish Academy of Sciences	Poland
		Lucien A. Gerardin	Research Director, Futures Studies Group	France
		Dr. H. Geschka	Innovation Planning Division, Battelle-Institut	West Germany
		Professor E. Happold	School of Architecture and Building Science, University of Bath	UK
		Knut Holt	Section of Industrial Management, University of Trondheim, Norwegian Institute of Technolog	Norway
		Erik Hultberg	Arkitektene Hultberg Resen Throne-Hoist & Boguslawski A/S	Norway
		Christopher Jones	Design Methods	UK
		Professor Tom W. Mayer	Director of ABACUS, Computer Unit, University of Strathclyde, Dept. Of Architecture & Bldg Science	UK
		Professor Gerald Nadler	University of Wisconsin, Madison, Department of Industrial Engineering	USA
		Professor Henry Sanoff	North Carolina State University at Raleigh, School of Design: Architecture, Landscape Architecture, Product Design	USA
		Professor George N. Soulis	Associate Dean of Engineering, University of Waterloo, Faculty of Engineering	Canada
		Dr. John C. Thomas	IBM, Thomas J. Watson Research Center	USA
		Professor Len Warshaw	Universite de Montreal, Faculte de I'Amen Agement, Ecote d'Architecture	Canada

Table 4 Changes in the editorial board in the early 90s

Editorial Boards of DESIGN STUDIES from 1979 to 2010

Early 90s	**General Editor**	>	**Professor Nigel Cross**	Faculty of Technology Open University	UK
		<	**Sydney Gregory**	Design Science	UK
	Co-edts.		**Professor James Powell**	School of Architecture, Portsmouth Polytechnic	UK
		>	**Ken Wallace**	Engineering Department, University ofCambridge	UK
		>	**Alwyn Jones**	City University Business School	UK
		>	**Michael Tovey**	Department of Industrial Design, Coventry Lanchester Polytechnic,	UK
		<	**Reg Talbot**	Management Science 'Department, University of Manchester Institute Science and Technology	UK
		<	**Barrie Evans**	Design Research Society	UK
	Int. Adv. Board		Professor Bruce Archer	Head of Department, Department of Design Research, Royal College of Art	UK
			Dr. Nigan Bayazit	Architectural Design Methods, Istanbul Teknik Universitesi, Mimarlik Fakultesi	Turkey
			Professor Geoffrey Broadbent	Head of School of Architecture, Portsmouth Polytechnic	UK
			Professor Richard Foque	Houtzijde 22, B 2418 Lille	Belgium
			Dr. Eng. Wojciech W.Gasparski	Design Methodology Unit, Praxiology Dept., Polish Academy of Sciences	Poland
			Professor E. Happold	School of Architecture and Building Science, University of Bath	UK
			Knut Holt	Section of Industrial Management, University of Trondheim, Norwegian Institute of Technolog	Norway
			Christopher Jones	Design methods	UK
			Professor Gerald Nadler	University of Wisconsin, Madison, Department of Industrial Engineering	USA
			Professor Henry Sanoff	North Carolina State University at Raleigh, School of Design: Architecture, Landscape Architecture, Product Design	USA
			Professor Tom W. Mayer	Director of ABACUS, Computer Unit, University of Strathclyde, Dept of Architecture and Bldg Science,	UK
		>	Dr Dipl. Ing Vladimir Hubka	Institut fiir Grundlagen der Maschinenkonstruktion	Switzerland
		>	George Rzevski	School of Electronic Engineering and Computer Science, Kingston Polytechnic	UK
		>	R.J. Talbot	Management Science 'Department, University of Manchester Institute Science and Technology	UK
		>	Dr Mineki Hattori	Department of Architecture, University of Chiba	Japan
		>	Professor V Papanek	School of Architecture and Urban Design, University of Kansas	USA
		>	John Lansdown	Centre for Advanced Studies in Computeraided Art and Design	UK

Table 4 (continued)

			Dr Patrick Purcell	Architecture Machine Group, Massachusetts Institute of Technology	USA
		<	Erik Hultberg	Arkitektene Hultberg Resen Throne-Hoist & Boguslawski A/S	Norway
			Dr. John C. Thomas	IBM, Thomas J. Watson Research Center	USA
		<	Professor George N. Soulis	Associate Dean of Engineering, University of Waterloo, Faculty of Engineering	Canada
			Professor Len Warshaw	Universite de Montreal, Faculte de l'Amen Agement, Ecote d'Architecture	Canada
			Lucien A. Gerardin	Research Director, Futures Studies Group	France
		<	Dr. H. Geschka	Innovation Planning Division, Battelle-Institut	West Germany
			Sydney Gregory	Design Science	UK

Table 5 Changes in the editorial board in the end of the 90s and early 2000s

Editorial Boards of DESIGN STUDIES from 1979 to 2010						
End of 90s and Early 2000s	General Editor		Nigel Cross		Faculty of Technology Open University	UK
	Regional Editors	>	Professor Norbert Roozenburg	Europe	Faculty of Design Engineering Delft University of Technology	Netherlands
			Dr David Radcliffe	Far East and Australia	Department of Mechanical Engineering, University of Queensland	Australia
			Henry Sanoff	The Americas	North Carolina State University at Raleigh, School of Design:Architecture, Landscape Architecture, Product Design	USA
		<	Ken Wallace		Engineering Department, University of Cambridge,	UK
			Alwyn Jones		City University Business School	UK
			Professor James Powell		School of Architecture, Portsmouth Polytechnic,	UK
			Michael Tovey		Department of Industrial Design, Gwentq Lax&ester Po1ytecbnic	UK
	Int. Adv. Board		Professor Bruce Archer		Department of Design Research, Royal College of Art,	UK
			Alwyn Jones		Centre for Business Systems Analysis, The City University,	UK
			Professor Richard Foque		Department of Architecture, University of Antwerp	Belgium

Table 5 (continued)

	Dr. H. Geschka	Innovation Planning Division, Battelle-Institut e.V	West Germany
	Christopher Jones	Design Methods	UK
	Professor Tom W. Mayer	Director of ABACUS, Computer Unit, University of Strathclyde, Dept. Of Architecture & Bldg Science	UK
	Ken Wallace	Engineering Department, University of Cambridge	UK
	Dr Mineki Hattori	Department of Architeclure, University of Chiba	Japan
	John Lansdown	Centre for Advanced Studies in Computeraided Art and Design, Middlesex Polytechnic	UK
	Dr Patrick Purcell	Architecture Machine Group, Massachusetts Institute of Technology	USA
	George Rzevski	School of Electronic Engineering and Computer Science, Kingston Polytechnic	UK
	Michael Tovey	School of Art and Design, Coventry University	UK
	Dr. James Powell	School of Architecture, Portsmouth Polytechnic	UK
	Professor W Ernst Eder	Department of Mechanical Engineering, Royal Military College of Canada	Canada
	Professor John Gero	Key Centre of Design Quality, University of Sydney	Australia
>	Dr David Haman	Faculty of Design, University of Technology	Australia
	Professor Warren P Seering	Department of Mechanical Engineering Massachusetts Institute of Technology	USA
	Professor Charles L Owen	Institute of Design, Illinois Institute of Technology	USA
	Dr Rivka Oxman	Technion - Israel Institute of Technology, Faculty of Architecture and Town Planning	Israel
>	Dr David G Ullman	Department of Mechanical Engineering, Oregon State University	USA
	Dr John Langrish	Institute of Advanced Studies, Manchester Metropolitan University	UK
>	Dr C Cathain	Department of Architecture Queen's University of Belfast	UK
	Dr Margaret Bruce	School of Management, UMIST	UK

Table 5 (continued)

			Professor Omer Akin	Department of Architecture, Carnegie Mellon UniversitY	USA
		>	Professor Steven D. Eppinger	Sloan School of Management. Massachusetts Institute of Technology	USA
			Dr Per Galle	Technical University of Denmark	Denmark
		<	Professor E. Happold	School of Architecture and Building Science, University of Bath	UK
		<	Professor Henry Sanoff	North Carolina State University at Raleigh, School of Design: Architecture, Landscape Architecture, Product Design	USA
			Professor Geoffrey Broadbent	Head of School of Architecture, Portsmouth Polytechnic	UK
		<	R.J. Talbot	Management Science 'Department, University of Manchester Institute Science and Technology	UK
			Professor V. Papanek	School of Architecture and Urban Design, University of Kansas	USA
			Dr Dipl Ing Vladimir Hubka	Institut fiir Grundlagen der Maschienenkonstruktion	Switzerland
			Professor Gerald Nadler	University of Southern California, Department of Industrial and Systems Engineering,	USA
		<	Knut Holt	Section of Industrial Management, University of Trondheim, Norwegian Institute of Technology,	Norway
			Dr. Eng. Wojciech W.Gasparski	Design Methodology Unit, Department of Praxiology, Polish Academy of Sciences,	Poland
			Dr. Nigan Bayazit	Architectural Design Methods, Istanbul Technical University,	Turkey

Table 6 Changes in the editorial board in 2010

Editorial Boards of DESIGN STUDIES from 1979 to 2010					
2010	Editor-in - Chief		**Nigel Cross**	Design and Innovation, Faculty of Technology, Open University,	UK
	Associate Editors		**N. Roozenburg**	School of Industrial Design Engineering, Faculty of Design, Engineering and Production, Delft University of Technology	Netherlands
		>	**P. Lloyd**	Department of Design, Faculty of Mathematics, Computing and Technology, The Open University	UK
		>	**R. Oxman**	Technion - Israel Institute of Technology, Faculty of Architecture and Town Planning	Israel
		<	Henry Sanoff	North Carolina State University at Raleigh, School of Design: Architecture, Landscape Architecture, Product Design	USA
		<	Dr Michael Rosenman	Key Centre of Design Computing and Cognition-Department of Architecture University of Sydney	Australia
	Editorial Board		Omer Akin	Department of Architecture-Carnegie Mellon University	USA
			J. Cagan	Carnegie Mellon University	USA
			D. Eppinger	Sloan School of Management Massachusetts Institute of Technology	USA
			P. Galle	The Danish Design School	Denmark
			Z. Langrish	Design Research, University of Salford,	UK
			P. Seering	Mechanical Engineering Department, Massachusetts Institute of Technology,	USA
			M. Tovey	School of Art and Design, Coventry University	UK
			D. Ullman	Robust Decisions, Corvallis	USA
			K. Wallace	Engineering Department, University of Cambridge	UK
		>	C. Atman	Center for Engineering Learning and Teaching, University of Washington,	USA
		>	P. Badke-Schaub	School of Industrial Design Engineering, Delft University of Technology,	Netherlands
		>	K. Dorst	Faculty of Design, Architecture and Building, University of Technology,	Australia
		>	L. Drew	Chelsea College of Art and Design, University of the Arts	UK
		>	D. Durling	Middlesex University	UK
		>	C.M. Eastman	Georgia Institute of Technology	USA
		>	C. Eckert	Department of Design, Development, Environment and Materials, Open University	UK
		>	K. Friedman	Swinburne University of Technology	Australia
		>	S. Hsiao	Department of Industrial Design, National Cheng Kung University, Tainan,	Taiwan, ROC

Table 6 (continued)

			L. Justice	School of Design, Hong Kong Polytechnic University	Hong Kong
			T. Kvan	University of Melbourne	Australia
			B. Lawson	Faculty of Architectural Studies, University of Sheffield,	UK
			K.-P. Lee	Korea Advanced Institute of Science and Technology	South Korea
			L. Leifer	Center for Design Research, Stanford University	USA
			U. Lindemann	Lehrsthuhl für Konstruktion im Maschinenbau, Technische Universität München,	Germany
			P. Rodgers	School of Design, Northumbria University	UK
			C. Rust	Sheffield Hallam University	UK
			Dr C Cathain	Department of Architecture, Queen's University of Belfast	UK
			Professor W Ernst Eder	Department of Mechanical Engineering, Royal Military College of Canada	Canada
			Professor Richard Foque	Department of Architecture, University of Antwer	Belgium
			Dr Mineki Hattori	Department of Architeclure, University of Chiba	Japan
			Alwyn Jones	Centre for Business Systems Analysis, The City University,	UK
		<	Christopher Jones	Design Methods	UK
			John Lansdown	Centre for Advanced Studies in Computeraided Art and Design, Middlesex Polytechnic	UK
			Professor Charles L Owen	Institute of Design, Illinois Institute of Technology	USA
			Dr. James Powell	School of Architecture, Portsmouth Polytechnic	UK
			Dr Patrick Purcell	Architecture Machine Group, Massachusetts Institute of Technology	USA
			George Rzevski	School of Electronic Engineering and Computer Science, Kingston Polytechnic	UK

Table 7 Brief information of the DS's special issues

DS-SPECIAL ISSUES				
Dec.	**Year**	**Editor**	**Issue**	**Design knowledge type**
80s	1982		Design Policy In Design Studies Conference	Epistemology Methodology
	1982		Design Education	Epistemology

Table 7 (continued)

	1983	Henry Sanoff James Powell	Designing For Behavior	Methodology
	1984	Alwyn H. Jones	Information Technology	Methodology
	1984	Donald Schön	Design: A Process Of Enquiry, Experimentation And Research	Epistemology
	1986	Henry Sanoff	The Function Of The Design Coalition Team	Methodology
90s	1993	Margaret Bruce	Case Study Methods In Design Research	Methodology
	1995	K. Dorst	Analysing Design Activity	Methodology
	1995	M. Tovey	Research in the UK Engineering Design Centres	Methodology
	1996	R. Oxman	Design Cognition and Computation	Epistemology Methodology
	1997	Ö. Akin	Descriptive Models of Design	Epistemology
	1998	T. Purcell	Sketching and Drawing in Design	Methodology Epistemology
	1999	C. Eastman, W. Newstetter, M. McCracken	Design Education	Epistemology
	1999	E. Frankenberger, P. Badke-Schaub	Empirical Studies of Engineering Design in Germany	Methodology
2000s	2000	P.A. Rodgers, A.P. Huxor	Web-based AI Design Tools	Methodology
	2000	P. Jagodzinski, F. Reid, P. Culverhouse	Ethnographic Approaches to the Study of Engineering Design	Methodology
	2002	P. Galle	Philosophy of Design	Epistemology Phenomenology
	2003	P. Lloyd	Designing in Context	Methodology
	2003	N. Cross	Common Ground	Epistemology methodology
	2004	N. Cross	Expertise in Design	Epistemology
	2006	R. Oxman	Digital Design	Methodology Epistemology
	2007	H. Sanoff	Participatory Design	Methodology
	2008	L. Candy, B. Costello	Interaction Design and Creative Practice	Methodology
	2009	P. Lloyd, J. McDonnell	Values in the Design Process	Epistemology
	2010	Marian Petre, Andre van der Hoek, Alex Baker	Studying Professional Software Design	Methodology

Table 8 Frequency of the keyword *program* in the articles

Program DESIGN STUDIES from 1979 to 2010	program	{program}	{programme}	{programmes}	programming	{programming }
within all fields	759	367	366	160	262	261
within the titles	6	-	3	6	7	7
within keywords	4	-	-	3	4	6
within abstracts	40	14	19	3	40	16

Table 9 Frequency of the keyword *programme* in the articles

Research programme DESIGN STUDIES from 1979 to 2010	research programme	{research programme}	{research programmes}
within all fields	658	56	56
within the titles	5	1	3
within keywords	3	-	2
within abstracts	17	5	-

Table 10 Articles which use the word *programme* in the title

Program DESIGN STUDIES from 1979 to 2010	year	{programme}
within the titles	1980	Design methods and theories: Demel, J 'User's characteristics of the GQVM programme' Vol 14 No 3/4 (1980) p 123 Design Studies, *Volume 2, Issue 3*, *July 1981*, *Page 176*
	1984	Regionalism as an architectural research programme in the work of Dimitris and Suzanna Antonakakis Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 166-174* Vasilia A. Metallinou
	1985	User needs programme for a research facility Design Studies, *Volume 6, Issue 4*, *October 1985*, *Pages 187-195* H. Sanoff

Table 11 Articles which use the word *programmes* in the title

Program DESIGN STUDIES from 1979 to 2010	year	{programmes}
within the titles	1984	Conceptual and artifactual research programmes in Louis I Kahn's design of the Phillips Exeter Academy Library (1966–1972) Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 159-165* Libero Andreotti
	1984	Architectural research programmes in the work of Le Corbusier Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 151-158* Stanford Anderson
	1984	Architectural design as a system of research programmes Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 146-150* Stanford Anderson

Table 12 Articles which use the word *program* in the keywords

Program **DESIGN STUDIES** from 1979 to 2010	**year**	**program**
within the keywords	1982	**Domain knowledge and the design process** Design Studies, *Volume 3, Issue 1*, *January 1982*, *Pages 31-36* John McDermot
	1984	**Architectural design as a system of research programmes** Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 146-150* Stanford Anderson
	1984	**Regionalism as an architectural research programme in the work of Dimitris and Suzanna Antonakakis** Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 166-174* Vasilia A. Metallinou
	1984	**Architectural research programmes in the work of Le Corbusier** Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 151-158* Stanford Anderson

Table 13 Articles which use the word *programming* in the title

Program DESIGN STUDIES from 1979 to 2010	year	programming
within the titles	1980	**Structured programming: Edward Yourdon *Managing the structureed techniques*** Design Studies, *Volume 1, Issue 5, July 1980, Page 316* Sydney Gregory
	1981	**Programming for microprocessors : Andrew Colin** Design Studies, *Volume 2, Issue 1, January 1981, Page 62* Sydney Gregory
	1983	**Design methods and theories: Preiser, WFE 'Behavioral science and the design studio—results of an experiment in sequencing post-occupancy evaluation, programming and design in a graduate level studio'** Design Studies, *Volume 4, Issue 2, April 1983, Page 143*
	1984	**Programming is an engineering profession : Hoare,** Design Studies, *Volume 5, Issue 4, October 1984, Page 269* H. Faber
	1985	**Programming as a craft: Sommerville, I 'Software engineering'** Design Studies, *Volume 6, Issue 3, July 1985, Pages 172-173* H. Faber
	1988	**Participatory programming for digital equipment corporation, inc** Design Studies, *Volume 9, Issue 1, January 1988, Pages 14-24* W. Graham Adams
	1997	**Comparative floorplan-analysis in programming and architectural design** Design Studies, *Volume 18, Issue 1, January 1997, Pages 67-88* Theo J. M. van der Voordt, Dick Vrielink, Herman B. R. van Wegen

Table 14 Articles which use the word *programming* in the keywords

Program DESIGN STUDIES from 1979 to 2010	**year**	**{programming}**
	1984	**Software design** Design Studies, *Volume 5, Issue 2, April 1984, Pages 68-72* A.M. Gordon
	1984	**Design as the exploration of constraints** Design Studies, *Volume 5, Issue 3, July 1984, Pages 137-138* Mark Gross, Aaron Fleisher
	1988	**Participatory programming for digital equipment corporation, inc** Design Studies, *Volume 9, Issue 1, January 1988, Pages 14-24* W. Graham Adams
within the keywords	1988	**The patients' view of their domain** Design Studies, *Volume 9, Issue 1, January 1988, Pages 40-55* Tun Sing Chen, Henry Sanoff
	1997	**Comparative floorplan-analysis in programming and architectural design** Design Studies, *Volume 18, Issue 1, January 1997, Pages 67-88* Theo J. M. van der Voordt, Dick Vrielink, Herman B. R. van Wegen
	2004	**The design brief as carrier of client information during the construction process** Design Studies, *Volume 25, Issue 3, May 2004, Pages 231-249* Nina Ryd

Table 15 Frequency of the keyword *constraint* in the articles

Constraint DESIGN STUDIES from 1979 to 2010	constraint	{constraint}	{constraints}
within all fields	**515**	**161**	**478**
within the titles	**3**	**-**	**3**
within keywords	**3**	**-**	**3**
within abstracts	**20**	**4**	**18**

Table 16 Articles which use the word *constraint* in the abstract

Constraint DESIGN STUDIES from 1979 to 2010	year	{constraint}
within abstracts	1988	**Constraints: Knowledge representation in design** Design Studies, *Volume 9, Issue 3, July 1988, Pages 133-143* Mark D. Gross, Stephen M. Ervin, James A. Anderson, Aaron Fleisher
	1993	**On computational models of drafting and design** Design Studies, *Volume 14, Issue 2, April 1993, Pages 124-156* Luias Apineda
	1996	**Frames of reference in architectural design: analysing the hyperacclamation (A-h-a-!)** Design Studies, *Volume 17, Issue 4, October 1996, Pages 341-361* Ömer Akin, Cem Akin
	2006	**Study of mental iteration in different design situations** Design Studies, *Volume 27, Issue 1, January 2006, Pages 25-55* Yan Jin, Pawat Chusilp

Table 17 Articles which use the word *constraint* in the title

Constraint DESIGN STUDIES from 1979 to 2010	year	{constraints}
within the titles	1988	Design as the exploration of constraints Design Studies, *Volume 5, Issue 3*, *July 1984*, *Pages 137-138* Mark Gross, Aaron Fleisher
	1993	Constraints: Knowledge representation in design Design Studies, *Volume 9, Issue 3*, *July 1988*, *Pages 133-143* Mark D. Gross, Stephen M. Ervin, James A. Anderson, Aaron Fleisher
	2006	The interaction of time and cost constraints on the design process Design Studies, *Volume 19, Issue 2*, *April 1998*, *Pages 217-233* Justin C.D Savage, Carolynne J Moore, John C Miles, Christopher Miles

Table 18 Frequency of the keyword *brief* in the articles

Brief DESIGN STUDIES from 1979 to 2010	brief	{brief}	{design brief}
within all fields	497	474	93
within the titles	1	1	1
within keywords	-	-	-
within abstracts	27	27	6

Table 19 Articles which use the word *design brief* in the title

Brief DESIGN STUDIES from 1979 to 2010	year	{design brief}
within the titles	2004	The design brief as carrier of client information during the construction process Design Studies, *Volume 25, Issue 3, May 2004, Pages 231-249* Nina Ryd

Table 20 Articles which use the word *design brief* in the abstract

Brief DESIGN STUDIES from 1979 to 2010	year	{design brief}
within abstracts	1983	Researching the design/production interface: product specifications Design Studies, *Volume 4, Issue 1, January 1983, Pages 13-19* M.H. Oakley, K.S. Pawa
	1996	Design rationalization and the logic of design: a case study Design Studies, *Volume 17, Issue 3, July 1996, Pages 253-275* Per Galle
	2004	The design brief as carrier of client information during the construction process Design Studies, *Volume 25, Issue 3, May 2004, Pages 231-249* Nina Ryd
	2006	Architect and user interaction: the spoken representation of form and functional meaning in early design conversations Design Studies, *Volume 27, Issue 2, March 2006, Pages 141-166* Rachael Luck, Janet McDonnel
	2010	An activity theory focused case study of graphic designers' tool-mediated activities during the conceptual design phase Design Studies, *Volume 31, Issue 5, September 2010, Pages 461-478* Stella Tan, Gavin Melles
	2010	Design requirements, epistemic uncertainty and solution development strategies in software design Design Studies, *6 October 2010* Linden J. Ball, Balder Onarheim, Bo T. Christensen

Table 21 Frequency of the keyword *requirement* in the articles

Requirement DESIGN STUDIES from 1979 to 2010	requirements	{requirements}	design requirements	{design requirements}
within all fields	745	690	745	84
within the titles	9	7	8	2
within keywords	7	6	6	2
within abstracts	47	44	44	3

Table 22 Articles which use the word *requirement* in the title

Design Requirements DESIGN STUDIES from 1979 to 2010	year	{requirements}
within the titles	1989	Analysis of design abstraction, representation and inferencing requirements for computer-aided design Design Studies, *Volume 10, Issue 3, July 1989, Pages 169-178* Jami J. Shah, Peter R. Wilson
	1991	Formalized specification of functional requirements Design Studies, *Volume 12, Issue 4, October 1991, Pages 221-224* K. Jacobsen, J. Sigurjónsson, Ø. Jakobsen
	1998	Environmentally conscious design: matching industry requirements with academic research Design Studies, *Volume 19, Issue 1, January 1998, Pages 63-80* Lisa Argument, Fiona Lettice, Tracy Bhamra
	2000	Unexpected discoveries and S-invention of design requirements: important vehicles for a design process Design Studies, *Volume 21, Issue 6, November 2000, Pages 539-567* Masaki Suwa, John Gero, Terry Purcell
	2005	Design engineering competencies: future requirements and predicted changes in the forthcoming decade Design Studies, *Volume 26, Issue 2, March 2005, Pages 123-153* Mark A. Robinson, Paul R.Sparrow, Chris Clegg, Kamal Birdi
	2005	Establishing user requirements: incorporating gamer preferences into interactive games design Design Studies, *Volume 26, Issue 3, May 2005, Pages 243-255* Gabriel Jacobs, Barry Ip
	2010	Design requirements, epistemic uncertainty and solution development strategies in software design Design Studies, *6 October 2010* Linden J. Ball, Balder Onarheim, Bo T. Christensen

Table 23 Articles which use the word *requirement* in the keywords

Design Requirements DESIGN STUDIES from 1979 to 2010	**year**	**{requirements}**
within the keywords	1986	**The information systems design process: many views of one situation** Design Studies, *Volume 7, Issue 2*, *April 1986*, *Pages 80-86* Lyn Antill
	1988	**Negotiating between children and adult design values in open space projects** Design Studies, *Volume 9, Issue 2*, *April 1988*, *Pages 67-75* Mark Francis
	1991	**Formalized specification of functional requirements** Design Studies, *Volume 12, Issue 4*, *October 1991*, *Pages 221-224* K. Jacobsen, J. Sigurjónsson, Ø. Jakobsen
	2006	**Clients' activities at the design front-end** Design Studies, *Volume 27, Issue 6*, *November 2006*, *Pages 657-683* Patricia Tzortzopoulos, Rachel Cooper, Paul Chan, Mike Kagioglou
	2010	**Representing structure in a software system design** Design Studies, *6 October 2010* Michael Jackson
	2010	**Design requirements, epistemic uncertainty and solution development strategies in software design** Design Studies, *6 October 2010* Linden J. Ball, Balder Onarheim, Bo T. Christensen

Table 24 Articles which use the word *design requirement* in the title

Design requirements DESIGN STUDIES from 1979 to 2010	**year**	**{design requirements}**
within the titles	2000	**Unexpected discoveries and S-invention of design requirements: important vehicles for a design process** Design Studies, *Volume 21, Issue 6*, *November 2000*, *Pages 539-567* Masaki Suwa, John Gero, Terry Purcell
	2010	**Design requirements, epistemic uncertainty and solution development strategies in software design** Design Studies, *online 6 October 2010* Linden J. Ball, Balder Onarheim, Bo T. Christensen

Table 25 Articles which use the word *design requirements* in the keywords

Design requirements DESIGN STUDIES from 1979 to 2010	year	{design requirements}
within the keywords	2010	Design requirements, epistemic uncertainty and solution development strategies in software design Design Studies, *6 October 2010* Linden J. Ball, Balder Onarheim, Bo T. Christensen
	2010	Representing structure in a software system design Design Studies, *6 October 2010* Michael Jackson

Table 26 Articles which use the word *design requirements* in the abstract

Design requirements DESIGN STUDIES from 1979 to 2010	year	{design requirements}
within abstracts	1984	Designing the documentation that explains how IT works Design Studies, *Volume 5, Issue 2, April 1984, Pages 73-78* Patricia Wright
	2008	Investigating the cognitive behavior of generating idea sketches through neural network systems Design Studies, *Volume 29, Issue 1, January 2008, Pages 70-92* Yinghsiu Huang
	2010	Design requirements, epistemic uncertainty and solution development strategies in software design Design Studies, *6 October 2010* Linden J. Ball, Balder Onarheim, Bo T. Christensen

Table 27 Frequency of the keyword *function* in the articles

Function DESIGN STUDIES from 1979 to 2010	function	{function}	functionalism	{functionalist}	{functionalists}
within all fields	861	740	29	27	3
within the titles	14	8	-	-	-
within keywords	5	5	1	-	-
within abstracts	61	36	1	2	-

Table 28 Articles which use the word *function* in the title

Function DESIGN STUDIES from 1979 to 2010	year	function
	1981	**Function of tacit knowing in learning to design** *Design Studies, Volume 2, Issue 4, October 1981, Pages 209-214* Chris Abel
	1986	**The function of the design coalition team** *Design Studies, Volume 7, Issue 3, July 1986, Pages 122-124* M.R. Beheshti
	1990	**Function sharing in mechanical design** *Design Studies, Volume 11, Issue 4, October 1990, Pages 223-234* Karl T. Ulrich, Warren P. Seering
	1991	**Designing by functions** *Design Studies, Volume 12, Issue 1, January 1991, Pages 51-57* A.L. Johnson
	1992	**Kinds of seeing and their functions in designing** *Design Studies, Volume 13, Issue 2, April 1992, Pages 135-156* Donald A. Schon, Glenn Wiggins
	1993	**Representing design knowledge as a network of function, behaviour and structure** *Design Studies, Volume 14, Issue 3, July 1993, Pages 314-329* Min Yan
	1995	**Design function deployment — a design system for the future** *Design Studies, Volume 16, Issue 4, October 1995, Pages 447-470* S. Sivaloganathan, N. F. O. Evbuomwan, A. Jebb, H. P. Wynn
within the titles	1996	**The functions of plastic injection moulding features** *Design Studies, Volume 17, Issue 2, April 1996, Pages 201-213* Stephen L. Wood, David G. Ullman
	1996	**Two functions of analogical reasoning in design: a cognitive-psychology approach** *Design Studies, Volume 17, Issue 4, October 1996, Pages 417-434* Willemien Visser
	1998	**Purpose and function in design: from the socio-cultural to the techno-physical** *Design Studies, Volume 19, Issue 2, April 1998, Pages 161-186* M.A Rosenman, J.S Gero
	2004	**The situated function–behaviour–structure framework** *Design Studies, Volume 25, Issue 4, July 2004, Pages 373-391* John S. Gero, Udo Kannengiesser
	2010	**The roles that artefacts play: technical, social and aesthetic functions** *Design Studies, Volume 31, Issue 4, July 2010, Pages 311-344* Nathan Crilly
	2011	**Comparing collaborative co-located and distributed design processes in digital and traditional sketching environments: A protocol study using the function–behaviour–structure coding scheme** *Design Studies, Volume 32, Issue 1, January 2011, Pages 1-29* H.H. Tang, Y.Y. Lee, J.S. Gero
	2011	**Technical Functions: On the Use and Design of Artefacts** *Design Studies, Volume 32, Issue 1, January 2011, Pages 109-111* Per Galle

Table 29 Articles which use the word *function* in the keywords

Function **DESIGN STUDIES** from 1979 to 2010	**year**	**function -- {function}**
within keywords	1984	**Designing with both halves of the brain** *Design Studies, Volume 5, Issue 4, October 1984, Pages 219-228* Michael Tovey
	1995	**Design function deployment — a design system for the future** *Design Studies, Volume 16, Issue 4, October 1995, Pages 447-470* S. Sivaloganathan, N. F. O. Evbuomwan, A. Jebb, H. P. Wynn
	1996	**The functions of plastic injection moulding features** *Design Studies, Volume 17, Issue 2, April 1996, Pages 201-213* Stephen L. Wood, David G. Ullman
	1998	**Purpose and function in design: from the socio-cultural to the techno-physical** *Design Studies, Volume 19, Issue 2, April 1998, Pages 161-186* M.A Rosenman, J.S Gero
	2011	**Comparing collaborative co-located and distributed design processes in digital and traditional sketching environments: A protocol study using the function–behaviour–structure coding scheme** *Design Studies, Volume 32, Issue 1, January 2011, Pages 1-29* H.H. Tang, Y.Y. Lee, J.S. Gero

Table 30 Articles which use the word *function* in the title

Function DESIGN STUDIES from 1979 to 2010	year	{function}
within the titles	1981	**Function of tacit knowing in learning to design** *Design Studies, Volume 2, Issue 4, October 1981, Pages 209-214* Chris Abel
	1996	**The function of the design coalition team** *Design Studies, Volume 7, Issue 3, July 1986, Pages 122-124* M.R. Beheshti
	1990	**Function sharing in mechanical design** *Design Studies, Volume 11, Issue 4, October 1990, Pages 223-234* Karl T. Ulrich, Warren P. Seering
	1993	**Representing design knowledge as a network of function, behaviour and structure** *Design Studies, Volume 14, Issue 3, July 1993, Pages 314-329* Min Yan
	1995	**Design function deployment — a design system for the future** *Design Studies, Volume 16, Issue 4, October 1995, Pages 447-470* S. Sivaloganathan, N. F. O. Evbuomwan, A. Jebb, H. P. Wynn
	1998	**Purpose and function in design: from the socio-cultural to the techno-physical** *Design Studies, Volume 19, Issue 2, April 1998, Pages 161-186* M.A Rosenman, J.S Gero
	2004	**The situated function–behaviour–structure framework** *Design Studies, Volume 25, Issue 4, July 2004, Pages 373-391* John S. Gero, Udo Kannengiesser
	2011	**Comparing collaborative co-located and distributed design processes in digital and traditional sketching environments: A protocol study using the function–behaviour–structure coding scheme** *Design Studies, Volume 32, Issue 1, January 2011, Pages 1-29* H.H. Tang, Y.Y. Lee, J.S. Gero

Table 31 Articles which use the word *functionalism* in the abstract

Function DESIGN STUDIES from 1979 to 2010	year	functionalism
Within keywords-abstracts	1985	**Designing for people or ball-bearings?** Design Studies, *Volume 6, Issue 3, July 1985, Pages 163-168* Jonathan D Sime

Table 32 Articles which use the word *functionalist* in the abstract

Function DESIGN STUDIES from 1979 to 2010	year	{functionalist}
within abstracts	1979	**The history and science of the artificial** *Design Studies, Volume 1, Issue 1, July 1979, Pages 49-58* Philip Steadman
	1980	**Appropriation of space in a design office** *Design Studies, Volume 1, Issue 5, July 1980, Pages 273-279* Ian Cooper, Rita Harris, Robert Tranter, Alan Lipman

Table 33 Articles which use the word *functionalist* in all fields

Function DESIGN STUDIES from 1979 to 2010	year	{functionalists}
within all fields	1983	**Categories in architectural theory and design: derivation and precedent** *Design Studies, Volume 4, Issue 4, October 1983, Pages 215-226* David S. Capon
	1986	**The concept of participation** *Design Studies, Volume 7, Issue 3, July 1986, Pages 153-162* Fredrik Wulz
	1982	**Learning to mean** *Design Studies, Volume 3, Issue 4, October 1982, Pages 205-211* Phil Roberts

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WORK EXPERIENCE

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2011- Present	ESOGU	Department of Architecture	Research Assistant
2010-2011	METU	Department of Architecture	Research Assistant
1997- 2009	ESOGU	Department of Architecture	Research Assistant

FOREIGN LANGUAGES

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PUBLICATIONS

1. Özten, Ü., "Problems of Intuition in Computer Aided Architectural Design," Built Environment and Information Technologies, proceedings of CIB PGRC, Ankara, Türkiye, 2006. ISBN: 975-429-242-6
2. Özten, Ü., "Humanism of the 'New Monumentality' and the Problems of Collective Identity in Modern Architecture and Urban Design," proceedings of the International Forum on Urbanism, IFOU. Modernization and Regionalism Re-inventing Urban Identity,Beijing-China, 2006. ISBN: 90-78658-01-0
3. Özten, Ü., "Why Architectural Program Today?" proceedings of the Congress of Iberoamerican Society of Digital Graphics, SIGraDi, From Modern to Digital: The Challenges of a Transition, Sao Paulo Brazil, 2009. ISSN: 2176-0519
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5. Özten, Ü., Anay H., "Re-Reading Architecture and Its Object" proceedings of the 4T: Turkish Design History Society, 2010, Deciphering the Object, İzmir, Turkey, 2010. ISBN: 978-975-633-9
6. Özten, Ü., Anay H., Anay M., "Brick: A Logical Tool for the Modern Space Construction" proceedings of the 4th Terra-Cotta Symposium, Eskişehir, Turkey, 2010. ISBN: 978-975-93349-9-4
7. Özten, Ü., Anay H., "Bauhaus Pedagogy and Digital Design'" proceedings of the 8'th Conference of the International Committee for Design History and Design Studies, ICDHS Sao Paolo 2012 - Design Frontiers: territories, concepts, technologies (e book) ISBN: 978-85-212-0692-7
8. Özten, Ü., Anay, H., "Towards an Evolutionary Conception of Constraint Based Design" proceedings of the DesignEd Asia Conference: Delimitation Creating with Constraints, Hong Kong, 2013 ISBN: 978-988-16721-5-5

Books

1. Özten, Ü., Anay, H., (Ed.) Biçim ve İşlev: Bugün biçim ve İşlev Üzerine Tartışmanın Neresindeyiz? ESOGÜ, 2011 (Turkish) (Peer Reviewed) ISBN: 978-975-7936-86-2

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1.Özten, Ü., Anay, H., "Önsöz," in, Biçim ve İşlev, Eskişehir Osmangazi Üniversitesi Yayınları, Mimarlık Kuram Kitaplığı, Eskişehir, 2011, pp: 1-4. (Turkish) ISBN: 978-975-7936-86-2

2.Özten, Ü., Anay, H., "Giriş: Mimarlıkta Biçim ve İşlev Tartışmasının Neresindeyiz?," in, Biçim ve İşlev, Eskişehir Osmangazi Üniversitesi Yayınları, Mimarlık Kuram Kitaplığı, Eskişehir, 2011, pp: 5-9. (Turkish) ISBN: 978-975-7936-86-2

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1. Özten, Ü., Anay, H., "Dijital Dönüşüm: Osmangazi Üniversitesi Mimarlık Bölümünde bir Paperless Studio Deneyimi Değerlendirmesi," Yapı Aylık Mimarlık Kültür ve Sanat Dergisi, 274, 2004, pp: 34-37. (Turkish) ISSN: 1300-3437

2. Özten, Ü., Anay, H., Anay, M., (2005). Coney Island, The Parachute Pavilion Competition, Eds. Zoe Ryan and Jonathan Cohen-Litant, Van Allen Institute, Princeton Architectural Press, 2007, 151, ISBN-10: 1568986238, ISBN-13: 978-1568986234