Complexity Theory and Urban Planning

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Abstract

Urban environments are complex. Urban areas are the environment for multiple activities such as people working in offices, shopping, purchasing services, interacting with friends and family, eating at restaurants, purchasing and constructing structures (homes, banks, factories etc.) and not so benign ones such as crimes involving persons or property. Interacting and influencing this intricate maze of human activities are governmental and non-governmental bodies at all scales (local, regional, national, global). Nevertheless, these social, political and economic activities operate not in a vacuum but within the physical and built environment with its opportunities and constraints. Such is the environment that urban planning must confront and challenge to effectively guide urban development. Within the last few decades, urban planners, urban geographers and others have noted the inadequacy of using existing scientific methods and organizational structures based on concepts tied to logical-positivism such as rationalism, reductionism and comprehensive long-range planning to address the problems and challenges of the urban environment. There have been attempts to revise or modify the planning process with various approaches, but none could have categorized as being even partially effective. The advent of complexity theory as a vehicle to understand and plan urban areas is opening up new avenues of thoughts in both physical and social sciences. Complexity theory, although having roots in physics, mathematics and computer science, has developed a set of metaphors that are presently being used outside of these disciplines in the social sciences. This 'language' of complexity provides the bridge between complex systems modeling and practical applications. Although not a panacea, it is certain that the methods tied to the present practice of urban planning are inadequate to address the evolving urban environment. This essay will introduce complexity theory and the associated metaphors, discuss their relationship in analyzing urban areas and present suggestions of how urban planning might be revised to incorporate complex theory to be more effective.
Keywords: urban planning, urban policy, complexity theory, urban development, metaphors

Introduction

The urban environment is collection of an incredible variety of interrelated elements both human and physical. It is composed of individuals who have different backgrounds, ages, occupations, lifestyles, and incomes. Each person is interacting daily with family, fellow employees, government officials and others in urban settings. They occupy different housing types, shop in different locations and go to work in industries or services. Within this environment are governmental and non-governmental groups that influence and interact with individuals. Persons and goods are not static, but by necessity must be transported by a variety of conveniences (automobile, truck, bus, light rail, bicycle, by foot, motorcycle etc.) in multiple directions both internal external from their homes. Other commercial and industrial entities operate within the urban environment and globally; encompassed by the physical environment for resources (water, food, materials etc.). The built environment of cities being connected to these dynamic settings are likewise constantly in flux. How could one describe this milieu as anything but complex?

To state that urban environments are complex is not a new insight. It is blatantly apparent for even the casual observer. There is no need for urban geographers and planners to present this to those outside of the field as some new discovery. Urbanists (urban geographers, urban sociologists, urban planners etc.) have created a diverse and rich literature in their attempt to understand the intricate and integrated elements of urban environments. As a sub-field of urban planning, urban planning theory has sought to understand the underpinning elements related to the practice of urban planning. However, urban planning theory has been accused of irrelevancy at it has dealt with subjects, which did not have a direct or indirect effect on the practice of urban planning (Archibugi, 2004). The actual practice of urban planning is developed from a mix of different philosophies and methodologies mostly drawn from logical positivism/rationalism and espousing comprehensive, structured and esoteric planning philosophies, which have their roots in the early 20th Century.

It is clear to discern, that there is incongruence between the actual urban 'reality' which is complex and non-linear and the application of linear rationalist planning methods (long range plans, Euclidean zoning etc.) to 'solve' urban problems. In browsing a standard textbook that is being used to instruct planners, Urban Land Use Planning (Berke et al. 2006) which is a derivative/continuation of the standard text by Chapin of the same title, the methods are essentially a revision of past methodologies based on the rational-comprehensive approach to urban planning which is connected to modernist scientific thought. There are additions related to sustainability and citizen involvement, but the changing nature of the subject of urban planning—the city or urbanized area is being inadequately addressed. Edward Kaiser (1995) implies that the opponents and critics of the present practice of urban planners are mistaken. He points out that the numbers of planning organizations and the inclusion of planning into many aspects of governing cities and regions constitute the success of urban planning. (It should be noted that Kaiser is one of the main authors in Urban Land Use Planning and it previous version. This book is considered one of the main texts for educating urban planners and has been used by this author and others in planning schools as an introductory text for urban planning.) What he fails to indicate is the effectiveness of urban planning has been in changing urban environments.

Quietly and steadily developing and in contrast to modern science based on logical positivism is research and methodologies associated with complexity theory. Complexity theory has a history stretching back almost 50 years (Gleick 1987). However, its use in the analysis of urban areas has occurred only within the last 15 years (i.e., fractal analysis, cellular automata). For many including this author, the book that introduced complexity to the study of urban areas, was Fractal Cities by Michael Batty and Paul Longley (Batty and Longley, 1995). It made planning theories, forecasts, and traditional methods of analysis seem mundane and antiquated. It opened up the discipline of urban geography to the discipline of complex theory and complex system including fractals, chaos, neural networks, agent-based modeling, cellular automata, and fuzzy logic. It also is leading planning away from objective and technocratic leanings to ones that are subjective, impassioned, inclusive and perhaps spiritual. Batty (2005) has subsequently written another book concerning agent- based modeling, fractal and complexity. While Batty's books concentrates on methodology, others are applying the philosophy of complexity theory to planning. Patsy Healy (2006) has just recently published another seminal book, which takes the application of complexity theory to the practice of urban planning. Healy and Batty have started a movement that is building momentum in urban planning literature. Complexity theory and applications to urban settings are developing a substantial literature from the technical focusing on use of cellular automata, fractal analysis and agent based modeling, neural networks, and urban growth, There is also a growing literature related to urban planning methods and theory related to complexity theory.

In this transitory stage in scientific thought where there are multiple threads on complexity theory (including complex systems), there needs to a medium to understand the overall concept of complexity theory. It would appear that there is an emerging 'language', which can be applied both to complexity theory as applied to mathematics and in the social sciences. This 'language' is appearing in the form of metaphors. These metaphors are allowing for the development of a new 'cosmology', which is proving to be a robust approach to confront a myriad of situations, which were ignored or inadequately addressed by modernist science. The body of complex theory metaphors can subsequently be applied to urban planning. The author intends this essay to be a vehicle to outline a framework for further research and to provoke constructive debate.

Complexity, Complex Systems and Chaos Theory

The definitions of complexity and chaos are numerous and diverse. It would seem that chaos theory and complexity theory are separate theories. But, after inspection of the both it would seem that chaos theory is a subset of complexity theory. Bar-Yam (2003) states that, " A dictionary definition of the word "complex" is: "consisting of interconnected or interwoven parts." If the parts are interrelated and thus associated with one another, this could be termed a system. Therefore, complexity has been incorporated into systems theory and referred to as complex systems (Cameron and Larsen-Freeman 2007). Although the literature of complexity is broad and related, this paper will focus on complex systems.

Complex systems are usually couched in the language of agent based modelling, where the parts are considered agents. These agents (considered as individuals or organizations with certain characteristics) associating with other do not interact randomly or capriciously but self-organize in a manner that is dynamic, but also non-linear, resulting in states of existence, referred in complexity theory as 'emergent states.' The systems are open such that new elements or agents can come into the system to change it to another state. (Cameron and Larsen-Freeman 2007, Heylighen 2008)

One characteristic of all complex systems is their chaotic nature. Chaos, by the general public is considered to be a synonym for randomness and disorder. If this was true then there would little basis for its study by mathematicians, physicists and others. Jension (Gliek 1987) describes chaos as the " irregular, unpredictable behavior of deterministic, nonlinear dynamical systems." Notice that there are terms in this definition which are also connected with complex systems theory, such as 'dynamic' and 'non-linear.' If you add this to the previous definition of complex system, it could be easily said that agents are also deterministic due to their characteristics. The image is one of a churning organism which is altering itself constantly and sometimes erratically to a different states, some times stable for a long period, but ultimately changing. There may also be an infinite amount of possible states due to the introduction of different factors. We have many examples of complex systems in nature such as weather, earthquakes, and cell development. One of the most complex and intriguing phenomena is the development of a child from a single cell to a wonderfully intricate and interconnected whole which has the ability to do phenomenal achievements such as create great music, travel in outer space or self destruct from indulgence in alcohol or drugs.

Complexity and complex systems theory has a broad and growing literature. It is not the intent of the author to give a full discussion of these areas. Nevertheless, in reading literature concerning complexity, complex systems and chaos, there are certain concepts that are pervasive in almost all discussions related to complexity. In summary, complex systems are non-linear, adaptive, unpredictable but deterministic, dynamic, disordered but having order, integrative, interactive and self-organizing. Many of the same concepts have been expressed in Taoism, Zen and Quakerism. One can see the threads of a developing cosmology related to these areas. This movement may be a 'quiet revolution' that could change science and society. However, for the present time, these concepts and philosophies are 'behind the curtain' like an understudy in a play, either to be doomed to obscurity or destined to appear in a dramatic and transforming role in the 'theater' of ideas.

Complexity theory and systems are bound to accompanying and complementary areas of interests would be those such as agent based and cellular automata modeling, fuzzy logic, fractal analysis, neural networks, and artificial intelligence. There is also a link to quantum physics, which reveals an expanding kaleidoscope of concepts into complexity theory. Complexity theory does not discard all the past methods of analysis, but selects parts of them that are deemed appropriate until more compatible methods are developed. For example, those involved in complex systems theory still uses significant portions of statistics and other mathematics (i.e., calculus) for their analysis. However, just as logical-positivism, linear modeling, Fordism, rationalism, and Newtonian physics are connected with modernism, likewise complexity theory is a product of post-modernism (Smith and Higgins 2003). As such, complexity theory represents a philosophical break from the ideas that dominated much have the 19th and 20th Century. While the proponents' of complexity theory claim that it represents a scientific paradigm shift, the root may more have its basis in a social movement with science backing it up (Smith and Higgins 2003) similar to the modernist movement which also was related to a certain agenda (Toulmin 1992).

Bridging Theory and Practice: The Development of Complexity Metaphors

How does one take these concepts and philosophies to make them 'digestible' not only to scientists, but to others outside of these disciplines? One manner is by the creation of metaphors. Metaphors are 'symbols' or linguistic representations so that we can simplify very intricate and detailed discussions, mathematics and theories to facilitate their application and further understanding. By using commonly understood linguistic terms, scientists and non-scientists can better understand an area of interest. Metaphors are terms that describe phenomena by using common or familiar terms. A set of metaphors can create an atmosphere for the interpretation of processes that were previously being dismissed or poorly addressed through other metaphors associated by a particular school of thought. Metaphors allow scientists and others to view phenomena in entirely different manner. Ashkenazi (2006) further states:

> Metaphors play an important role in science, as well. In science, metaphor is a tool of exploration and discovery, providing a way of imposing or discovering structure within novel or unfamiliar situations by relating them to familiar experiences. Metaphors such as "electricity is a fluid" or "atoms are hard spheres" are contextual cues that direct the scientist's attention to look for details associated with fluids or hard spheres. Fluids can be associated with flow and conservation; hard spheres with packing and random motion. Even if these metaphors are ultimately replaced by more elaborate mathematical models, they still guide the thoughts of practicing scientists when they try to make sense of a new experience.

It is the author's and others opinions that metaphors are a necessity to conceptualize areas of study so that there eventually is a common language among related scientists. They provide the structure for understanding a multiplicity of ideas. Does reality change because we use metaphors? Actual reality does not change, but perceived reality does and the ability to transform it from one stage to another may be facilitated by the use of metaphors. Physical and human processes continue with or without the development of metaphors. However, these processes cannot be understood or transformed without the invention of metaphors. Metaphors and archetypes may be a physiological necessity in how humans understand their environment in which we inhabit. Models can be seen as metaphors for the description of occurrences. Scientists' belief in a model can become so entrenched that one begins to believe in the model and its predictive power despite evidence of its faults (Ravetz 2002). Mathematical models supposedly in 'reductionist' science base their formulation on data that has been collected 'randomly' and 'objectively'(although in practice they are neither), analyzes the outcomes and then uses them to conjecture about future situations. These models have been used to justify decisions, although they are extremely flawed.

Complexity theory and complex systems metaphors have their roots in physics (Gleick 1987). Many of these metaphors can be traced back to the works of Mandelbrot, Lorenz, Neumann, Bertalanffy, and Langton (MacGill 2008). From obscure research and somewhat incomprehensible to most outside of physics and mathematics, has sprung a set of terms and concepts that have become prominent in the scientific world and has if only in a minor way made it into popular vocabulary , for example, 'The Butterfly Effect.'

Lissack (1997) contends that complexity theory has developed its own set of metaphors:

> Complexity refers to the condition of the universe which is integrated and yet too rich and varied for us to understand in simple mechanistic or linear ways. We can understand many parts of the universe in these ways but the larger and more intricately related phenomena can only be understood by principles and patterns-not in detail. Complexity deals with the nature of emergence, innovation, learning and adaptation. This theory contends that once these rules are found it will be possible to make effective predictions and even to effectuate control of the apparent complexity. Complexity theory has its own set of language, its own means of describing things.

If one inspects the literature of complexity theory, there are developing sets of metaphors being used. Among some of the most prominent them are the metaphors of agents, chaos, fractals, fitness landscape/environment and emergent states. Within these metaphorical categories are also related concepts, such as vortex, entropy, oscillation and self-organization. (Developed somewhat separately from complex system theory is the concepts of social capital and hard/soft infrastructure concepts developed by Alexi Danchev (2008, 2006) which have great potential within the application of complexity theory to social problems.) The following will briefly outline the meaning of the most prominent metaphors being used in complexity theory. From the author's experience, many of these metaphors have been connected to cellular automata and agent based modeling as they are the primary modeling tools for those involved with the study of complexity theory. The following will briefly describe these metaphors.

Agents

Agents are objects, which may be animate or inanimate. In terms of living agents, they can be individuals, institutions, private companies, associations etc. All agents have a variety of characteristics in which they operate. In agent-based modeling (ABM), these are often described as 'rules'. In an agent-based situation, agents are not isolated but interact and perhaps transform themselves. The transformation process in complexity theory is termed self-organization. In complexity theory, agents can be described as 'molecular' or 'networked' (Murray 2003). The molecular concept of complexity states that are agents are distinct entities, which interact with other agents in perhaps, coordinated but are not associatively linked. A network agent environment conceives as agent having links and association, whether they are permanent or transitory. However, it is understood that agents do not continue to gyrate without resolution, but lead to self-organization.

The root of agent-based modeling is cellular automata. Cellular automata (CA) is the changing of one cell by its interaction with one or several adjacent cells. CA was originally conceived by Von Nueman and Turning (Batty 2005). CA works on a set of rules such that set the initiation of the actions. The results may exhibit various forms from ordered to chaotic. The rules of CA are the basis for those in determining the characteristics of agents in agent based modeling.

Chaos

Chaos is one of the most powerful metaphors of complexity theory. It evokes images of randomness, confusion, destruction, disorganization, catastrophe, mayhem and apocalypse. (This notion of chaos is so pervasive that often one often gets veiled disapproval in academia if one states that they are interested in chaos theory.) It is the antithesis of order and the logical-positivist/rational view of the world. Chaos theory is nested within the complexity theory. Often it is incorrectly perceived as being separate from complexity theory or on an equal standing. Chaos represents the non-linear dynamics of the interaction of agents. It also means the discovery of order from disorder. The metaphor chaos in complexity theory inherently denotes something that is on going and not static. It could be considered something that is not in order or something is in transition. Chaotic action could be described in a variety of manners which makes it intriguing, but at times a amorphous term. The best example is the creation of fractals, which could be termed deterministic chaos. When these phenomena go through changes it is termed in complexity theory as oscillations. These osciallations are sometimes referred as 'the edge of chaos' (Lewin 1999) (Langton 1990) (Green, D. and Newth, D. 2001.) This term describes the effective direction within the context of a multitude of actions. Working in the company of excited individuals working toward the resolution of a problem, could often be described as 'the edge of chaos.' This is opposite of the 'chaotic edge' (Green 1994). This is where there is turmoil, damage, distruction and stress in the different parts of an emerging state. Those involved in catastrophic events such as earthquakes, hurricanes or war would be in the 'chaotic edge'. These events are not welcomed, but their aftermath may lead to better states in the future.

One could easily describe the financial crisis that began in the latter part of 2008 as a phenomena on the 'chaotic edge.' At the writing of this paper, the outcome is unknown. However, it will stabilize and reach another state, with or without government intervention. The severity of this crisis will be ultimately related to how those who are directing the global economy understand chaotic theory and complexity, although they may not state this directly or even aware that they are dealing with the 'stuff' of these theories.

Fractals

The term fractal is not only a linguistic metaphor, but a visual one for illustrating complexity. Fractals are formed by the division of one element by a set of rules. For example, they are directly linked with the idea that one action iterated can evolve into complex visual elements. In common with cellular automata, fractal formation is governed by the rules. In this sense, they are deterministic, but in another unpredictable based on slight changes in the rules or in the process of formation. The concept of fractal generation and the vocabulary of fractal analysis emanates from works by Mandelbrot (1983). However, the basic concepts of fractal analysis were first introduced by D'Arcy Wentworth Thompson (1992, 1917) in his book On Growth and Form.

Fractal analysis is also a manner of looking at an object in a non-Euclidean manner regardless of the scale or the individual characteristics of the object. The elements contained in fractals can be points, lines, polygons or pixels. However, one characteristic of fractals is that they are self-similar. For example, one line can divide into two and then those two lines can be divided into four and eight and so forth. Changes in a formula can create designs that 'almost take on a life of their own' and can be manipulated to mimic the growth of any entity. Fractal analysis is also linked to spatial metrics--the measurement of the fractals among themselves such as the distance between points or polygons.

Fractals can be analyzed in a number of manners. One of the most common is to examine the dimension, lacunarity, and scaling (Falconer, 2003). Dimension refers to the fractal variation. The dimension for a fractal is always between 1 and 2 with 1 being a line and 2 being a plane. Lacunarity refers to the texture of a fractal. A fractal with more gaps has a higher lacunarity. Fractal scaling refers to the iteration of certain patterns measured by changes in the dimensions. 'Real life' fractal dimensions have certain meanings when compared with abstract fractal objects. Due to the nature of fractal generation, fractals are self-similar, scale less and determined by the initiating formula or rules.

Environment and Fitness Landscape

The environment is the boundaries in which agents interact. The boundaries are essentially scale less, analogous to fractals. The environment could be actual or theoretical. It is the context in which agents interact which may include barriers and constrictions depending on the context of simulation. Environments would create the context for such as the simulation of urban growth or investigating the process of interactions between groups. The fitness landscape refers to the strengths or weakness of processes in an environment (Roos and Oliver 1999).

Emergent States and Self-organization

Not completely separate from environment is the result of the actions of individual agents. Self-organization is the process where agents interact in a collective manner. An emergent state would be the situation where there is a determinable outcome related to self organization. In complex systems, the process leading to emergent states may be that could be considered oscillating or erratic (this could also be termed chaotic according to one of definitions of chaos). Emergent states can be stable for a long period of time or one that is leading to another emergent state. Examples of emergent states could be found in numerous processes in reality, such as bacterial growth, traffic, political opinions, etc (De Wolf and Holvoet 2005).

Applications of Complexity Theory to Urban Planning

Metaphors are the compression of concepts into simple terms that are able to understood by reference to another commonly understood term. Thus, they become the means to understand concepts that may be difficult or impossible to grasp without their intercession. The collection of metaphors associated with complexity theory have the ability to become the medium to view the city in a fundamentally different mode thus transforming the perception of urbanization and the context and practice of urban planning.

In the present urban and global environment, sustainability is the overriding theme guiding its development. Issues such as global warming, economic justice and stability, environmental balance and other issues, which are sub-sets of sustainability are being inadequately addressed by urban planning presently. Urban and regional planning will continue to exist, but certainly not in its present form. Viewing urbanization 'through the lens' of complexity theory is aptly suited to address sustainability as it naturally embodies interrelated and multifaceted elements. While, urban planning as presently practiced, with its basis in the rationalism, utopianism, modernism, reductionism and elitism, is ill suited for addressing the innately complex aspects of sustainability.

Urban planning seeks to operate within this complex urban environment. Traditionally, urban planning has consisted of data collection, goal setting, alternative determination, selection of the best alternative and monitoring. The end result was also a proposed 20-year land use plan. The rational comprehensive planning process has been revised to by Kaiser to be more flexible and adaptive to greater citizen participation and sustainability (Berke et al. 2006). However, this process is still fatally flawed due to the inherent modernist and rationalist approach regardless of the type of revision and the approach. There are elements when taken separately, such as land use surveys, suitability indices and environmental protection area plans which might still be valid. Nevertheless, the overall framework and structure is the primary barrier for effective planning within a complex urban context. Although one might look fondly back to early planning theories and practices with a degree of nostalgia, it is seems to be unavoidable that we must discard them.

Complexity theory examines the non-linear, but deterministic processes. The urban environment contains many non-linear processes, but they emanate from entities, which are not random, but have purpose and characteristics. In light of some of my present and past research, I have been contemplating about how can chaos and complex systems theory can be integrated into the practice of urban and regional planning. The analysis of urban phenomena using complex system analysis techniques such as fractal analysis and agent based modeling are numerous. However, there is a gap from theory to practice that is just beginning to be explored in urban planning theory literature. Michael Batty (Batty, 2005) (Batty, 1995) and Patsy Healey (Healey, 2006) seem to have started to close the gap between chaos theory and urban analysis and planning practice. However, their concepts are on the periphery of urban planning literature and would not be considered by the mainstream of urban planners as guides to not presently changing the manner that planning is practiced on a daily basis.

I think that it is relevant to ask: How exactly do urban and regional planners put the findings of these analytical tools into decision-making? Actually, chaotic planning and intuitive ways of confronting the complexity of urbanization has been around for a long time, but has never really identified it as such. Incremental planning, 'muddling through' and a host of other techniques may possibly be considered chaotic planning. Strategic planning is considered a vehicle to reduce the planning procedure by focusing not on the comprehensive and long range aspect of urban planning, but reduce it to the short term and to a specific aspect, such as economic development. However, the mind set of logical positivism and elitism still permeates this process. Strategic planning also leaves some of the long-range aspects of urban planning which is worthy of salvaging, such as protection of natural areas, water resource management, industrial development for future generations to be handled in other manners. While most planners would regard the methodologies and the effectiveness of planning organizations to guide urban development as inadequate, there is a lack of examples to effectively transition into a state that will sufficiently alter the present state of urban planning.

Urban planning can easily be framed within the context of complexity metaphors. There are agents, be they politicians, urban planners, developers, citizens, government officials etc. Agents could also force either natural or manmade such as technology, weather, but technology is not divorced from humans, as they are human creations. Likewise, they may be framed as environments depending on the jurisdictional constraints. In the milieu of urban planning, the actions of agents do not carry equal influence. There are 'super-agents' which carry more influence than other agents. Such 'super-agents' could be considered government officials, politicians, non-governmental organizations (NGO) and developers. Urban planners although having more influence than individual citizens, although there may be an exception due to the influence of one citizen, would not be considered a 'super-agent'. Although within the 'super-agent' category there are those that have more influence than others. In the urban planning arena, these agents organize around specific and general issues. A special category of 'super agents' is those that are classified as 'visionary agents', having a dramatic influence on other agents and their environment. Examples of modern 'visionary agents' are Gandhi, Martin Luther King, Bishop Desmond Tutu, the Dalai Lama, and Nelson Mandela. In an urban planning context, 'visionary agents' could be considered those as Lewis Munford, Patrick Geddes, and Jaime Lerner (past mayor of Curitiba, Brazil.(See Vassoler-Froelich (2007) for the details of the role of Mr. Lerner in his role in the planning process in Curritiba). Overriding are a special class of 'visionary agents' which radically transformed the environment for their generation and successive ones such as Marx, Martin Luther, Napoleon, John Locke, Roseau, Machiavelli and Newton,

These metaphors create a new context for urban planning to operate. Does it really change the way that urban planning operates? For those urban planners that have probably intuitively or by contemplation grasped the concepts of complexity, probably not too much. However, the urban planning agencies within which urban planners operate still are producing 20-year plans and still endorse the urban planning culture that has lost its effectiveness to guide urban development in a substantial manner, embracing complex system theory as a 'paradigm' or 'cosmology' may be a large jump which is impossible for them presently .

Implications for the Practice of Urban Planning

Viewing the forces of urbanization within the context of complexity theory metaphors radically changes how urban planning operates. It may be too early to consider the present state of scientific thought developing around complexity theory as a new paradigm. However, there are numerous examples to indicate that the use of complexity theory and related applications such as agent-based modeling, fractal analysis, fuzzy logic and neural networks to analyze urban phenomena is being utilized at a greater frequency to analyze many aspects of urbanization. They are providing new insights into the processes and dynamic aspects of urbanization that were not possible with tradition methods. In this context, I would like to comment briefly urban planning might be transformed with the context of complexity theory metaphors.

<u>Abandonment of Traditional Long Range Planning</u>

The linear aspect and the static nature of long range planning is in direct opposition to the dynamic nature of urbanization. It is ludicrous that one can plan for 20 years knowing that unknown factors such as economic downswings, technological changes, natural disasters may change the structure of an urban area completely obviating any semblance of orderly progressive planed development that was linked with such a plan. In the same vein, static and single use zoning that has been tied to long range planning should be eliminate in favor of flexible, mixed use and appropriate designation with the shifting and emerging landscape of an urban area. With the aspect that there is not one possible feasible alternative, but infinitely numerous one makes the 20 year long-range plan with a fixed land use plan a relic of modernism. Although this does not mean that there not some worthy aspects that should be preserved. One is the designation of environmentally sensitive areas where areas should not be compromised due to development. Another is the preservation of historical, cultural or aesthetic aspects or protecting citizens from possible environmental hazards such as flooding, landslides of an urban area or region. These would be considered long range projects, but not a comprehensive plan. Neither does this mean that collecting and analyzing data, determining the needs of different segments, examining the impacts of future possible development of a city or region should be abandoned.

The abandonment of the long range plan should be replaced by appropriate policies and regulations to ensure the multiple and changing goals and objectives of the diverse nature of the community. The policies may be a confusing collection to those planners tied with a rigid version of urban planning. However, a complex and organic set of policies and regulations will serve the diverse, integrated and dynamic urban setting much better than those prescribed by rational comprehensive planning.
The manner that this would work in practical application may be considered to be ad-hoc and somewhat capricious to those accustomed to rigid regulations. However, they may not be too unfamiliar with planners who have intuitively grasped the nature of urban development.
In development terms, the policies and regulations would frame the entry conditions of new developments, not a predetermined land use or zoning designation.

Examination of the Demand and Supply Side of Urban Scenarios and Policy versus Physical Planning Options

With the development of various 'chaos based' models, such as cellular automata, agent-based modeling, it is possible to examine both the effects of supply and demand characteristics of different scenarios. Although these models are still in development, there is little doubt that they will be in urban planner's 'toolbox' in the next five years, if not sooner. It is still useful to investigate 'what if' scenarios. After study, specific policies can be developed to address specific needs. These policies can be then translated into regulations at the local level. By examining the supply and demand aspects of urbanization , many alternatives can be explored instead of a fixed number.

Rethinking the Nature of Processes

With the context of complexity theory metaphors, the urban environment could be viewed as one which is in constant flux changing in a way that is unpredictable for even the short term due to numerous factors. One can view the process of urban phenomena as one of numerous agents interacting within various scales. The recognition of the chaotic nature of various aspects of urbanism leads to different actions by those agents that are attempting to improve aspects of urbanization. In this context, urban planning agencies should not focus on rigid regulations such as static zoning and subdivision regulations, but policies and processes.

Drawing from the basis of agent based modeling, one should focus on the agents. This can be done by working at the neighborhood level to discern the needs of citizens and work on neighborhood problems as well as address other issues that concern them related to living within a particular urban environment. Obviously, this would require an enormous workforce of urban planners if done in the traditional manner of top down administration. The solutions would be train volunteers and other professionals that would work in this micro level. Also, with the Internet, urban planning agencies could solicit and structure neighborhood planning. The key here is empowerment of the individual, the agent to be a part of making the plan, not the object of the plan. It is from the individual that efforts such as recycling, energy conservation, and recreation needs etc. have their support.

Although individual citizens role are important and there should be more done to empower citizens as active participants in the planning process, there are other agents that transform the environments of urban residents. Shaping the manner that these 'super agents' operate and developing dialog among them is key to changing the foci of the urban environment.

In the present state of most urban areas, persons with a vision are rare. However, this does not mean that these persons do not exist in any area. The problem is that the present urban political machinery from proposing solutions discourages them. This machinery will never encourage such a person, in that there raison d'être to keep the status quo for his or her own benefit. Individual citizens who likewise empower them to struggle against formidable and rigid public and private entities must support these urban visionaries.

Changing the Urban Environment

The environment of cities is dynamic and the result of numerous individual actions. However, this environment is not one of individual agents acting randomly and without boundaries, but within a set of boundaries that have been shaped by past super agents; thus framing the actions of all participants. These super agents can be actual persons or the artifacts of individual or the results of collective collaboration, such as technology. The future actions of these super agents can be result in a better future urban environment or one that is worse. The emerging urban environment or boundaries are determined by setting the "rules" of the operation of all agents.

The Role of Urban Planners and Planning Organizations

Using complexity metaphors to construct a new way of viewing all that is occurring within the boundaries of urban areas can change the way that planners view themselves and the role of planning. In viewing the urban environment as one which is complex with multiple actors and possible outcomes, the idea of systematically arriving at some optimal state becomes idealistic if not deluded. Those in urban planning at all scale levels must evaluate if is an effective agent of influence or one that it marginalized. Unfortunately, many in urban planning are still be influenced by the rationalism, logical-positivism and other ideas borne out of modernism. One of the continuing misconception about urban planning is that it should be somehow neutral and divorced from politics. This has resulted in an advisory role for urban planning agencies or commissions which has resulted in their recommendations being adopted haphazardly according to the views of policy makers. This situation is a fading one, as one finds a greater number of planning organizations which are located within implementing agencies. To be effective within the context of the present state of urbanization, planning departments need to have the ability to act with authority. The concept of a dedicated planning departments within urban areas may have to be completely revised or phased out. Separate planning sections within implementing agencies may be much more effective in combination with coordination bodies. This restructuring can already be seen in many countries.

What is more important is how planning organizations view the urban environment. If their perceptions are shaped by the metaphors of complexity theory, the manner in which urban problems are approached could be significantly altered. Instead of spending numerous hours developing population, housing, economic and transportation forecasts which may have limited value, their efforts would be directed toward such actions as: working with politicians, developers, and other governmental officials to establish policies that would direct the future state of urban areas; developing close contacts with neighborhood groups to determine what would be in their best interests; empowerment of citizens in the planning process; the application of agent based models and other techniques as tools to explore the workings of the urban area; making urban information more transparent; and a greater concentration on the details of urban development. Taken separately, these are not novel ideas. Within the context of complexity theory metaphors they are transformed. The problem is the reluctance to detach urban planning concepts from the historic roots of urban planning thought and theory which is firmed attached to rationalism, logical positivism and utopianism.

Within this metaphoric concept, a planner must see himself as a modern day shaman. A shaman in tribal societies was one that led people on visions, facilitators, presented magic and led indirectly. A planner will obviously not be leading people out into the wilderness to enable them to see visions, shaking rattles during meetings, and transforming him/herself metaphysically into other animals. What a planner can do is to: enable persons to think about the present and visualize a better future (not a utopia) that would lead to a better and more just urban environment at any scale; present data through spatial technologies and through innovative modeling that may enhance a vision or lead to better policies (the magic of technology); and establish personal contacts with those at all levels so that he/she can be a translate their interests to others. In a complex and chaotic world, there is a need for persons to create ripples and sometimes disturbances to cause change. The planner must see her/himself as one who causes all agents to think in manners that they may have not thought before and sometimes create controversy (not for its own sake, but as a catalyst leading to the change of rules). The above described role of a planner is in direct opposition to the idea of a planner who is objective, “a good soldier” or exclusively performing administrative tasks as directed by others, or a modeler only presenting results for decision makers. Such a role for a planner does hark back to the concept of an advocate planner which has generally been disregarded as idealistic. In a chaotic and complex manner, each planner would seek his/her own role within the setting and adapt appropriate techniques, but still retaining the ‘aura’ of a shaman. One of the hallmarks of complexity is adaptation. Urban planners must likewise be adaptive and ‘shift shape’ to fit their peculiar environment.

Conclusion

These subjects are sometimes unwieldy and difficult to merge in a coherent manner. As with any subject that is still in formation, there is a large amount of uncertainly and vagueness. Nevertheless, I think that it is important that these ideas are addressed regardless due to their potential to become catalysts in changing the essence of how cities are viewed and how urban planning is practiced. There is a plethora of literature on different aspects of complexity theory, which this article attempted to address. However, this was not the purpose of this article. The article was a vehicle so that the author could bring together the concepts of complexity theory and attempt to formulate how these could be applied in the practice of urban planning.

We live in a metaphoric world. It is a necessity for operating within the world that we live. Metaphors are not only just concepts or descriptions. They enable us to view reality in a different manner and enable change as individuals and as societies. They are the language of concepts. However, metaphors can be stumbling blocks and prevent things from occurring if adhered to rigidly and against contradictory information. The metaphors of reductionist science are inculcated into the very fabric of science and society. The formulators of such modern science such as Bacon and Newton are in very science textbook and enshrined as bringing wisdom to the superstitious and backward. Many of the ideas and associated metaphors are in direct opposition to that of the currently accepted scientific thought. They represent something new, exciting and still controversial similar to many other noteworthy ideas. Complexity theory is not the panacea and proclaiming it to be a new paradigm may be premature. However, its metaphors are bringing new light to subjects and energizing them in a manner that modern science has been incapable. The development of complexity theory from its roots in mathematics and physics to its transferral into the social sciences including the field of urbanism (urban geography, urban economics, urban transportation planning, traffic management and urban planning etc.) and their tools (spatial technologies, statistical analysis etc.) further demonstrates the robustness of these metaphors and concepts. It is expected that these concepts will be further explored possibly leading to changes that will change the perceptions of urban phenomena and the manner that urban planning is practiced.

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