ID 1475 | DESIGNING WITH UNCERTAINTY: A FORM BEHAVIOUR APPROACH TO BEHAVIOURAL SCIENTIFIC STUDIES

Onur Tümtürk[1]
[1]Middle East Technical University, Ankara/TURKEY
onurtumturk@gmail.com

1 INTRODUCTION: BEHAVIOURAL SCIENCES AS AN EMERGING DESIGN PHILOSOPHY

The expeditious rise of the Modernism discourse -and its contributions on the architecture and urban design theory and practice at the beginning of the 20th century -has given much of its place to harsh criticisms and brand-new questions in the following years. According to Lang (1987), major developments arising from the Modern Movement such as unprecedented growth in human knowledge, major social changes, and increase in the standard of living made design praxis difficult rather than making it easier. Lang legitimizes this speculative and critical point of view with the assertion of having the technological ability to construct buildings, neighbourhoods, and cities in a wide variety of ways without fully understanding the ramifications of designing for human behaviour. Within this critical approach, after mid-1900s a new field of environmental studies – generalized as behavioural sciences -has emerged in the context of man and environment relationship which deals with the complex systematic interactions between the people and built environment.

Behavioural sciences which is dealing with the subject of human actions is a generic term that includes anthropology, sociology and psychology and even sometimes politics and economics (Bashiri, 2015). It is a comprehensive design philosophy which takes the human needs, preferences and values as the basis to satisfy the human needs and to eliminate environmental restraints and stresses. According to Carl Jung (1958), "people are as much a product of the physical environment as that of the social environment". Moreover, according to Lang (1987), "the physical world, of which the built environment is a part, is locked in an evolving relationship with the social and cultural worlds of people. […] Architects and urban designers are primarily concerned with changing the physical world so that it better fits a set of human needs". For the fields of urban design and architecture, it is a crucial need to use the behavioural sciences and environmental psychology as a methodological tool. Architecture and urban design -as disciplines dealing basically with enhancing the quality of human life – are concerned fundamentally with understanding what lies behind the nature of environment. While questioning the mutual interaction between man and environment, according to Rapoport (1977) there are three general questions which constitutes the main specifications of behavioural sciences and its concerns over man and environment relationship:

> *"1. How do people shape their environment – which characteristics of people […] are relevant to the shaping of particular environments?*
> *2.How and to what extent does the physical environment affect people, i.e., how important is the designed environment and in which contexts?*
> *3.What are the mechanisms which link people and environments in this two-way interaction?" (Rapoport, 1977)*

In the light of all these fundamental questions, behavioural scientific approaches develop an understanding about the impact of designers' work on people's lives especially when they design environment for people whose behaviour patterns and values are different than their own. This situation represents the complex nature of man and environment relationship and the natural issue of uncertainty. The fact that while the design professions have much in the way of normative theory, they are weak in positive theory or explanatory theory results in the erroneous conclusions about the impact of designers' work on people's lives. Indeed, the failure and problems of contemporary urban spaces are caused by the fact that design research and theory is not sufficiently empirical – which means we as designers need a comprehensive positive theory to be value-free, to avoid bias, to look for alternative explanations and to apply the rules of scientific method to observation and explanation. Therefore, according to Lang (1987), search for a positivistic approach is a crucial need and behavioural sciences offer the design professions much to help us develop both positive theory and an understanding of our normative theories. This issue leads architects and urban designers to the abandonment of 'absolutist positions' on what constitutes good design and the adoption of a 'relativist position'. This means that the design professions require a broader and more explicit understanding that they currently have of both the person environment relationship and the process of design.

Considering that the fundamental purpose of behavioural sciences is to develop positive theories, it is clear that these sciences have an important role in the development of theoretical foundations of design in various ways. If the position of behavioural sciences in architecture be considered as a model for professional architects and urban designers, it will lead to the success of the design. If designers use the help of environmental psychologists and direct their design towards creating environments that meet human needs, then the built environment can satisfy aspects of human needs such as survival, safety, belonging, esteem, learning and beauty and so on. In general terms, using the behavioural sciences in the design process increases the quality of the final product and process' itself.

2 COMPLEXITY AT THE ROOTS OF MAN-ENVIRONMENT RELATIONSHIP

It is still certainly valid in architecture and urban design theories that built environment is most crucial determinant for human behaviour patterns and life quality of the space. According to Lang (1994), while the quality of the built environment is certainly a major attribute of environmental quality, it is also tempting to go beyond this level of thought to consider the built environment, as the Modernists did, as the independent variable in the relationship between physical and social worlds – social behaviour being the dependent variable. However, via the help of developed literature on 'complex nature of human behaviour and also complexity of the urban space', it can be easily stated that the interaction -or the relationship ¬between man and environment is not simple as that. In other words, human behaviour is not a direct result of the effects of the urban space; or the urban space is not a direct outcome from the behaviours of its users. Interrelationships between these two phenomena do not represent a simple linear process. Indeed, man and environment relationship is much more complex and consists of intricate, dynamic and nonlinear processes.

As extraordinarily complex beings, humans and their individual and collective behaviour patterns can only be understood via the relational model which is more complex than the organismic and role models. According to this behavioural scientific model, "the human being is seen as both a subject and an object, as a succorer as well as a succorent". People are individuals who are the sum of their roles in society and need to be seen in relationship to others. To fully understand the implications of this complex model of people for urban designers, we need to understand how human beings experience the environment, and what motivates the way they experience it (Lang, 1987).

In addition to the complexity of human beings, all human settlements have complex patterns within which other meta-patterns-or micro patterns-exist. Moreover, all these patterns emerge under the dynamic process of urban change. At this point, Lang's criticism over "the Modernists' failure to understand the richness of human needs, the richness of the environment, and the complexity of the relationship between people and environment" is mentionable to open up a discussion about how recently developed complexity theories can help us to understand the complex interaction between man and environment as the main research question of this paper. This criticism takes its roots from the criticism of four basic theoretical positions (a free-will approach, a possibilistic approach, a probabilistic approach and a deterministic approach) about man-environment relationship. According to Barlas (1994), with the advent of ecological and environmental psychology, architectural determinism and simple behaviourist approaches was seriously questioned and challenged. The current approaches to the analysis of man-environment relations are probabilistic – which means it is based on an understanding of the dynamic interplays between human and spatial behaviour -in nature (Lang 1987, Lang et al. 1974). "Accepting the probabilistic approach would mean to acknowledge the 'uncertainty' concerning man's motivations, knowledge and decision making modes" (Barlas, 1994).

While Jon Lang's and more recent behavioural scientists' strong emphasis over the complexity issue related with man-environment relationship is seminal and very influential in that times, their approach to the concept of uncertainty in complex systems is substantially 'naïve' due to the lack of comprehensive literature about the complexity theories. According to Lang (1987), designers will always be making decision with uncertainty and so, behavioural sciences may reduce this uncertainty but will not eliminate it.

While Lang's point of view about his acceptance of the uncertainty as a concept which cannot be eliminate totally is worthy to note, a critical perspective should be developed to the issue of reducing uncertainty in order to raise a discussion. With the development of complexity science and its effects on architecture and urban design, concept of uncertainty cannot be seen as a drawback for design process or product. The fact that cities are complex systems which essentially contains various uncertainties, reducing the uncertainty seems unreasonable. Instead, designers should learn how to deal with uncertainty by using it as a design input: which means they should learn to 'design with uncertainty'. Within this context, complexity theories will help designers to develop better behavioural scientific approach to the fields of architecture and urban design.

3 EMERGING PARADIGM OF COMPLEXITY

Complexity science is a field that grew from chaos theory and the study of fractals in the 1980s. After 1990s, theory of complexity has led to the different scientific studies for urbanism, geography and architecture, and theorists studying in this field have increasingly directed their attention toward the dynamic processes and global patterns that emerge from the collective interactions of a system's individual components (e.g., Cowan, Pines, & Meltzer, 1994; Holland, 1995). Pierre Frankhauser who is a French geographer studied the urban complexity by conducting multiple studies of urban built surfaces, that there was a real geometric structure to them, and that it is possible to extract the fractal dimension of an urban area by analysing the built and unbuilt zones. According to Helie (2007), he thus proved that the city is a complex structure with a geometric order, and not simply a mathematical anomaly. Michael Batty studied complexity simulation methods, such as cellular automata, agent-based models, and catastrophe models. With his overarching work, Cities and Complexity, he showed the output of cellular automata as morphologically similar to cities. Last but not the least, Nikos Salingaros has taken a more material and less analytical approach to urban complexity. He explained the concept of 'urban web' as a set of connections between physical spaces that are differentiated and complementary and which cannot be subdivided in sub-sets.

Although most of the principles of complexity theory have originated in the physical and natural sciences, Gell-Mann (1995) states that "even more exciting is the possibility of useful contributions to the life sciences, the social and behavioural sciences, and even matters of policy for human society". According to Eidelson (1997), "many areas of the behavioural and social sciences have already attracted the attention of complexity investigators; among these fields are social networks, organizational development, economic instabilities, urban development, political transitions, international relations, social movements". As a transdisciplinary collection of concepts from different scientific fields of studies such as physics, economics, sociology and ecology; complexity theories and complex systems has prepared a background for urban design and architectural theories. According to Eidelson (1997),

> *"it has taken time for planning to adopt complexity thinking beyond metaphor or common usage of the term, but we now appear to be at a tipping point where complexity planning is exploring methods of engagement with bottom-up phenomena, structural and functional co-evolution and resultant adaptable and self-organisational systems, rather than the question of whether cities are complex". (Eidelson, 1977)*

In the context of all this theoretical background, complex systems are basically considered as the aggregates involving many components generating a recognisable global (collective) behaviour and large-scale order which are not controlled centrally, but generated by many local interactions (Caliskan, 2013). In addition to this definition, they are adaptive, unpredictable and generative systems including continuous information processing and adaptive feedback loops. In order to challenge the conventional views on urban planning and design, to understand the complex and nonlinear nature of man-environment relationship and to develop better approaches in terms of the behavioural sciences, searching for models of complexity and the various kinds of complex systems is a crucial necessity.

3.1 COMPLEX ADAPTIVE SYSTEMS

As a general term, 'complex adaptive system (CAS)' derived from the complexity theories and it means "a 'complex macroscopic collection' of relatively 'similar and partially connected micro-structures' formed in order to adapt to the changing environment and increase its survivability as a macro-structure" (MacLennan, 2012). CAS is a large collection of diverse parts interconnected in a hierarchical manner such that organization persists or grows over time without centralized control. The brain (e.g., Haken, 1996; Kelso, 1995), the immune system (e.g., Bremermann, 1994; Holland, 1995; Varela, Sanchez-Leighton, & Coutinho, 1992), an ant colony (e.g., Kelly, 1994; Sole, Miramontes, & Goodwin, 1993), and human society (e.g., Mainzer, 1993; Weidlich & Haag, 1983) are often presented as examples.

As the most fundamental principle of the CAS, individual micro-units in the system gather information from the surrounding – neighbouring – units and from the external environment through a continuous and dynamic process. The collected information and system's responses to this information are formulated according to the system's local rules and codes. Thus, an interesting competition and a selection process is observed to make some properties stronger and to constrain others. At the end of the process, entirely new and unexpected properties can also emerge spontaneously. According to Eidelson (1997), "the complex adaptive system is poised for potential change and adaptation either through alteration of its rules, connections, and responses or through modification of the external environment".

From this point on, it is a vital necessity to analyse complex adaptive systems and their attributes briefly in order to find out their overlapping features with the behavioural scientific approaches. While doing this, the most valid assumptions about the nature of man-environment relationship via the help of Proshansky (1974)'s "The Influence of the Physical Environment on Behaviour: Some Basic Assumptions" will be used to compare them according to the basic attributes of CAS.

Firstly, the features of "hierarchical arrangements with distributed control" and "self-organization" is vital for complex adaptive systems. The numerous and diverse interacting units that constitute a complex adaptive system are typically arranged in a hierarchical structure. Simon (1995) has noted that some aggregations, such as human society, involve an especially complex network structure because each agent may belong within a number of different structures at the same hierarchical level (e.g., an individual may simultaneously be a member of a family, a professional organization, and a therapy group). Social systems also demonstrate decentralized control in a variety of ways. In animals, for example, the "intelligent" behaviour of a swarm of bees selecting a new hive site or a colony of ants locating a food source unfolds despite the absence of an executive agent (Kelly, 1994). Moreover, Barton (1994) describes self-organization as "a process by which a structure or pattern emerges in an open system without specifications from the outside environment".

Secondly, Proshansky (1974) asserts that the physical setting that defines and structures any concrete situation is not a closed system; its boundaries are not fixed either in space or in time. This assumption implies that human behaviour and its interaction with the space is not static and linear but dynamic. As the same, according to Eidelson (1997), the course of self-organization in complex adaptive systems is often influenced by feedback controls using the nonlinear interactions among its parts to generate snowballing effects. By means of dynamic – nonlinear – feedback loops the adaptation and learning can be achieved ultimately in the context of human and spatial behaviour.

Thirdly, according to Proshansky (1997), "every component of the environment interacts or has defined relationships with every other component in two ways: (a) it acts on all other aspects, and (b) it is acted upon by all other aspects and in particular, receives the consequences of its own action". Similarly, another important structural feature of a complex adaptive system is the nature of the connections among its components. Simon (1981) described that intra-component linkages tend to be stronger than inter-component linkages, and neighbouring components tend to have stronger connections than distant components.

Fourthly, Proshansky et al. (1997) states that behaviour in relation to a physical setting is dynamically organized: a change in any component of the setting has varying degrees of effects on all other components in that setting, thereby changing the characteristic behaviour pattern of the setting as a whole. Similar dynamic organization can be observed in CAS as well. The self-organization process does not inevitably lead the CAS to a single fixed or static state. Indeed, many theorists and investigators have concluded that complex adaptive systems often exhibit internally generated fluctuations – which means dynamism -beneath their macroscopic stability.

Lastly, an overlapping feature in the context of environmental adaptation of human behaviour can be observed in CAS. Several investigators have found the concept of fitness landscapes useful in analysing the adaptation and coevolution of complex adaptive systems (e.g., Gell-Mann, 1994b; Kauffman, 1993; Wright, 1986). Heylighen and Campbell (1995) have used a fitness landscape approach in describing how systems evolve through the twin processes of variation and selection.

While the behavioural or social scientist faces many challenges in translating complexity theory principles into their own domain, a considerable value in simply uncovering similarities between specific aspects of dynamical systems and human social behaviour can be expressed according to the assertions above. As a result of the greater complexity of human behaviour and accordingly spatial organization, it can appear as if deterministic causal laws do not govern social phenomena. Instead, the complexity perspective also illuminates the interplay between the fragility and stability that characterizes many of the phenomena explored by behavioural and social scientists (Eidelson, 1997). Within this perspective, it can be trustfully stated that complexity theory would generate some important theoretical insights and research findings in the agenda of urban design and architecture.

4 DESIGNING WITH THE UNCERTAINTY: A SPECULATIVE APPROACH TO COMPLEXITY

After giving all the related theoretical literature for behavioural sciences, complexity of human and spatial behaviour, complexity theories and overlapping attributes of behavioural sciences and complex adaptive systems, a critical question of 'can design process be managed under the uncertain conditions which are natural results of complexity' can be raised. At this point, remembering the Lang's and other important behavioural scientists' approach to uncertainty would be appropriate to enlarge the discussion. According to Lang (1987), "designers will always be making decision with uncertainty and so, behavioural sciences may reduce this uncertainty but will not eliminate it".

If there are some certain key words that seems to fit perfectly our ever-changing and dynamic urban space, these would be complexity and uncertainty. Indeed, the concept of complexity's itself is "a state of uncertainty within collective action" (Caliskan, 2013). As our world changes dramatically and unexpectedly, societies have started to experience uncertainties in all fields of their social life. According to Murray (1961), a fundamental definition of uncertainty is "liability to chance or accident", "doubtfulness or vagueness", "want of assurance or confidence; hesitation, irresolution", and "something not definitely known or knowable". With the rapid growth of understanding of complex adaptive systems in recent years, it is realized that ecological, human and urban systems having dynamic and ever-changing behaviour and structure cannot be understood fully by means of conventional approaches and theories. As a conventional approach to the problem, according to Pahl-Wostl (1995), uncertainty and lack of predictive capabilities equal ignorance. Such a point of view is very inadequate to deal with the complex environmental problems. As Wilson (2002) stated that if we conceptualize complex urban systems from the complex systems perspective, we are likely to approach the uncertainty problem in a way very different from the conventional.

In a Newtonian world, the stability of cause-and-effect relationships makes it possible to pursue reductionist science and makes us to intervene in the system with predictable outcomes. However, what is problematical about complex systems in this regard are their pervasive nonlinear, causal relationship (Holling, 1987). According to Levin (1992), "at any time a large number of factors may influence the outcome of a particular event, each one to a greater or lesser extent; at another time, the strength of those same causative factors on the same event may be very different". The result is a decline in predictability which means a system which is dynamic, changing and full of uncertainties. The idea of working with uncertainty is not new in the planning context. Rittel (1973) introduced the challenging concept of 'wicked' problems to the planning debate. "Contrary to 'tame' (manageable) problems which could be defined clearly, wicked problems have no clear start, end or ultimate solution because they are intrinsically uncertain, non-linear and complex". The complexity sciences, rediscovered Rittel and embraced his 'wicked' problems fully (Conklin, 2005) as wickedness represents precisely the fundamental uncertainties observed by the complexity sciences in the real world. Moreover, Christensen (1985)'s work referred to a type of complexity allowing variation in types of planning issues, a variation which depended on uncertainty.

In order to bridge with concepts from the complexity sciences such as non-linearity, emergence, path-dependency, transitions, co-evolution, adaptivity and self-organisation, uncertainties should be used as a design input rather than seen as obstacles for design process. By allowing uncertainties, designers can avoid from the static, fixed and linear thinking mechanisms which are not useful to manage complex systems. Instead, they can achieve more incremental, adaptive, dynamic and complex solutions to the complex problems of our age. As it is known from the related literature, complexity concepts from evolutionary biology, social sciences, psychology and ecology have played a significant role in demonstrating cities are evolving open systems due to the influence of biological cognitive agents – human beings with their dynamic behavioural nature -on multiple urban processes (Allen, 1997; Batty and Marshall, 2012; Holling, 2001; Portugali, 2016). According to De Roo and Silva (2010), "temporal dynamics and 'wicked' problems posit the fundamental issues of uncertainty and unknown unknowns". Uncertainties are a product of the interactions and interdependencies between elements and dynamic environments and as such are an intrinsic part of how urban systems and networks function. In the context of complex systems' natural capability of adaptation and co-evolution through the processes of variation and selection, designers should benefit from errors, random behaviours or most importantly uncertainties. In fact, Kelly (1994) views "honour your errors" as a guiding commandment for effective adaptation. He advises that by nurturing small failures, a system can make large failures less probable. That is, small cracks can prevent larger fractures. Indeed, errors and uncertainties are often renamed innovations when they lead to a better problem solution or a more adaptive path. "Furthermore, tolerating minor mistakes and allowing uncertainties for variabilities instead of trying to correct or eliminate them also frees a system to focus on more important and more urgent functions" (Kelly, 1994). For urban designers, architects, social and behavioural scientists and theorists, issue of complexity and uncertainty seems exciting to experience new paths and methods of design and to develop novel strategies for more diverse and complex systems. However, at this point, what remains unclear, is how can we cope with – or rule -the uncertainties to meet the needs of human beings by developing behaviour sensitive approaches?

The answer to this vital question is actually lying deep down in the well-known theory of urban design and architecture.

4.1 RECURSIVE PATTERNS: PERCEPTIBLE ORDER OF UNCERTAINTIES

The fundamental characteristics of complex systems leads difficult questions to answer: How can designers cope with the uncertainties while they are trying to sustain human needs in the environment without predicting the consequences of their actions? If we are living in the world of complexity, would accepting the uncertainties as undefeatable mean that we have no rational basis for design?

Even if complex systems contain uncertainties and emergent behaviours, there is 'perceptible order' in these systems. This understandable order refers to dynamic, characteristic and recursive patterns in architecture and urban design theory. Holling (1987) states that "I would describe this order as recurring similar patterns, never quite the same, sometimes startlingly novel because of the changing and adapting elements of the system, but also usually distinguishable from patterns in other systems". According to Christen (2009), "pattern is the repetitive configuration of the physical entities in space or that of the events in time. Moreover, Holland (1992) suggests that learning in this kind of environment is based on the identification of recurring system patterns. The checker board game that he uses as an example of pattern learning is a relatively simple example of a complex adaptive system. It presents a limited and stable set of possible system states and patterns; the criteria for successful intervention in the system are fairly clear and the time and resource costs of learning are relatively low (Wilson, 2002).

For the behavioural scientist, Nowak et. all (1994) have recommended looking for regularities or patterns rather than focusing solely on uncovering one-way causal links between variables; bidirectional causality, in which each variable is simultaneously both a cause and an effect, is commonplace in complex systems. Within these observed patterns of behaviour, it may be possible to detect signs of nonlinearity and dynamism. From the behavioural scientific point of view, according to Rapoport (1977),

> *"the environment is a series of relationships among elements and people and these relationships are orderly – they have pattern. The environment has a structure and is not a random assemblage of things. It both reflects and facilitates relations and transactions between people and the physical elements of the world. These relationships in the*

physical environment are primarily spatial – basically objects and people are related through separation in and by space". (Rapoport, 1977)

Therefore, concerning with the behaviour of the form and recursive patterns on the space would lead us understanding nature of complexity and dealing with the uncertainties at the roots of human behaviour and space's itself. From this point of view, recursive urban patterns can be considered as the vital systematic relationships in a complex system. This idea of systematic relationship refers to the idea of Jacobs (1961) – city as an organised complexity. Jacobs (1961) presents the multiplicity of choice experienced with the emergent diversity of the urban elements (i.e. street, block and building) as the source of urban complexity. Within all this perspective, urban patterns can be considered as the key factor for learning to deal with complexity and designing with the uncertainty as a natural result of the state of being complex.

4.2 ON PATTERNS AS 'THE ATOMS OF ENVIRONMENTAL STRUCTURE'

In order to evaluate environmental design as a rational process and develop a scientific approach to the man-environment relationship positive design models and methodologies must be specified. According to Lang (1987), one of the most influential model has been proposed by Christopher Alexander (1964). His approach consists of decomposing a problem into components that are as independent of each other as possible, establishing a hierarchy among them, and then finding patterns of the environment that meet the requirement of each component of the problem.

In 1966, Alexander and Poyner – in their extraordinary work: "The Atoms of Environmental Structure" - argue that the critical aspect of environmental problem-solving is the satisfaction of basic behavioural tendencies and that the nature of the design process is the determination of tendencies and of possible conflicts between tendencies in different environment-behaviour settings. The work of Alexander and his colleagues on the understanding of the structure of design problems, the translation of behavioural findings into form statements, and the development of a pattern language for the description and cataloguing of environment-behaviour patterns continues to advance at a rapid rate (Moore, 1970). These continuous and dedicated studies created 'the form-behaviour approach' – which relates behaviour to form - to the environmental design studies; and later on, they are modified into 'a pattern language' approach. The form behaviour approach has focused on ways to identify form-behaviour problems and to translate behavioural understandings and behavioural research into testable form 'patterns'. Alexander and colleagues (1977) stated that urban space is mostly generated by the recursive patterns and these perceptible patterns are organized in an interconnected and hierarchical system that allows for infinite combination – which points out the complexity and unknowability of certain ends. Ulrich (2006) describes patterns as:

"It is important to realize, according to Alexander, that patterns are not arbitrary design ideas but can and need to be identified and verified through careful observation. Furthermore, patterns become meaningful only within a hierarchy of interdependent patterns, in which each pattern helps to complete larger patterns within which it is contained, and in turn is further completed by smaller patterns that it contains. Each pattern has a well-defined place in the overall network of patterns; together, they constitute a pattern language, a vocabulary of design that consists not just of words but of mental design images". (Ulrich, 2006)

In general terms, pattern languages address to two different needs; firstly, a way of controlling a complex system – which is urban space and its relationship with the human behaviour, and secondly a design tool which helps the designer to build a coherency. Moreover, as a generative system, pattern language has the ability to generate unlimited number of combinations to deal with the complexity at the roots of manenvironment relationship. According to Nguyen (2015), "pattern languages help us to tackle the complexity of a wide variety of systems. Each "pattern" represents a rule governing one working piece of a complex system, and the application of pattern languages can be done systematically".

When the form behaviour approach and the concept of patterns are evaluated in the context of behavioural scientific studies and the complexity sciences, they offer seminal and overarching point of views. According to Salingaros and Mehaffy (2006), "the pattern language contains rules for how human beings interact with built forms, codifies the interaction of human beings with their environment, and determines how and where we naturally prefer to walk, sit, sleep, enter and move through a building, enjoy a room or open space, and feel at ease or not in our garden". The pattern language is a set of inherited tried-and-true solutions – containing the concept of 'uncertainty' - that optimize how the built environment promotes human life and sense of well-being. It combines geometry and social behaviour patterns into a set of useful relationships, summarizing how built form can accommodate human activities. Besides, pattern languages which genuine and defines an adaptive design method have evolved, and, as with all evolved systems, they have developed an extraordinary degree of organized complexity (Salingaros and Mehaffy, 2006).

In short, revisiting the form-behaviour approach as a methodological tool to cope with uncertainties arising from the complexity and emphasizing the contribution of patterns in this context leads to introduction of behavioural data into the design and planning process. Moreover, this approach creates a basis for a shift from linear and static methods of behavioural sciences to the dynamic, adaptive and complex ones. According to Marshall (2009), "we no longer see the universe as an entirely predictable, deterministic place. We now see it more as a complex; sometimes chaotic place, but one where we can still find patterns in the complexity".

Modern urban planning has succeeded in eliminating complexity with its reductionist approaches, running away from the uncertainties and leaving it's behind the empty and disastrous urban environments for us to live with. Therefore, the pursuit of complexity models to cope with uncertainties and developing the form-behaviour approaches to apply them should be the main concern for the fields of urban design and architecture.

5 CONCLUSION

After mid-1900s, the expeditious rise of the Modernism discourse has led to the harsh criticisms and brand-new questions. In the way of searching for new answers to these vital questions, behavioural sciences - a comprehensive design philosophy which takes the human needs, preferences and values as the basis to satisfy the human needs and to eliminate environmental restraints and stresses - has emerged in the context of man and environment relationship. However, behavioural sciences' deficient and limited point of view about the issue of man and environment relationship should be questioned in the context of emerging new paradigms. Contrary to the very first approaches in behavioural sciences, human behaviour is not a direct result of the effects of the urban space; or the urban space is not a direct outcome from the behaviours of its users. Interrelationships between these two phenomena do not represent a simple linear process. Indeed, man and environment relationship is much more complex and consists of intricate, dynamic and nonlinear process which is full of uncertainties.

Within the general context of this paper, a critical perspective is developed to the issue of reducing uncertainty – which is a general approach of 'conventional' urban planning and design - in order to raise a discussion. With the development of complexity science and its effects on architecture and urban design, concept of uncertainty cannot be seen as a drawback for design process or product. The fact that cities are complex systems which essentially contains various uncertainties, reducing the uncertainty seems unreasonable. Instead, designers should learn how to deal with uncertainty by using it as a design input: which means they should learn to 'design with uncertainty'. In that sense, complexity theories and complex systems – which are basically considered as the "aggregates involving many components generating a recognisable global (collective) behaviour and large-scale order which are not controlled centrally, but generated by many local interactions" - will help designers to develop better behavioural scientific approach to the fields of architecture and urban design (Caliskan, 2013). In order to challenge the conventional views on urban planning and design, to understand the complex and nonlinear nature of man-environment relationship and to develop better approaches in terms of the behavioural sciences, searching for models of complexity and the various kinds of complex systems is a crucial necessity. With this fundamental aim, the question of 'can design process be managed under the uncertain conditions which are natural results of complexity' has been raised.

In order to bridge with concepts from the complexity sciences such as non-linearity, emergence, path-dependency, transitions, co-evolution, adaptivity and self-organisation, uncertainties should be used as a design input rather than seen as obstacles for design process. By allowing uncertainties, designers can avoid from the static, fixed and linear thinking mechanisms which are not useful to manage complex systems. Instead, they can achieve more incremental, adaptive, dynamic and complex solutions to the complex problems of our age. For urban designers, architects, social and behavioural scientists and theorists, issue of complexity and uncertainty seems exciting to experience new paths and methods of design and to develop novel strategies for more diverse and complex systems. However, at this point, what remains unclear, is how can we cope with – or rule - the uncertainties to meet the needs of human beings by developing behaviour sensitive approaches? The answer to this vital question is actually lying deep down in the well-known theory of urban design and architecture.

Even if complex systems contain uncertainties and emergent behaviours, there is ‘perceptible order’ in these systems. This understandable order refers to dynamic, characteristic and recursive patterns in architecture and urban design theory. When the form behaviour approach and the concept of patterns are evaluated in the context of behavioural scientific studies and the complexity sciences, they offer seminal and overarching point of views. The pattern language is a set of inherited tried-and-true solutions – containing the concept of ‘uncertainty’ - that optimize how the built environment promotes human life and sense of wellbeing. It combines geometry and social behaviour patterns into a set of useful relationships, summarizing how built form can accommodate human activities. Besides, pattern languages which genuine and defines an adaptive design method have evolved, and, as with all evolved systems, they have developed an extraordinary degree of organized complexity (Salingaros and Mehaffy, 2006).

In short, revisiting the form-behaviour approach as a methodological tool to cope with uncertainties arising from the complexity and emphasizing the contribution of patterns in this context leads to introduction of behavioural data into the design and planning process. Moreover, this approach creates a basis for a shift from linear and static methods of behavioural sciences to the dynamic, adaptive and complex ones. Therefore, the pursuit of complexity models to cope with uncertainties and developing the formbehaviour approaches to apply them should be the main concern for the fields of urban design and architecture. Within these vital concerns, this concise research opens up a discussion about how recently developed complexity theories can help us to understand the complex interaction between man and environment and to cope with uncertainty as an inevitable attribute of this interaction.

BIBLIOGRAPHIC REFERENCES

Alexander, C. (1964). Notes on the synthesis of form. Cambridge: Harvard University Press.

Alexander, C., & Poyner, B. (1966). The atoms of environmental structure. Berkeley: Center for Planning andDevelopment Research, Institute of Urban & Regional Development, University of California.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). A pattern language: towns, buildings, construction. New York: Oxford University Press.

Barlas, A. (1994). The street: Its meaning, functions, origins, death and rebirth. Unpublished Phd. Thesis. University of Pennsylvania.

Barton, S. (1994). Chaos, self-organization, and psychology. American Psychologist, 49, 5-14.

Bashiri, S. (2015). The Role of Behavioral Sciences in Environmental Design: An Emphasis on the Need for Collaboration between Psychologists and Architects, J. Appl. Environ. Biol. Sci., 5(11S), pp.359-364.

Christen, M. (2009). ‘Patterns in the Brain: Neuroscientific Notes on the Pattern Concept’, (ed.) A. Gleiniger and G. Vrachliotis, Basel: Brikhauser.

Christensen, K.S. (1985). Coping with uncertainty in planning. Journal of the American Planning Association 51: 63–73.

Conklin, J. (2005). Dialogue Mapping: Building Shared Understanding of Wicked Problems. Hoboken, NJ: Wiley.

Cowan, G. A., Pines, D., & Meltzer, D. (Eds.). (1994). Santa Fe Institute Studies in the Sciences of

Complexity, Proceedings Volume XIX. Complexity: Metaphors, models and reality. Reading, MA: Addison Wesley.

Eidelson, R.J. (1997). Complex Adaptive Systems in the Behavioural and Social Sciences. Review of General Psychology, vol.1, no.1, pp. 42-71.

Gell-Mann, M. (1995). Plectics. In J. Brockman (Ed.), The third culture: Beyond the scientific revolution (pp. 316-332). New York: Simon & Schuster.

Heylighen, E, & Campbell, D. (1995). Selection of organization at the social level: Obstacles and facilitators of metasystem transitions [On-line]. (Available: file://ft.p.vub.ac.be/pub/projects/Principia_Cybernetica/WF-issue/Social_MST.t)

Holland, J. H. (1992). Adaptation in natural and artificial systems (2nd ed.). Cambridge, MA: MIT Press.

Holland, J. H. (1995). Hidden order: How adaptation builds complexity. Reading, MA: Addison Wesley.

Holling, C.S. (1987). Simplifying the complex: The paradigms of ecological function and structure. European

Journal of Operational Research 30: pp.139-146.

Jacobs, J. (1961). The death and life of great American cities. New York: Vintage Books.

Jung, C. (1958). The undiscovered self. Boston: Little, Brown.

Kelly, K. (1994). Out of control: The rise of neo-biological civilization. Reading, MA: Addison Wesley.

Lang, J. (1974). Designing for human behaviour: architecture and the behavioural sciences. Stroudsburg, PA: Dowden,

Hutchinson & Ross.

Lang, J. T. (1987). Creating architectural theory: the role of the behavioral sciences in environmental design. New York: Van Nostrand Reinhold Co.

Lang, J. T. (1994). Urban design: the American experience. New York: J. Wiley & Sons.

Levin, S. (1992). The problem of pattern and scale in ecology. Ecology 73: pp. 1943-1967.

MacLennan, B. (2012). Evolutionary Psychology, Complex Systems, and Social Theory. Retrieved from: http://web.eecs.utk.edu/~mclennan/papers/EPCSST, Last Access: 19.01.2017.

Marshall, S. (2009) Cities, Design and Evolution, London: Routledge

Moore, G. T. (1970). Emerging methods in environmental design and planning; proceedings of the Design Methods Group first international conference, Cambridge, Mass., June 1968. Cambridge, MA: MIT Press.

Murray, J. (1961). The Oxford English Dictionary, Vol. XI, Clarendon Press, Oxford.

Nguyen, N. H. (2015). Understanding the Generative Process in Traditional Urbanism: An application Using

Pattern and Form Languages. Unpublished Phd. Thesis. Arizona State University.

Nowak, A., Vallacher, R. R., & Lewenstein, M. (1994). Toward a dynamical social psychology. In R. R.

Vallacher & A. Nowak (Eds.), Dynamical systems in social psychology (pp. 279-293). San Diego, CA: Academic Press.

Pahl-Wostl, C. (1995). The Dynamic Nature of Ecosystem: Chaos and Order Entwined. Chichester, Eng.: John Wiley and Sons.

Proshansky, H. (1974). Environmental Psychology and the Design Professions. In J. Lang et al., eds. Designing for Human Behaviour: Architecture and the Behavioural Sciences, Stroudsbourg, Pa.: Dowden Hutchinson and Ross. pp. 72-97.

Rapoport, A. (1977). Human aspects of urban form: towards a man-environment approach to urban form and design. Oxford: Pergamon Press.

Rittel, H.W.J. and Webber, M.M. (1973). Dilemmas in a general theory of planning. Policy Sciences 4: pp.155–169.

Salingaros, N. A., & Mehaffy, M. W. (2006). A theory of architecture. Solingen: Umbau-Verlag.

Simon, H. A. (1981). The sciences of the artificial. Cambridge, MA: MIT Press.

Simon, H. A. (1995). Near decomposability and complexity: How a mind resides in a brain. In H. Morowitz & J. L. Singer (Eds.), Santa Fe Institute Studies in the Sciences of Complexity, Proceedings, Volume XXII. The mind, the brain, and complex adaptive systems (pp. 25-43). Reading, MA: Addison Wesley.

Stegner, W. (1987). Crossing to safety. New York: Random House.

Ulrich, W. (2006). The Art of Observation: Understanding Pattern Languages. Journal of Research Practice 2.

Wilson, J. (2002). Scientific Uncertainty, Complex Systems, and the Design of Common-Pool Institutions. In Ostrom E. et al. (Eds.), The Drama of the Commons. (pp. 327-361). Washington, DC: National Academic Press.