

An Essay on the defining Design Process as a Philosophical and Conceptual Term

Asiye Nisa KARTAL^{1*}, Hasan Basri KARTAL²

¹*Architecture and Built Environment, University of Nottingham, Nottingham, UK*

²*Architecture and Built Environment, University of Nottingham, Nottingham, UK*

**Corresponding author: a.nisa.gunduz@gmail.com*

Abstract – Every human product occurs as the consequence of a design process. The concept of design and design process generally accepted as similar or little differences in the context of interdisciplinary studies. This article aims to discuss the design process as a philosophical and conceptual concept from the pre-modern era to now by focusing on generated theories' outputs. This article shows us the design process itself is examined independently from the final products under the discipline of design methodology. In design methodology studies, continuity of design process, prevention of the mistakes or decreasing the mistakes to the minimum levels during the design process and prevention of repetitions and delays aimed to be solved. The article says thanks to these benefits of design process' studies, more qualified products created, and design processes developed positively.

Keywords – design, design idea, design process, design method, design theories

I. INTRODUCTION

Human beings like the other species have to fulfil their basic needs and because of the human beings' weakness and unpreparedness when faced to the dangerous situations in nature, they have to use their minds to create solutions against these unexpected conditions and tried to change the environmental facts. These impacts forced human beings to create alternative artificial environments to live. They achieved these issues by speaking and making instruments/tools. They learned to act collectively to fulfil some needs such as being fed, sheltering, protecting themselves against the enemies moreover acting collectively developed their ability to speak and to make instruments and this process became more complex throughout the human history. In this period, productive activities to be protected and to be sheltered are defined as the collective design by some design historians (Szalabaj, 2017; Beth, Jungnickel, and Lenz, 1999). After the emergence of agricultural society, organizational structures become more complex and work-sharing occurred. Work sharing triggered the specialization and caused to emerge the craftsmanship. In the craftsmanship period, products and architectural works generally created by trial and error method with very limited opportunities. In craftsmanship, the learning of design process based on master-apprentice relationship and imitation of the masters' way or methods and generally the competence of the apprentice was evaluated by his master and the guilds. And in craftsmanship period, generally, creation processes dealt with instant demands and achieved by verbal directions of the master furthermore generally there are no holistic approaches or theories moreover based on short term solutions. In craftsmanship, the design process began through obtaining knowledge, continues generation alternative solutions but after obtaining the approval of master, work-sharing began and, in this process, no changes are accepted. Therefore, the design is the embodiment of the master's imagination in craftsmanship period. Because the fragmented structure of design process in

craftsmanship was difficult and time-consuming, design process tried to be planned and represented by sketches or scaled drawings before construction start (Lawson, 2005; Yaneva, 2012; Brawne, 2005).

II. APPROACHES ON DESIGN PROCESS IN PRE-MODERN AGE

In the Renaissance period, thanks to the discovery of drawing methods based on the linear perspective brought about the acceleration of the design process and preventing contingencies and review the mistakes before producing. Important decisions and modifications could be tried through sketches and scaled drawings based on perspective and this issue provide to prevent the mismatches in the holistic structure of the design and to deal with design process holistically. This development triggered the complexity in the building process and new working group prototypes occurred such as designer architects who deal with creating new solutions on the contrary of traditional repeated ones and representing the building and its details using linear perspective, also some different groups such as practitioner architects, suppliers or workers etc. Despite the discovery of a new method, the learning process and knowledge of design is traditional and based on the master-apprentice relationship. However, the new projection method provided a more powerful sense of geometric proportions and to check mistakes through drawings and triggered the specialisation of the areas in the design process as the design phase and construction phase. In the late Renaissance Period (1500-1600), architectural drawings were used as the communication devices between designer architects, practitioner architects and construction masters and architects developed new representation methods and discovered plan, section and façade drawings as well as perspectives and replica models. And the design process began to be represented by 2D and 3D drawings in the paper as a plane. As well as linear perspective, in late Renaissance, new perspective styles such as axonometric, isometric, orthographic projection were

discovered. Projective geometries based on the different techniques of the foundation of the Cartesian coordinate system (Burrows, 2018; Cottingham, 2008).

Rene Descartes after 1600s founded analytical geometry and developed the coordinate system to express geometry numerically in 2D planes and to obtain numerical knowledge from geometric models (Cottingham, 2008). Girard Desargues (1591-1661) formulated the rules of linear perspective and developed techniques based on expression 3-dimensional geometric shapes or solids by 2D planes (Field and Gray, 1987). In 1671, the first architectural academy in modern meaning called Universal Fabric was founded by Jean-Baptiste Colbert (1619-1683) consultant and Finance Minister of King Louis XIV of France and architectural education began to separate from craftsmanship education and the architectural profession began to be independent of craftsmanship and more prestigious (James, 1837). After the 1700s, thanks to the foundation of projective geometry by French mathematician Gaspard Monge (1746-1818), projective geometry had become an important expression tool in design education since 1795. According to Monge, the coordinate system is the infinite matrixes and expression of 3D models and solids by 2D planes can be achieved by reflecting the projection of appearances of 3D objects towards 2D plane elements of the coordinate system. Monge's strategy was firstly accepted by design and engineering academies and afterwards became widespread by the ends of the 20th Century. However, at the ends of the 20th Century, thanks to the development in computer-aided design, more complex geometrical forms can be expressed by computers instead of projective geometry methods (Andersen, 2016).

After the Industrial Revolution, fundamental changes in design activity like the other fields of life happened. Craftsmanship could not deal with increased demands and fast and mass production strategies were began to be preferred in design process like happens in the other fields. In the design process, some architects benefited from standardization strategies and new materials such as glass and steel which can be produced by the new rising technologies. Thanks to newly opened architectural schools, a lot of architects were educated. Contemporary design mentality began to be formed at the beginning of 20th Century by Werkbund Academy and its follower Bauhaus Design School. In these schools, opportunities emerged thanks to the industrial revolution and traditional techniques and methods were aimed to be integrated and this attempts became widespread in all over the world quickly and triggered to be searched the design and design process in the lights of sciences systematically (Raizman, 2003; Ambler, 2018).

To sum up, due to the increasingly sophisticated lifestyles, conditions, knowledge, demands and needs transformed the production strategies and made them more complicated. Graphic designer John Maeda(1966-....) summarizes the transformation of the content of design and design process under the effects of developments in the economic, social, cultural fields by focussing on the medium of design and explains that in the past designers' design for real conditions and environments but nowadays, designers design for virtual environments such as website design and graphic design (Maeda, 2001).

III. ANALYSING THE DESIGN PROCESS IN THE TWENTIETH CENTURY

Especially, after the second half of the 20th century, searches on design processes became widespread. In general meaning, the searches can be categorized in five periods historically in the 20th century. These are focused on integration industrial and traditional methods in the 1920s, professionalism in design in 1930s, debates on design methods in 1950s, approaches and models on the design process in 1970s and holistic and cognitive psychological approaches in 1980s to now (Brawne, 2005).

From the 1920s and 1930s to 1950s design studies focussed on the evaluation of the final product. However, after the 1950s and 1960s, the design process was evaluated as the articulation of the series of activities and examined these steps separately from each other. In the 1950s, thanks to Wilhelm Wundt (1832-1920) 's pupil and founder of Wurzburg School focussing on anthropological-integrative psychotherapy Oswald Kulpe (1862-1915) and his researches suggesting benefiting from arithmetical transformation and analysis based searches to solve complex design problems and focussing on problem-solving behaviour having deciding tendencies as a controlling mechanism and this approaches triggered the searches on defining problem-solving in design process associated with the terms purposive activity, systematic control and the existence of checking mechanisms (Wundt and Judd, 2013; Külpe, 2018). Also, the Gestalt movement contributed to the formation of theories in the 1950s. In this period, generally, the design process was searched by three sub-categories as analysis, synthesis, and assessments/evaluation. As it can be seen easily, at this time design process studies focuses on the defining steps of the way from beginning to the final product. In the analysis step, the design problem is explored and divided into small fragments and defined and analyzed the problem. Also collecting information for the solution and clarification of the relationships between the parts of the problem emerges in this step. Synthesis is defined to collect fragmented solutions and generate a holistic approach to complete the design process. Assessment step is generally focused on the results and check the accordance between the first design problem and the final product as the solution. Design theorists generally created sub-categories to clarify this three-step to clarify and understand the design process (King and Wertheimer, 2005). Morris Asimow (1906-1982) defined these steps as "design elements", John Chris Jones (1927-.....), used the term "design factors", Leonard Bruce Archer (1922-2005), used "sub-Problems", Christopher Alexander (1936-....) identified "incompatible variants". In every concept of theorists, the content of concepts changed under their theoretical structure but generally, these concepts have similar contents. Also, some theorist re-defined these steps following their design methodology. For instance; Alex Faickney Osborn (1888-1966) defined the process as "brainstorm", William J. J. Gordon (1919-2003) associated the process with his invented method "synectics", Fritz Zwicky (1898-1974) identified as "morphological analysis", John Luckman also created an "analysis of interconnected decision-areas" to define the process and John Chris Jones (1927-.....) suggested the creation of catalogue groups. In Analysis-Synthesis-Assessment model, the best-understood part was the analysis

phase. The issues of how the synthesis step can be realized and which criteria will be used in the assessment step are ambiguous. Because of the ambiguity of definitions in these steps, these searches shifted from science to the philosophy of science and speculative debates emerged. Especially, in this area falsification theory of Karl Popper (1902-1994) was preferred at that time but some criticism based on the difference of scientific theories and structure of design process occurred. Therefore, at that time, clear theories could not be suggested, and very different ideas emerged after this period due to the ambiguity. This three-step model is also used by the other design areas to clarify the process. After this model, the following models focussed on more participating human into the design process and to solve the problems of designer faced during the design process (Raizman, 2003; Beth, Jungnickel and Lenz, 1999).

Analytical approaches to design processes occurred in the 1960s. First attempts about the design strategies suggested in Conference on Design Methods in 1963, and following this conference, Design Methods in Architecture was organized in 1967 and caused to face theorists whose definitions about design process based on its rational scientific structure and their opposite as intuitional artistic aspects. In the 1960s and the early 1970s theorists were called as the first-generation theorist. At that period main issue was focussing on the structure of the design process and the main question was whether design process is rational, definable, and systematic or intuitional, non-definable and chaotic. Some theorists such as Alex Faickney Osborn, William J. J. Gordon, Edward Mtchett and Geoffrey Broadbent have adopted the intuitionalist approaches and rationalistic approach was adopted by some theorists such as Christopher Alexander, Morris Asimow, John Chris Jones, Leonard Bruce Archer. Intuitionalist theorists claimed there cannot be a scientific explanation about the design process and associated design process with designer's instincts and they asserted human beings can only define inputs and outputs in the design process and cannot know what happens in the brain during the process. According to this attitude, design occurs as the result of an irrational process of human thinking controlled by intuition unconsciously. Because of their approaches based on only defining inputs and outputs, this approach also called black-box approach. According to them, the design process cannot be definable and controllable and scientific and rationalistic thought were obstacles for creativity based on mental complexity and intuition. On the opposite side, rationalists aimed to describe the design process logically and scientifically and believed randomness can be reduced or eliminated by dividing the design process into steps and analysing these steps. They also claimed the design process should depend on rationalistic explanations and be checkable. Designing and planning of the design process itself also gained importance as much as designing the final product. On the contrary implicit and mystical characteristics of intuitionalist approach, rationalist attitude tended to be explicit and systematic and due to that, this approach also called open box approach. Rationalists aimed transparency of design process and to define objectification/embodiment of the process by symbols, words, schematics for clarifying every step of the process. After the middle of 1970s, thanks to advancements in general and dynamic system theory and second cybernetics

one of the other approaches emerged based on including designer to design process which can be defined design as a self-regulating system. Because of the rising rationalistic approaches in studies on the design process, some theorists especially intuitionists left the research field and rejected new rising ideas. After this challenge between theorists, some searches in the field was about to stand still. However, the theory which was adopted the idea "design process as the self-regulating system" provided the formation of second-generation researches whose ideas focussing on participatory and argumentative sides of the design process (Aspelund, 2016; Black and Eddin, 2019; Guney and Moraes, 2008).

In the 1970s, past general assumptions about design process changed due to the criticisms on the decreased role of the designer in the design process, mechanical explanations of the rationalistic approach preventing creativity and uniqueness. Approaches reasoning the design process appeared in two ways in searches. One attempt tended to use scientific methodology and methods during the design process and the other attempt focussed on reconstructing design process research in the lights of values of natural science such as objectivity, universality, and rationality. In the middle of 1970s, second-generation research whose ideas focussing on the participation of designers and users in the design process appeared. However, this generation was not as prolific as much as the first generation in terms of publications. Horst Willhelm Jakob Rittel and Irwin Altman were some theorists who focus on the main concerns of the early 1970s. As aforementioned one of the other main issue with participation were argumentation/mental reflexivity in the mid-1970s. One of the most significant contributions in this side of design process researches were made by Allen Newell (1927-1992) and Herbert Alexander Simon (1916-2001) who put Information Processing Theory forth. According to their theory, the design process was thought as the flow of information and deals with limits of short and long term memory by supposing the mental codification, operation, re-defining information were similar effects on mental process especially on problem-solving. Newell and Simon's roots of this theory can be found in their work Elements of a Theory of Problem Solving published in 1957. Newell and Simon's theories were made important contributions especially examining relationships between cognitive psychology and design process. One of the other main contributions occurred due to the emergence of protocol analysis methods based on recording designers' activities, words and behaviours and examining them. Charles M. Eastman and Ömer Akın made some research focussing on analysing the design process by benefiting from protocol analysis in the late 1970s. Eastman and Akın, differently from first-generation researches, the defined design process in non-linear and recyclable and cyclical. Towards the end of 1970s, design process researches shifted to cognitive psychology and examining the cognition in design, formation of information and memory relationships, representation and architecture relationship, classification of design knowledge gained significance and triggered to be formed new areas in design process researches. These research focus on synthesizing rationalistic and intuitional approaches under the perspective of cognitive psychology. Cognitive approaches accept design as intuitional activity however differently from intuitional approaches' intuition definitions based on manifestation due

to a sudden hunch; they define intuition as an emerged transaction by designer's refining his/her past experiences and memory. Thanks to cognitive approaches, some issues such as how designers' professional knowledge formed, how designer experience creative process gained significance and solutions and theoretical backgrounds were tried to be found in the field of cognitive psychology (Brown, 2007; Kellogg, 2003; Sternberg and Sternberg, 2017).

The attempts provided analysing the structure of creative knowledge in the design process, conceptualizing operations, perception of the problem and attaining information etc. In the 1980s design process research focussed on a holistic explanation of design process benefiting from cognitive psychology. Perception, formation, comprehending design representations logically and transforming this information to design theories were some issues of 1980s design types of research. In the 1980s another significant development, as well as a lot of publications on these issues, was the appearance of new magazines and journals on design and architecture questioning the process. The other issues dealt with by theorist in this period was meaning in information flow during the design process, verbal communication, visual reasoning, design epistemology etc. (Lawson, 2005; Yaneva, 2012).

Thanks to developments in cognitive psychology and computer science, the design process began to be examined more sophisticatedly. Also new emerging methods and strategies such as computer-aided design after the 1990s; furthermore, new demands depending on new developments such as mass customization caused design process to become more complex. These situations bring about architects' using new information from the other disciplines and architectural process became more interdisciplinary. Because of the complicated structure of the design process, research on this field divided into different interests and formed new discipline. Because of this complication, recently, theorists use design methodology to describe the field examining the design process. According to Nigel Cross, these searches can be categorized as; searches based on an interview with designers, observations and field study, protocol analysis, reflection and theorization, design simulation studies etc. Also, the design process studies separated following the product of design itself due to the different design disciplines have different design processes. For instance, the architectural design process is different from graphic design or fashion design processes. Also, in every type of design processes, the idea based on design can only be associated with human beings was accepted. Due to this acknowledgement, sometimes design process research of one discipline can be generalized for the other disciplines and could be presented as a general design process theory. Therefore, recently, in the design process researches of one discipline provide to create general and specific theories of the design process. In the 2000s two mainstream movements shaped the field. One of them was design cognition and the other one was design computational models. Design cognition focussed on examining the cognitive process in the design process and computational models focussed on systematic approaches and methods. Recently, disciplines which design studies have been made recently can be listed as, design education, design theories and methods, design psychology, design computation, design support

systems etc. (Cross, 2010; Cross, Christiaans and Dorst, 1996).

IV. CONCLUSION

It can be easily inferred that there are three major design approaches in the 20th century. First, one can be described as systematic approaches which emerged thanks to the influences of operational research and deals with the design process as a system and aimed to examine by dividing it into fragments and study all fragments in themselves. This was the mainstream movement amongst the first-generation theorists (from the beginning of 1960s to mid-1970s) and this approach was generally handled with a model based on three steps: analysis, synthesis, and assessment/evaluation. And in this approach there were two different sub-approaches; black-box approaches of intuitionists based on the idea that only inputs and outputs of the design process can be definable but the process cannot, and open/transparent box approaches of rationalists based on the idea that all the process can be definable scientifically and logically. Because of its strict rationalist view ignoring the designer's role and creativity and user demands, next-generation theorist occurred. They stressed the significance of participatory and reflexivity or reviewability of the design process. In this approach designer is seen as a consultant, advisor of the users instead of expertly identified by first-generation ones and taking attention on designer's abilities lose its significance and instead of one expert/designer centred schemata, 2nd generation theorists purposed user's joining to the process. Adding that, due to this approach, the designer's impact on design process decentralised. Thanks to its attributions based on flexibility in terms of the position of designer, 2nd generation approaches was adopted more commonly than first ones. After the mid-1970s, due to the advancement in computer science and cognitive psychology, the third approach based on benefiting from these new disciplines to explain design process comprehensively and holistically emerged. 3rd approach tried to preserve and integrate intuitional and rationalistic approaches and focussed on some concepts of psychology such as perception, cognition, representation etc. In this approach, the position of intuition was preserved but its process supported by rationalistic/scientific psychological theory and designers' seeking and understanding themselves by exploring how they think, act during this process was aimed. After the third approach, due to the advancements in sciences and architectural methods or techniques, design process became more complicated and the research or approaches aimed to examine the process through more sophisticated and interdisciplinary methods and tactics. After the second half of the 20th century, thanks to Phenomenology and Existentialism also some psychological methods, the significance of describing the human experience improved and different design definitions emerged following these theories or philosophies. Design process theorists defined design or design process by starting from their own experiences. As it can be easily that, every designer defines design activity under their mentality, perspective, and theoretical background. Because of the impossibility of handling all design theories in one essay, general attributions of systematic, participatory, and cognitive approaches are tried to be examined.

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